Investigation report

Contact with two bridges by the sea-river vessel ANDRE-MICHEL 1
on 2 October 2021,
on the Rhône diversion canal at Donzère (Drôme),
one casualty

Bureau d'enquêtes sur les évènements de mer
Bureau d'enquêtes sur les accidents de transport terrestre

Investigation report published: december 2022

Note

This report has been drawn up according to the provisions of the Transportation Code, especially clauses L.1621-1 to L.1622-2 and R.1621-1 to R.1621-38 relating to technical and safety investigations after marine casualties and terrestrial accidents or incidents and concerning the implementation of directive 2009/18/CE on the investigation of accidents in the maritime transport sector and in compliance with the «Code for the Investigation of Marine Casualties and Accidents» laid out in Resolution MSC 255 (84) adopted by the International Maritime Organization (IMO) on 16 May 2008 and published by decree n° 2010-1577 on 16 December 2010.

It sets out the conclusions reached by the investigators of the Marine Event Investigation Bureau (*BEA*mer) and the Land Transport Accident Investigation Bureau (BEA-TT) on the circumstances and causes of the occurrence analysed and proposes safety recommendations.

In compliance with the above-mentioned provisions, the analysis of this incident has not been carried out to determine or apportion criminal responsibility nor to assess individual or collective liability of a civil nature. **Its sole purpose is to improve maritime and fluvial safety and the prevention of maritime pollution by vessels and to draw safety lessons that could prevent future incidents of the same type**. The use of this report for other purposes could, therefore, lead to erroneous interpretations.

For your information, the official version of the report is written in the French language. The translation in the English language is to facilitate the reading of this report to those who are not French speakers.

1 Summary

On Saturday 2 October 2021, the sea-river vessel[1] ANDRE-MICHEL 1, flying the Maltese flag, was sailing up the Rhône, on ballast, from Torre Annunziata in Italy, bound for Saint-Usage (21) where she was going to load wheat.

The maritime crew was made up of 7 Ukrainian seamen. The 68-year-old river pilot, a resident of France, joined the vessel at 7.00 am in Port-Saint-Louis-du-Rhône, where he took over the shiphandling of the vessel.

At around 8.15 pm, on the Rhône diversion canal at the level of the town of Donzère (26), the vessel struck the deck of the RN7 bridge at KP 174.5 with her wheelhouse, then that of the railway bridge 150 m further on.

The upper part of the wheelhouse was crushed by the impact, it was torn off and tipped backwards and buckled, trapping the river pilot who lost his life. The captain, who was also on the bridge, was slightly injured.

After these impacts, the crew managed to stop the vessel a little further on.

FRELON, another sea-river vessel, arrived on the scene on 3 October in the middle of the morning. She came alongside the damaged vessel and towed her abreast to a wharf located 2 km upstream. River navigation had been stopped since the accident and resumed shortly before noon.

The bridges that were struck were damaged, notably the road bridge, without any major damage.

The BEA-TT and the BEAmer draw five safety lessons from this technical investigation and make three safety recommendations.

2 Factual information

2.1 Background

The sea-river vessel ANDRE-MICHEL 1 departed the port of Torre Annunziata in Italy on 29 September 2021 and sailed up the Rhône on 2 October 2021, light on ballast, with a maritime crew and a river pilot on board. She was bound for Saint-Usage on the Saône to load wheat.

The vessel was owned by the single ship company ANDRE MICHEL 1 LTD (IMO number 5630527)[2], based in the Republic of Malta.

[1] A sea-river vessel has technical characteristics that enable her to sail both at sea and on inland waterways.
[2] Permanent and unique 7-digit identification number assigned to ships and shipping companies

She was managed by Ship Management Services (IMO number: 5281241), based in Ukraine and identified as the ISM[3] manager. This company was responsible for the technical and administrative management of the vessel within the meaning of the international ISM regulations, as well as her manning.

She was operated by the company ABCRM (IMO number: 5507477), with approximately three voyages per month on the Rhône-Mediterranean route. This company was linked to the shipowner by a time charter contract. It has its headquarters in Nantes and an agency in Port-Saint-Louis-du-Rhône (13) and also operated on this route two other sea-river vessels belonging to other owners.

On average over the last three years, the CNR has recorded the passage of approximately 450 sea-river vessels per year through the Bollène lock (84), which represents 15% of the number of units carrying freight.

A sea-river vessel is subjected to maritime regulations as far as the rules on the vessel and the crew are concerned. When operating in inland waters, she must also comply with the river regulations regarding the requirements for the river pilot and the police regulations for inland navigation.

For navigation in river areas, sea-river vessels must therefore use a river professional, as their maritime crew does not include any member holding a "river steering licence" or able to communicate in the French language.

This inland waterway professional on board sea-river vessels is often called in French « *pilote fluvial* » or « *pilote de rivière* ». He is referred to as « *conducteur fluvial* » in the French version of the present report with reference to the Transport Code which defines the notion of "driver" and not that of "pilot". Yet he is called a «river pilot» in the English version. The Transport Code[4] gives him authority over the vessel. In practice, the river pilot steers the vessel.

It is not a regulated profession like maritime pilots, any holder of a certificate of competency for the operation of commercial boats[5] can be a river pilot of a sea-river vessel.

ABCRM regularly works with 7 to 8 river pilots, who are called upon according to their availability. These pilots are self-employed and are called upon by the charterer on an ad hoc basis according to needs, and are therefore involved in the form of a provision of services.

[3] International Safety Management code
[4] Articles L4210-1 et L4212-1 of transports code
[5] In this report, boat refers to an inland waterway boat

2.2 Vessel particulars

- Name : ANDRE-MICHEL 1
- Type : Sea-river cargo vessel
- IMO number : 8511914
- Flag : Malta
- Length overall : 79.05 m
- Breadth : 11.30 m
- Depth : 4.30 m
- Height : 9 m masts and wheelhouse lowered
- Summer draught[6] : 3. 30 m
- Tonnage : 1318 metric tons
- Propulsion : 772 kW
- Year of construction : 1986

ANDRE-MICHEL 1 was classified at the time of the accident by the classification society Bureau Veritas.

She had the various international certificates necessary for her maritime navigation and, by extension, river navigation. According to the regulations, these certificates allow the vessel to sail in inland waters without being subject to the technical requirements applicable to boats. Her latest class and statutory certificates were issued by Bureau Veritas on 27 August 2019 with a validity of 5 years.

The vessel is fitted with the required maritime navigation equipment but is not equipped with an electronic chart display and information system (ECDIS[7], not required) for inland navigation. She is fitted with sea and river radars, the latter mounted above the wheelhouse, as well as an automatic steering system for sea voyages and a dedicated steering system for river navigation.

This vessel is equipped with a hydraulically height-adjustable wheelhouse with a stroke of 2.20 m, in particular, to allow passage under bridges during navigation in river areas. The wheelhouse can therefore be lowered or raised according to the available clearance. When in the lowered position, it results in reduced visibility, as described in section 3.7.

[6] The summer draught corresponds to the vessel's draught corresponding to the maximum permissible load in salt water during the summer season when the cargo is not wood.
[7] ECDIS is an electronic display system for navigational charts and related information. Inland ECDIS allows the display of river charts.

The various masts and antennas are mounted on axles that allow them to be tilted by means of hydraulic cylinders. According to the plans, the total height of the vessel, with the wheelhouse fully lowered, masts and antennas folded down, is 9 m.

The vessel ANDRE-MICHEL 1 in sea configuration (bridge, main mast and foremast deployed)
Source ABCRM

2.3 Information about the crew

The maritime crew consisted of 7 Ukrainian seafarers, all of whom had the required qualifications: a master, a first officer, a chief engineer, a second engineer, a deckhand and a seaman/cook.

The 55-year-old master has been sailing since 1997. He joined the Ship Management Services Company in 2002 as a first officer. He then worked in other companies before returning as a master in 2017. His last appointments were on the ANDRÉ-MICHEL 1. He usually sails at a rate of 4 months on board and 2 months off.

The 68-year-old river pilot was of Dutch nationality.
He had been established in France for a long time and had been legally registered in the business register as an individual entrepreneur in inland waterway freight transport since 1994. He also held the certificate of professional competency required to operate as an inland waterway carrier and to manage such a company.
He had been a river pilot on board sea-river vessels since 2006 and had already steered ANDRE-MICHEL 1 on the Rhône many times. He had a lot of experience in river navigation, either on his own account as a craftsman-boatman, he had been the operator of a boat, a Freycinet[8], or as a river pilot on board vessels. He had a good knowledge of the Rhône as well as of the vessel.

[8] Boat with dimensions adapted to the passage of Freycinet gauge locks (38.5 m long, 5.05 m wide, 250 to 400 tons)

He held the qualification required to operate this vessel on the Rhône, namely a certificate of competency for operating commercial vessels "group B"[9], unlimited length. He also held the necessary certificate for radar navigation and a restricted radiotelephone operator's certificate required for radio communications (VHF).
From the age of 65, the renewal of the certificate of competency to operate commercial vessels is subjected to the presentation of an annual medical certificate attesting to the fitness to operate. In this case, a renewal of the certificate of competency has indeed been carried out annually since 2018.

2.4 Information about the accident

The accident occurred on the evening of 2 October 2021, on the Rhône diversion canal, in the vicinity of the town of Donzère, south of Montélimar.

ANDRE-MICHEL 1 was sailing up the Rhône, with the river pilot at the helm. The master was on the bridge with him.

The weather conditions were good, the wind was light.

As explained in part 3.3, the flow was low and close to the low-water[10] flow, but the water level in the canal was high, and the clearance at the level of the bridge that was hit was around 6.40 m, i.e. close to the minimum (6.30 m) guaranteed on the Rhône.

Around 8.15 pm, the vessel struck the deck of the road bridge supporting the RN7 at KP 174.5, then the railway bridge 150 m further on, with her wheelhouse.

Photographs show the extent of the damage.

Tearing out and tilting of the wheelhouse, with roof compression - Source: VeriTech

[9] This means that it is valid for all inland waterways with the exception of those waterways on which the Rhine Personnel Regulations apply.
[10] The low-water flow corresponds to the lowest flows of a river.

Front views of the wheelhouse

Starboard front view of the wheelhouse

port forward interior view of the wheelhouse
Emergency hydraulic control (see 3.8)

Source: Gendarmerie

The upper part of the wheelhouse was crushed, the metal sheet was wrinkled, the whole wheelhouse was torn off and tilted backwards, deforming it and trapping the river pilot, who was trapped between the steering console and the rear console at the moment of impact, causing his death. The master, located in a space in the wheelhouse where he had more room, was only slightly injured and regained consciousness a few minutes later when crew members pulled him from the wreckage.

After these impacts, the vessel continued to drift and the crew managed to stop the engine and drop anchor. The vessel came to a complete stop 30 m from the bank on the right bank and across the canal, approximately 800 m after the Donzère “double bridges”.

View from the right bank of the stopped vessel trimmed y the stern

Source Gendarmerie (photo taken on 3 October 2021 at 8 am)

2.5 Emergency response

On the evening of 2 October and the morning of 3 October,

Around **9.00 pm**, the emergency services and the Compagnie Nationale du Rhône (CNR), which operates the waterway, were alerted, after the crew had made an emergency call to the ship's manager, who then informed the ABCRM Company.

The Drôme (26) and Ardèche (07) fire brigades quickly arrived on the scene, joined by the gendarmerie, the Donzère territorial brigade and then the specialised brigade (river brigade) of Valence.

9.30 pm – 10.30 pm, the fire brigade, using a small motor boat, was able to board the vessel. The captain was injured and taken care of by the fire brigade on the shore. It was noted that there was no water leak on the vessel.

The death of the river pilot was confirmed.

CNR has coordinated with Voies Navigables de France (VNF), which manages the waterway, to stop navigation.

The CNR was looking for the most suitable vessel from the surrounding area to come to the assistance of the disabled vessel by towing it.

11.30 pm - 4.00 am, the gendarmerie carried out findings on board the vessel and interviewed the crew members. The results of the drug and alcohol tests were negative. In order to secure the vessel and while waiting for a tow, the crew was asked to drop a second anchor.

Numerous exchanges took place, on one hand between CNR and ABCRM, and on the other hand, between CNR, the emergency services, the gendarmerie and the prefecture to seek a solution for towing the vessel, in order to make it safe as quickly as possible. The urgency was linked in particular to the forthcoming announcement of a Cévenol episode and a strong increase in the flow in the canal, with the risk of the vessel drifting away.

A CFT pusher tug could be used, but it was located quite far from the site. FRELON, which is one of the other sea-river vessels chartered by ABCRM, was also quite far away. The company contacted her to join the area. Another sea-river vessel was in the vicinity but did not have the agreement of her owner to intervene and carry out the tow. The solution of requisitioning this vessel, either judicially or administratively, was examined.

At **7.30 am**, the emergency services and the gendarmerie arrived on the site and proceeded to disengage the river pilot, the body was extricated at **8.45 am**.

At **9.20 am,** the road manager noted that there was no major damage to the bridge supporting the RN7, after having visited the site a first time during the night to make initial observations.

The weather conditions began to deteriorate and the wind began to pick up. Still on her anchor, the vessel was pushed by the wind and rotated 90° to position herself across the canal.

The emergency services were informed that FRELON was arriving in the area and could proceed with the tow. The crew of ANDRE-MICHEL 1 started up the bow thrusters to bring the damaged vessel back parallel to the shore, in order to be towed.

At **10.40 am**, FRELON came alongside the damaged vessel and towed her abreast to a wharf (dolphin) located 2 km upstream, at the entrance to the diversion canal. The canal was reopened to navigation at **11.40 am**.

FRELON towed abreast the damaged vessel – Source: CNR

On 21 October, the manager of the bridge supporting the RN7 carried out the detailed inspection of the structure that was scheduled before the accident, after having carried out two in-house visits on 5 and 6 October to ensure that there were no structural disorders.

On 8 November, the damaged vessel was transferred by a pusher tug to Port-Saint-Louis-du-Rhône after Bureau Veritas issued a certificate listing the conditions of the voyage.
The operation required prior cutting of the upper part of the crushed wheelhouse, in order to reduce the vessel's air draught and ensure her passage under the bridges

On 29 November, SNCF Réseau carried out a survey of the railway bridge and found that there was no major damage.

The vessel subsequently left the territory and was transferred to Turkey. She has since been repaired and has resumed operations under a different flag and with a different operator, while the Bureau Veritas has withdrawn her class.

3 Narrative

3.1 Management of the investigation and a reminder of the 2019 accident

In consideration of the circumstances of this accident, a technical investigation was launched by the BEAmer and the BEA-TT on 11 October 2021, and this in a joint manner given the imbrication of the river and maritime subjects (sea-going vessel sailing on a river).

The technical investigators visited the site immediately after the accident and again in December 2021. They visited the vessel again in Port-Saint-Louis-du-Rhône. They were able to talk to all the parties involved, obtain the requested documents and obtain the information gathered by the gendarmerie in the context of the judicial investigation conducted by the Valence public prosecutor's office.

The accident occurred at the same location and in circumstances similar to those of the accident of 28 September 2019: the sea-river vessel ARAMIS, sailing upstream and light (on ballast) had then struck the deck of the RN7 bridge at Donzère with her wheelhouse.

The report drawn up on this subject by the BEAmer and the BEA-TT highlights that the accident was most probably the result of a misjudgement of the position of the wheelhouse or of the river pilot forgetting to lower it before passing the bridge.

It points out that several factors may have contributed to this lack of attention, including possible river pilot fatigue related to rest and steering time, and highlights the following elements in conclusion:

- The dimensions of the vessel, which were close to the limits of the waterway, made it crucial to have continuous knowledge of the draught and air draught values. In particular, there is no clear indication on board of the level at which the wheelhouse is located.
- Improved information on the clearances below bridges would also help to focus the river pilot's attention. These improvements in the visibility of hazards would promote the involvement of the maritime crew in the safety of navigation on the river.
- The current organisation on board sea-river vessels when navigating on rivers leaves a lot of responsibilities to the river pilot alone.

The 2019 accident report includes detailed information on bridge clearances and sea-river transport. The present report is less detailed on these points. However, given that the accident site is known to be a high-risk area and given the two successive serious accidents that have occurred there, the investigations into the difficulties of crossing this area have been extended.

3.2 Navigation on the Rhône and police regulations

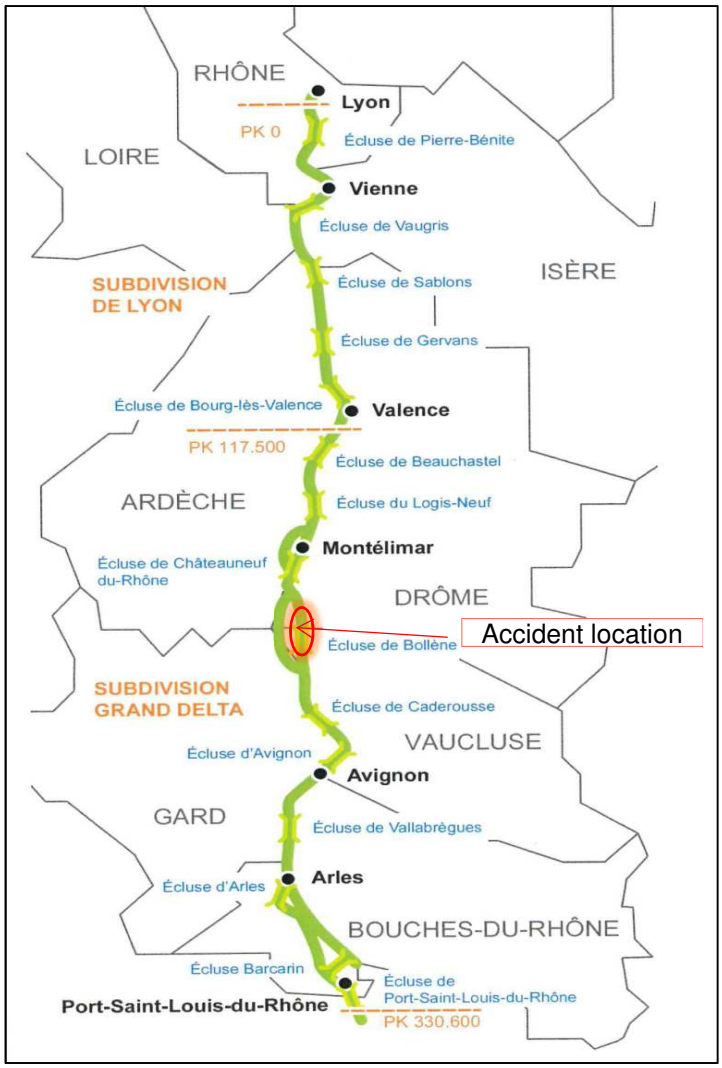


Diagram from the Notice to river traffic n°1

The waterway is operated by the CNR, which has been granted a concession by the State to develop the Rhône River for navigation, hydroelectricity production and agricultural irrigation.

The particular police regulations for navigation (RPP)[11] that apply there include the following provisions.

The Notice to river traffic No. 1, which is issued at the beginning of each year, is intended to present and explain the provisions of the RPP and to inform users of certain general provisions on the waterway.

The two bridges affected by the accident (the RN7 bridge at KP 174.5 and the railway bridge located 150 m upstream) are called Donzère “double bridges".

All boats and merchant vessels underway must activate their Automatic Identification System (AIS), which is a system of automated exchanges of messages between stations (boats, vessels, or land). Their speed of operation must not exceed 30 km/h (16.2 knots), or even less in certain areas, such as in the passage through Lyon.

[11] Inter-prefectoral order of 21 December 2018 on the special police regulations for inland navigation on the Rhône-Saône wide-gauge route

River pilots must announce themselves and provide information to the waterway operator when they enter the Rhône and Saône high-gauge network[12]. That compulsory notification must be made at the first lock encountered, according to a specific formalism for vessels accessing the network from the sea.

This formalism, described in Annex 13 of the RPP and explained in Notice to river traffic No. 1, requires the vessel to communicate her draught, but not her air draught. It was found that this formalism was not implemented at the moment: the navigation management centre (CGN) of the CNR stated that it requests the communication of draught data to both vessels and boats only in situations where there is a risk of low water level at the locks threshold.

There is also an obligation to report between boats, by radio communication (VHF), before passing a structure or a singular point on the sections listed in the RPP. The notice to river traffic n°1 also lists the sectors for which VHF reporting is recommended, the area of the two Donzère bridges affected by the accident is one of them.

About the characteristics of the waterway:

- The minimum guaranteed depth (depth of water available for navigation) is 3 m on the Rhône, except in abnormal conditions announced by the operator.
- The navigation channel is not buoyed in the Rhône diversion canals and is located 20 m from the banks.
- Clearances under bridges are discussed below.

3.3 Clearance under bridges

The RPP defines the characteristics of the engineering structures located on the navigable waterway by mentioning the clearance under the structure at the threshold of the Restrictions to Navigation during Flood Periods (RNPC), i.e. for the Rhône:

- 6.30 m from KP 0 (Pasteur bridge in Lyon) to KP 244 (SNCF viaduct in Avignon).
- Then, at least 7 m beyond KP 244.

These values, therefore, correspond to the minimum clearance provided by the structures, at least until the RNPC threshold is reached. Beyond this threshold, clearance is no longer guaranteed.

Since the accident in September 2019, it has been clarified in the Notice to river traffic No. 1 that the guaranteed regulatory clearance of 6.30 m may correspond to a current situation and not only to a situation with high flows.

[12] Waterways whose characteristics are adapted to the dimensions of vessels or convoys with a load of 1 000 tonnes or more.

Indeed, as mentioned in the report on this accident, some of the bridges on the route, including the two bridges at Donzère located in the vicinity of KP 174, will frequently have a clearance close to 6.30 m and, although the crews are generally aware that the clearance under the bridges on the Rhône may be at its guaranteed minimum of 6.30 m, not all of them seem to be fully aware that this may be the case even in periods of low water.

This situation is notably linked to the regulation of the canal by the CNR for navigation and irrigation in accordance with its regulatory operating instructions. In particular, a low flow implies maintaining the water level at a high level. To do this, the CNR uses a flow measurement station, located at Viviers, upstream of the canal, as well as three water level measurement stations, one of which, known as PR1[13], is located near the Donzère two bridges.

Thus, at the time of the accident of ANDRE-MICHEL 1, on 2 October 2021:

- The flow at the Viviers measuring station is 460 m^3/s and close to the low water flow.
- The water level at PR1 is 58.68 m[14], which, in comparison with the bridge deck elevations[15], gives a clearance of 6.35 m for the railway bridge and 6.42 m for the road bridge, i.e. a clearance close to the guaranteed minimum.

As an aid to navigation, the website www.inforhone.fr provides real-time clearance data (average over one hour) at 10 bridges on the Rhône, some of which are among the most limiting. Improvements are being studied as part of the development of the Rhône-Saône River Information Service (RIS). The BEA-TT recommended that the CNR add at least the Donzère two bridges affected by the accident, which was done in July 2022.

In addition, 26 bridges on the Rhône, including the Donzère two bridges and all bridges with less than 7 m of clearance, are equipped with an inverted (reading) scale or clearance beacon, installed on the approach to the bridge: the water level on the graduated scale gives the clearance under the structure in real-time. Reading requires the use of binoculars, or even a searchlight at night, and is sometimes difficult due to dirt on the beacon.

Following the 2019 accident, the BEA-TT also recommended that the CNR study the installation of C2[16] panels for bridges with frequent clearances close to 6.30 m, in order to better indicate these bridges, which are critical points in the section in relation to air draughts. The CNR has indicated that the action will be implemented by the end of 2022 and could concern 15 structures.

[13] PR stands for *point de réglage* i.e. control point
[14] The data recordings of the measuring station show that the level varied at most by 8 cm downwards and 5 cm upwards during the day of the accident.
[15] The elevations under the deck of the Donzère “double bridges” are given in section 3.4.
[16] Restriction signalling with C2 panels specifying that "the clearance over the water is limited; signalled limit: 6.30 m".

3.4 The Donzère “double bridges” and their approach

The Donzère “double bridges” consists of two bridges spaced just under 200 m apart and positioned in a sector where the canal makes an S-shaped bend.

The underdeck elevations are close to:

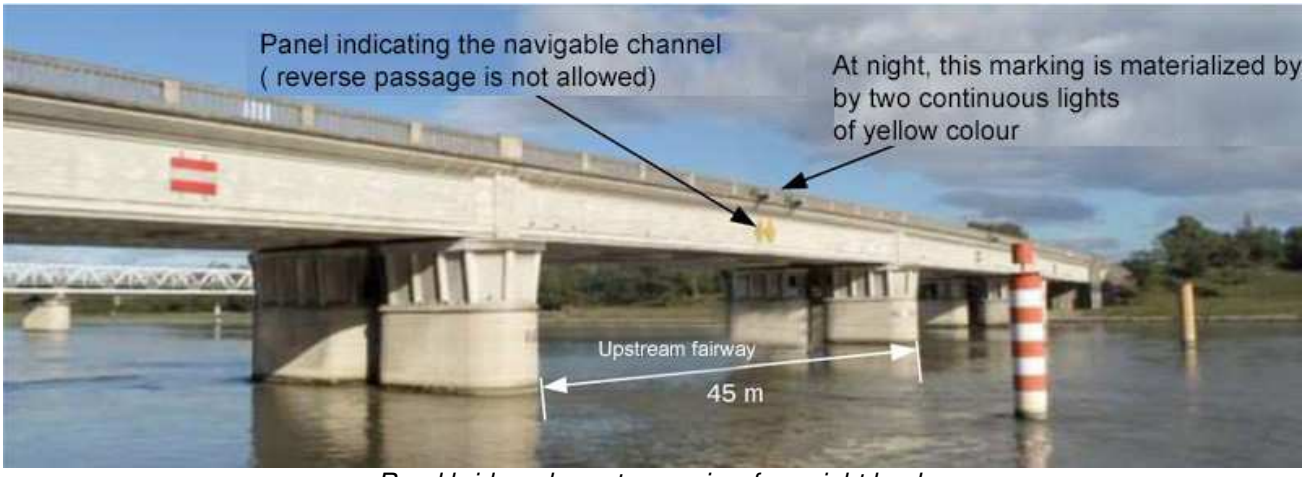
- 65.10 m NGF, for the bridge supporting the RN7 (and almost 5 cm less at the point where the vessel struck it in October 2021, given the slightly roofed profile of the structure).
- 65.03 m NGF, for the railway bridge.

These two bridges are preceded, about 5 km downstream of them, by two other bridges (RD358 and RD59) which are equally low, or even slightly lower (65 m and 65.05 m NGF).

Each of the bridges has two navigable fairways, each of which is 45 m wide and reserved for one direction of navigation, the bridges are passed in one direction only and in the fairway located on the port side in relation to the heading direction.

The corresponding signalling is provided by panels positioned on the arches of the bridges and associated with luminous lights. These lights are equipped with a twilight device: they light up automatically in low light.

Road bridge, downstream view from left bank



Road bridge, downstream view from right bank
The photograph in 3.5 gives a better view of the panels and lights.

Railway bridge, downstream view

Two spars[17] are positioned in front of the bridge piers, on both sides of the navigable channel, upstream of the railway bridge and downstream of the road bridge. They signal the entrance to the navigable channel and indicate the obstacle constituted by the bridge piers. They are red and white on the right bank and green and white on the left bank. It should be noted that the spar on the left bank downstream of the RN7 bridge is not coloured, as if it were under repair. The CNR has indicated that it will remedy this.

A manoeuvre is necessary (inversion of the navigation channel) to approach the sector, it is regulated by the RPP and is the subject of several mandatory signs, positioned upstream and downstream of the S bend. The CNR had the opportunity to check the conformity of the positioning of this signalling.

[17] Fixed beacon consisting of a cylindrical body (pole), whose diameter is proportional to the height

Thus, before taking the first bend in the S, an upstream boat will encounter the B4a panel on the left bank and then B3a on the right bank. Then, after passing the bridges and the second bend in the S, it will encounter the B4b panel on the right bank and then the B3b panel on the left bank.

Cross the channel to port	Hold the port side of the channel	Cross the channel to starboard	Hold the starboard side of the channel
 B4a	 B3a	 B4b	 B3b

Free height beacons are present upstream and downstream of the Donzère “double bridges”. Their position does not appear to be optimal: strictly speaking, and in order to maintain consistency with the inversion of the navigation channel, they should be positioned on the right bank downstream of the two bridges and on the left bank upstream of them.

The sector is known to be one of the main hazardous areas on the Rhône, due to its configuration, the low clearances under the bridges and the possible strong exposure to the wind (mistral laterally).

It was identified by the CEREMA[18] in the study on specific hazard areas for navigation carried out in 2019 on behalf of the Ministry of Transport. It is one of the sites that have been modelled, for this reason in particular, in the steering simulator on the Rhône hosted by Promofluvia[19].

Several accidents have already occurred there, including two in 2019 involving a sea-river vessel due to insufficient lowering of the wheelhouse.

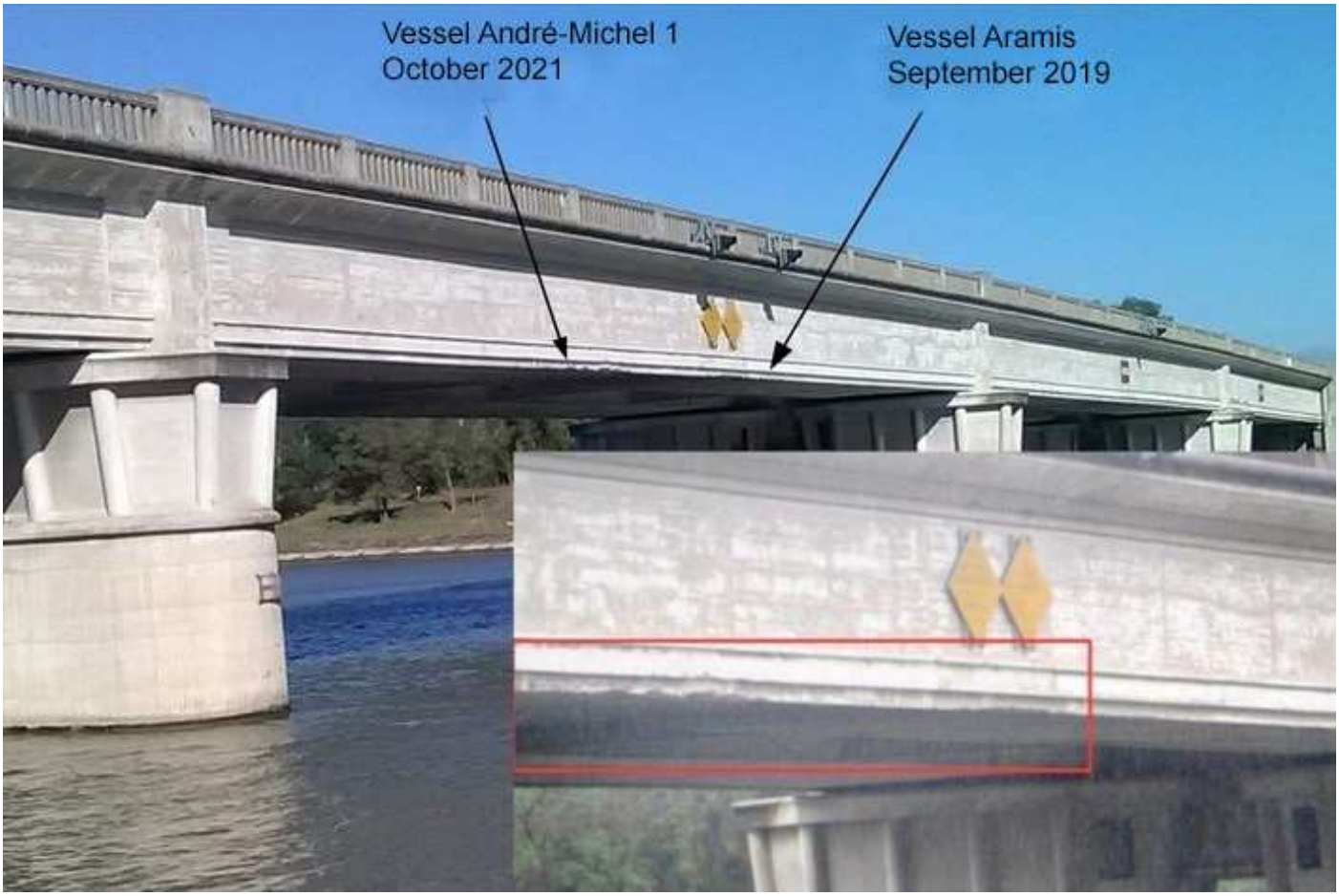
3.5 Impact points and damage to the bridges

Several damages are visible on the bridges, some of which can be attributed to the ANDRE-MICHEL 1 accident, while others can be attributed to previous navigation accidents.

Traces of orange colour, as is the wheelhouse roof fairing of ANDRE-MICHEL 1, could be seen at the bottom of the deck and make it possible to determine the place of impact of the vessel with the road bridge.

[18] Centre for studies and expertise under the Ministry of Ecological Transition and the Ministry of Territorial Cohesion and Relations with Local Authorities

[19] Association based in Lyon in charge of promoting the waterways and certain training courses



In continuation of this point of impact, the gendarmerie noted visible chafing marks under the entire bridge deck.

The inspection carried out by the road manager highlighted the presence of several spalling and splintering with exposed deformed and oxidised reinforcement. These disorders do not call into question the stability of the structure but must be the subject of a specialised repair, among other maintenance work to be carried out on the structure.

Source: DIR CE

The road manager explained that it is possible that the Vessel, after hitting the bridge deck beam, sank into the water as a result of the impact and then, on her upwards movement, hit the slab forming the underside of the deck.

As for the railway bridge, the gendarmerie noted that a metal crossbeam is bent in the south-north direction, although it is not possible to say whether this is the result of the ANDRE-MICHEL 1 accident.

The expert visit carried out by *SNCF Réseau* shows, at the level of each of the bridge's two navigable channels, impact points that can be attributed to a boat colliding with the bridge deck. The impacts are located at the level of the track of the platform used for inspections and maintenance of the structure.

Bottom view of the railway bridge and platform running rail

Source: SNCF Réseau

3.6 The vessel's air and water-draught

According to the vessel's plans:

- When the wheelhouse is in the lowered position, it is almost completely inserted into the upper deck, its roof fairing flushes with the deck, which is itself 8.60 m above the keel plate.

  All the appendages are folded down (magnetic compass of the upper bridge, various antennas, tripod of the river radar, etc.).

  In this position, the wheelhouse is at a lower level than the bulwark on this deck. All the upper elements are then placed under a line 9 m above the keel plate.

- In the upper position, the wheelhouse roof fairing (excluding appendages) is 2.40 m above the upper deck, i.e. 11.00 m above the keel plate.

- The wheelhouse stroke is estimated at 2.20 m.

After the accident, it was found that the wheelhouse was partially lowered, the remaining stroke was measured at 1.20 m.

View of the telescopic tower of the wheelhouse after the accident with a remaining stroke
Photo gendarmerie,
Captioned by BEAmer and BEA-TT

Just before the accident, the wheelhouse would therefore have been lowered by 1 m from its highest position and its roof fairing would have been 1.40 m above the upper deck, i.e. 10 m above the keel plate. The wheelhouse could not be operated by the crew after the impacts.

With regard to the vessel's draught and air draught values at the time of the accident, the answers provided by the crew to the questions asked by both the accident investigation bodies and the insurance experts are not fully consistent.

No corresponding data is recorded in the logbook. According to e-mail communications between the crew and the ship's operator, the forward and aft draughts were 2.20 m and 2.40 m respectively, both on departure from Italy and on leaving the lock at Port-Saint-Louis-du-Rhône. Additional ballasting was therefore carried out during the sailing up the Rhône. If this had not been the case, it would have been impossible for the vessel to pass the lowest bridges downstream of the accident site.

Photographs of the vessel's draught marks, taken by the gendarmerie the morning after the accident, show:

- 2.20 m at the forward draught scale;
- Just over 3.50 m at the aft draught scale.

As the difference between the aft and the forward draught (the trim) is 1.30 m, the trim is positive, the vessel is said to be "trimmed by the stern".

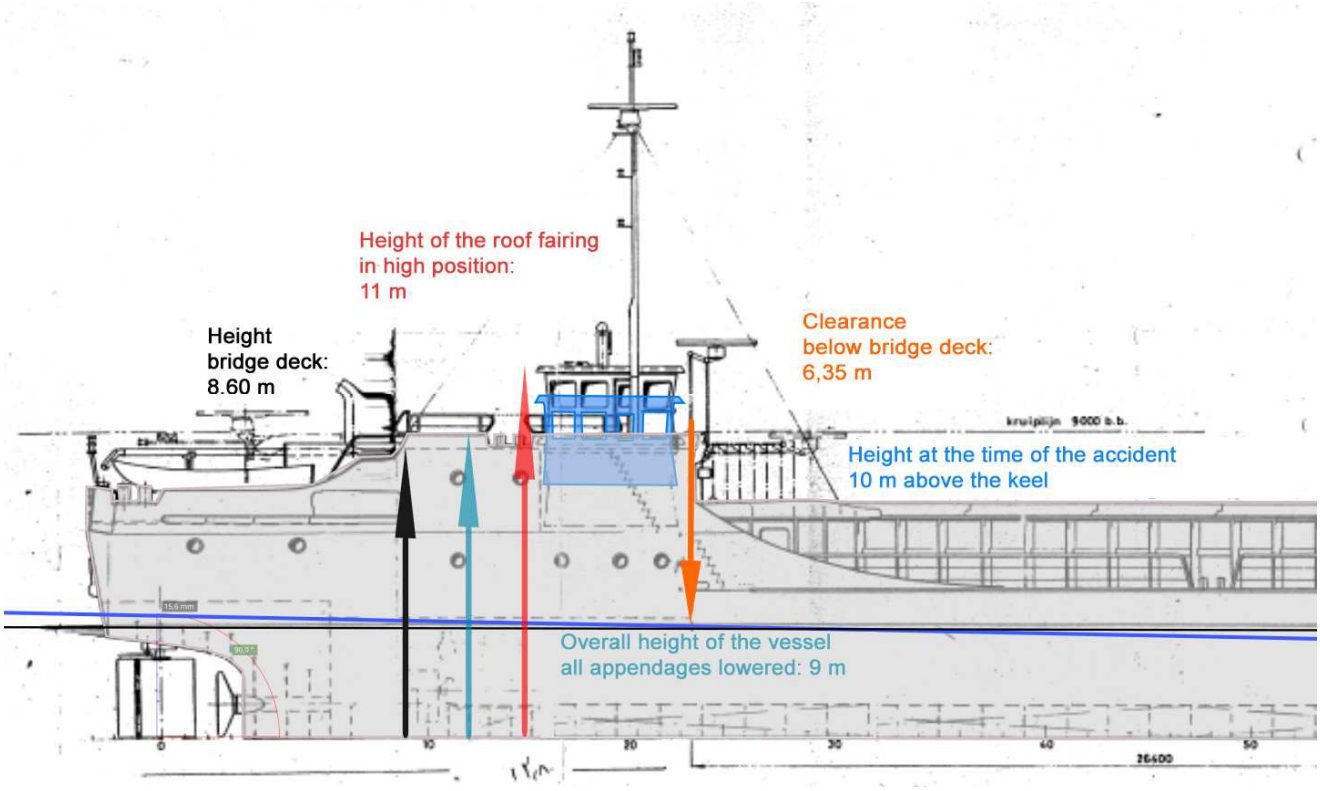
On the basis of this trim and considering, on one hand, the length between perpendiculars and, on the other hand, the distance between the aft draught scale and the point at the plumb line of the wheelhouse (these data are respectively 75 m and 14.40 m according to the vessel's plan), it is deduced by calculation that it is necessary to remove approximately 25 cm[20] to obtain the vessel's draught at the plumb line of the wheelhouse.

The vessel's draught at the plumb line of the wheelhouse would therefore be 3.50 - 0.25 = 3.25 m. Considering that the wheelhouse should have been 10 m above the keel plate, as mentioned above, the vessel's air draught at the time of the accident should therefore have been of the order of 6.75 m.

In theory, not counting the margin that must necessarily be adopted, the wheelhouse would therefore have had to be lowered by at least another 40 cm for the vessel to pass under the Donzère “double bridges”.

In addition, after the accident, the insurance experts found that the height of the wheelhouse, measured from the upper deck, was 1.60 m. Due to the deformation caused, the wheelhouse was found to be higher than it was just before the accident, which was partly the reason for the cutting out that had to be carried out in view of the vessel's towing in November 2021.

[20] (14,40 x 1,3) / 75 = 0,25 m



Extract of the general plan of the vessel with heights related to the keel plate.
Source ABCRM, captioned by BEAmer and BEA-TT

3.7 Visibility from the wheelhouse

When the wheelhouse is in the lowered position, it is almost completely inserted into the upper deck, the wheelhouse windows are hidden to port and starboard by the vessel's plating, and to the bow and stern by transverse bulkheads.

The forward transverse bulkhead has four 50 cm diameter portholes.

View of the poop deck from the forecastle, with the lowered wheelhouse in the background.

In the foreground lowered navigation mast.

Source: ABCRM

View from the upper deck with the wheelhouse in the lowered position and the appendages lowered. Source: ABCRM

View from the second porthole from the port side, vessel not trimmed.

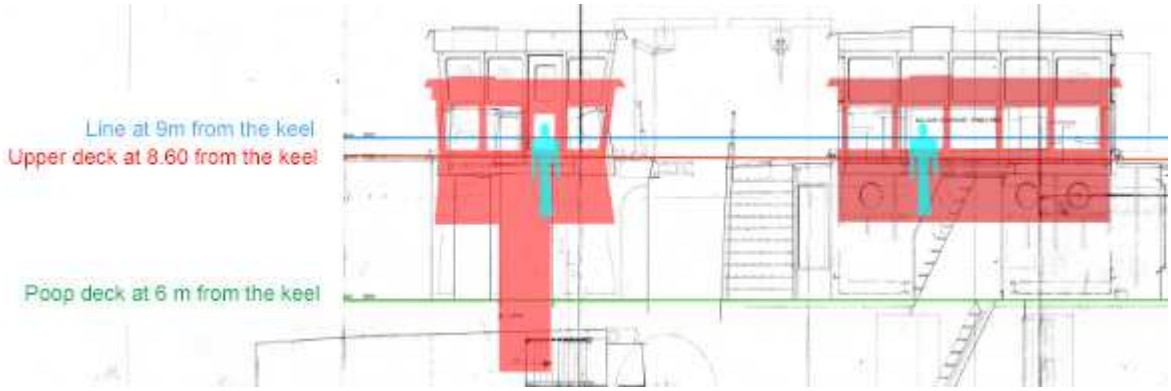
These portholes are the only means of seeing the vessel's bow from the wheelhouse in the lowered position.

Visibility is quite reduced: in this position, through a porthole, the horizontal opening is about 25°and visibility ahead of the bow is even more reduced as the vessel is trimmed by the stern.

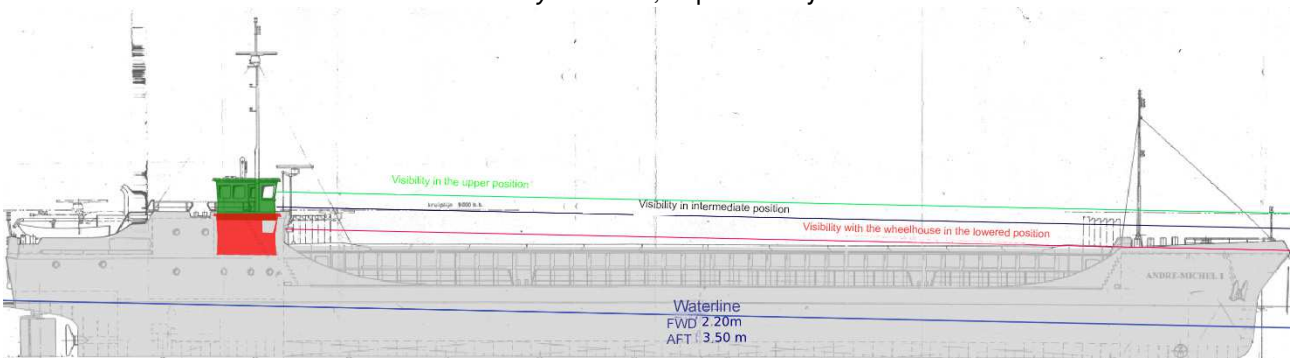
Modelling of the visibility from the wheelhouse was carried out with a configuration of 1.30 m of trim, as recorded after the accident. It shows that in such a configuration, with the wheelhouse in the lowered position, visibility through the portholes is hampered forward by the forecastle. When the wheelhouse has 1.20 m of remaining stroke, visibility is not hampered. It should also be noted that

a complete lowering of the wheelhouse implies a complete and momentary loss of visibility during the downward movement.

The vessel, therefore, has a visibility problem from the wheelhouse when it is in the lowered position. In addition, it should be noted that when the wheelhouse is in an intermediate position, it is not possible to get out of it.



Modelling of the position of the wheelhouse at the time of the accident, with 1.20 m of remaining stroke.
The different levels are related to the vertical distance to the keel plate.
Plan transmitted by ABCRM, captioned by *BEAmer and BEA-TT*



Modelling of visibility in the upper, lower position with draughts taken after the accident.
The intermediate visibility corresponds to the position at the time of the accident.
Plan transmitted by ABCRM, captioned by *BEAmer and BEA-TT*
A larger version of this diagram is shown in Appendix C.

3.8 The operation of the vessel's wheelhouse

The height of the wheelhouse is adjustable and it is assembled on a telescopic tower with a rectangular cross-section.

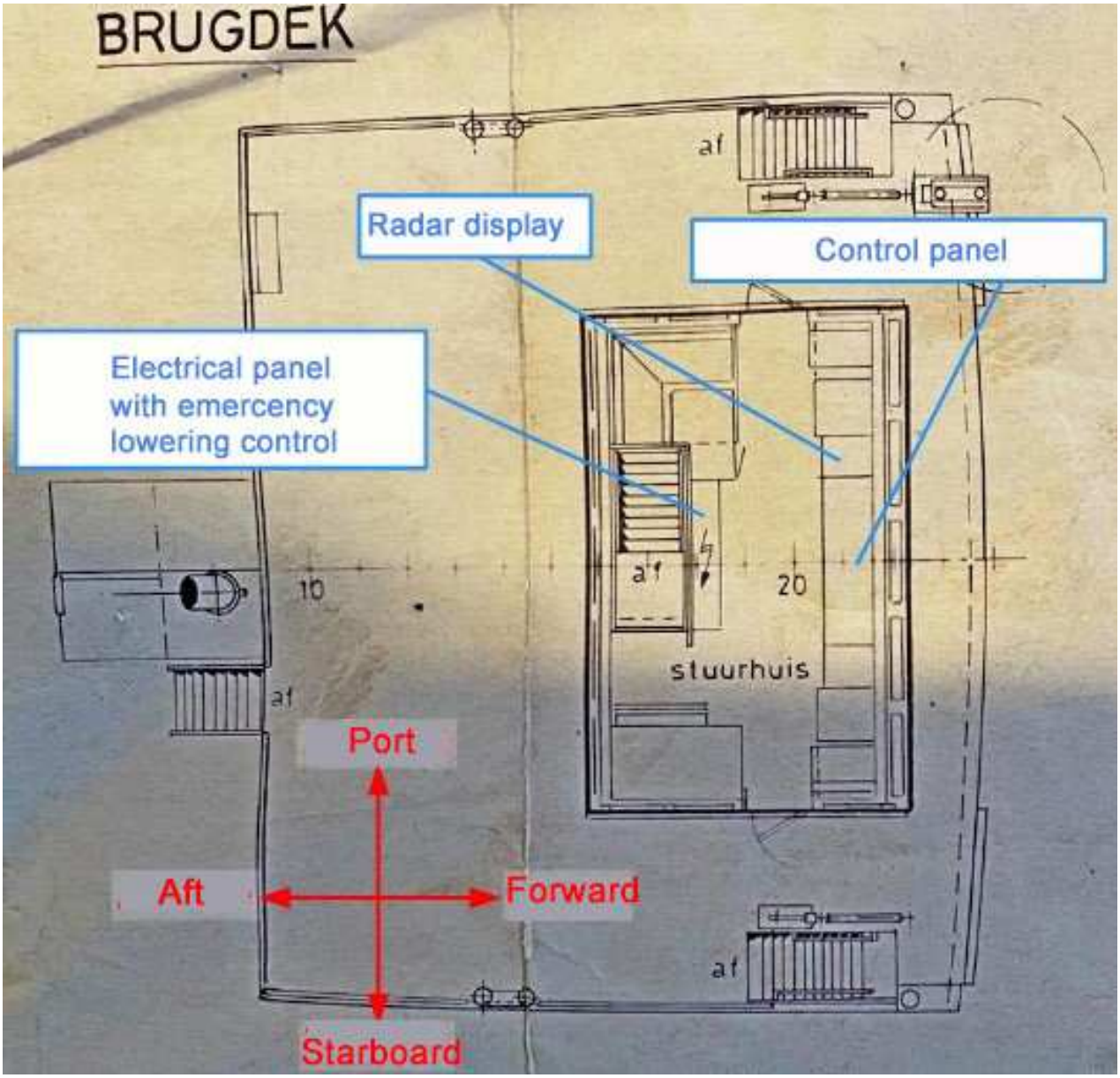
Port side control panel, looking towards the bow of the vessel.
Source: ABCRM

The corresponding hydraulic system is operated from a control panel in the wheelhouse.

Push buttons are available for raising and lowering the wheelhouse, but in practice, they are only used for raising.

View of the electrical panel from the port side looking aft of the wheelhouse.
Source: ABCRM

For lowering, the so-called emergency lowering device is systematically used, on the pretext that it is simpler to use and allows the wheelhouse to be lowered more quickly.
It is operated from a manual valve located on the electrical panel at the rear of the wheelhouse on the port side at an estimated height of 80 cm. By adjusting the degree of opening of the valve, it is possible to adjust the lowering speed of the wheelhouse. By opening the valve fully, the wheelhouse can be lowered completely in 7 to 8 seconds.



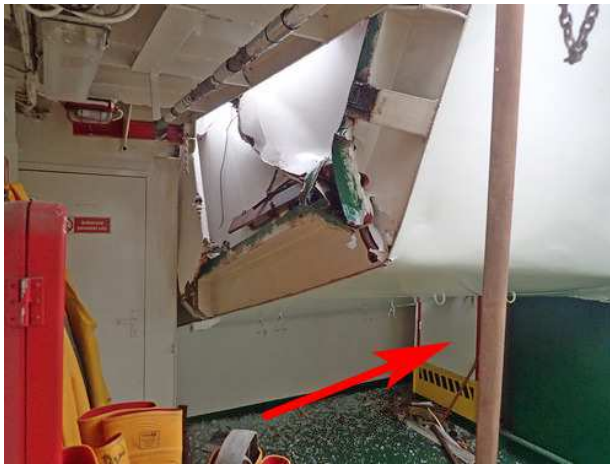
Extract from the general plan: wheelhouse and location of the main elements, top view.

The emergency device, by bleeding the hydraulic circuit, allows the wheelhouse to be lowered by gravity, whether or not the hydraulic power unit is in operation, provided that an obstacle, such as a door that has been left open, does not mechanically block the lowering of the wheelhouse.

According to the photos below, the access door to the accommodation was well closed and the doors of the wheelhouse were found intact, not warped.

During their second visit on board the vessel, the accident investigation bodies carried out an examination of the hydraulic system and did not find any faults. In addition, a functional test of the manual lowering valve of the wheelhouse was successful.

Starboard door of the bridge after removal and after cutting with a blowtorch. This door is also visible in the photos in 2.4



Access door to the accommodation. Source: gendarmerie

Port side wheelhouse door after removal – source: gendarmerie and BEAmer / BEA-TT

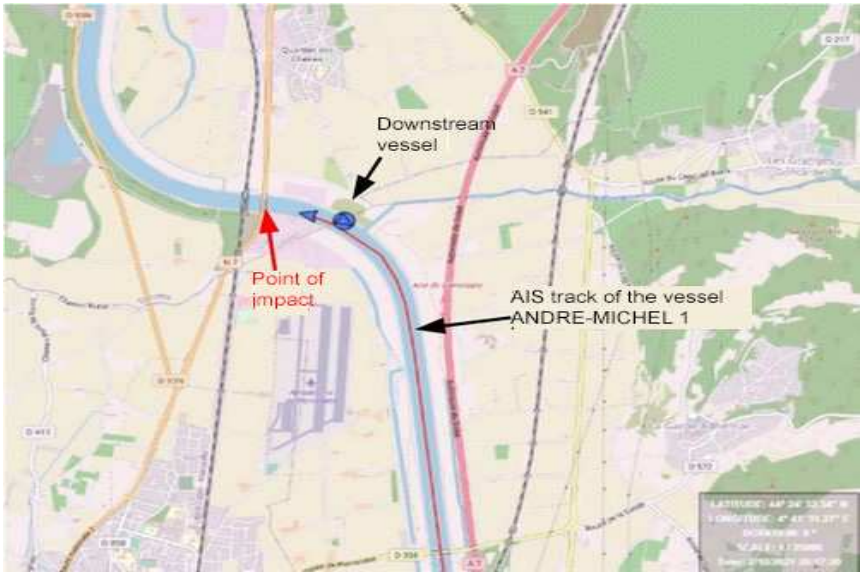
3.9 Circumstances, course of events, testimonies

On 2 October 2021, the river pilot joined the vessel at Port-Saint-Louis-du-Rhône at **7.00 am**, the vessel set sail 30 minutes later.

It sailed up the Rhône, passing through several locks, the last of which was at Bollène (84) at **7.20 pm**. The river pilot had the opportunity to inform the CNR of his intention to stop at Châteauneuf-du-Rhône (26), some ten kilometres upstream from Donzère.

Before arriving at the bridge supporting the RN7 at Donzère, the vessel passed under three bridges on the canal, two of which are slightly lower than the RN7 bridge.

The master was present on the bridge with the river pilot at the helm. The other crew members were at rest in their cabin.



According to the AIS recording available to the CNR, the vessel passed a downstream vessel at about **8.15 pm**, about two minutes before the accident, and each appears to have held her course. Her speed was around 13 km/h, which is consistent with the master's testimony (7.5 knots).

AIS track record
Source: CNR, captioned by BEAmer and BEA-TT

Then, as the vessel was passing under the Donzère “double bridges”, she collided with the bridge deck.

The first collision concerned the deck of the RN7 bridge.

A second collision occurred with the railway bridge deck. It would have been impossible for the vessel to pass under the railway bridge without striking the deck, with a deformed wheelhouse of the dimensions in which it was found after the accident. Furthermore, the master mentions in his report a first collision, followed by shocks, after which he lost consciousness and indicates that there was a collision with the second bridge which caused the destruction of the wheelhouse. One of the crew members mentions that he felt a first and then a second jolt. The master mentioned the second collision when he had lost consciousness following the first collision: this can be explained by the fact that the master endeavoured in his report to give the best possible account of the facts and by relying also on the testimony of his crews.
The vessel sank into the water to be able to pass the two bridges.

The master testified that the river pilot started to lower the wheelhouse when the vessel was 30 m from the bridge and that the wheelhouse had been lowered by about 1 m. Then, with 20 m between the bridge and the wheelhouse, the river pilot stopped the lowering manoeuvre; indeed, after the accident, the valve used to lower the wheelhouse was found by the crew in the closed position. The master shouted ("*The bridge is Urgently full down!*"), there was no reaction from the river pilot, who was standing at the helm and staring at the bridge. He states that the collision occurred 2 seconds later and that he had no time to influence the situation.

The master indicated to the BEAs investigators that starting to lower the wheelhouse only 30 m before the bridge was not abnormal because the wheelhouse could be lowered quickly. He suggested that the river pilot might have felt that the lowering achieved was sufficient to clear the bridge.

4 Analysis

The method selected for this analysis is the method recommended by IMO A28 / Res 1075 «guidelines to assist investigators in the implementation of the casualty investigation code (Resolution MSC 255(84))».

*BEA*mer and BEA-TT have at first drawn the sequence of events which caused the casualty namely:

Collision with the two Donzère bridges

In this sequence, the so-called accidental events (causal events resulting in the casualties and assessed as significant) have been identified

These events have been analysed with regard to natural, material, human, and procedural factors to identify factors having contributed to their occurrence or having contributed to worsening their consequences (contributing factors). Among these factors, those raising safety issues presenting risks for which existing defences were assessed inadequate or missing have been pointed out (safety deficiencies).

Factors without influence on the course of events have been disregarded, and only those which could, to an appreciable extent, have had an impact on the course of events have been retained.

4.1 Causes of the accident and related factors

The investigations carried out established that the direct cause of the accident was the insufficient lowering of the wheelhouse by the river pilot.

The area is considered dangerous because of the two bridges to be passed in succession. They are preceded by a change of navigation side and then a curve. This can lead to waiting until the last moment to lower the wheelhouse.

With a speed of 7.5 knots i.e. 3.85 m/s, the river pilot can wait until the bow is 30 m from the bridge to start lowering the wheelhouse, as it can make a full downward run in 7 to 8 seconds. However, it is possible that the anticipation was not optimal and that this had the effect of increasing the risk-taking, another river pilot indicated that he took at least a 200 m margin from this bridge to lower the wheelhouse on this vessel.

It was found after the accident that the wheelhouse was not fully lowered, with 1.20 m of stroke remaining on the hydraulic cylinder. The vessel's air draught at the time of the accident would have been approximately 6.75 m, with an available clearance of approximately 6.35 m, for the road bridge, at the location where the vessel passed, as well as for the railway bridge. The wheelhouse was therefore not sufficiently lowered.

The valve used to lower the wheelhouse was found in the closed position after the accident. According to the master, after a partial lowering, the river pilot probably stopped the lowering of the wheelhouse while the latter was 20 m from the bridge.

There was no technical failure to explain why the lowering of the wheelhouse stopped and why it was not lowered sufficiently to clear the bridge. As a matter of fact, the lowering system used on board, by bleeding the hydraulic circuit, leads to a lowering of the wheelhouse by gravity and works even if the hydraulic pump is stopped. Furthermore, the findings, as presented in 3.8, do not allow for the possibility that a mechanical blockage, such as an open door, could have prevented the lowering of the wheelhouse. Since the wheelhouse could be lowered by 1 m, this implies that the side doors and the access door to the accommodation were closed.

The river pilot lowered the wheelhouse so that it was 1 m lower than its highest position. He could have lowered it a further 1.20 m, but with a complete and momentary loss of visibility during the lowering, visibility would have been reduced to the single porthole opposite the helm and, given her positive trim ("trimmed by the stern"), would have been hampered by the bow of the vessel. It is therefore understandable that the river pilot did not want to lower the wheelhouse completely or that he sought to do so as late as possible.

The river pilot could have lowered the wheelhouse by another 40 cm or so, while still retaining some visibility.

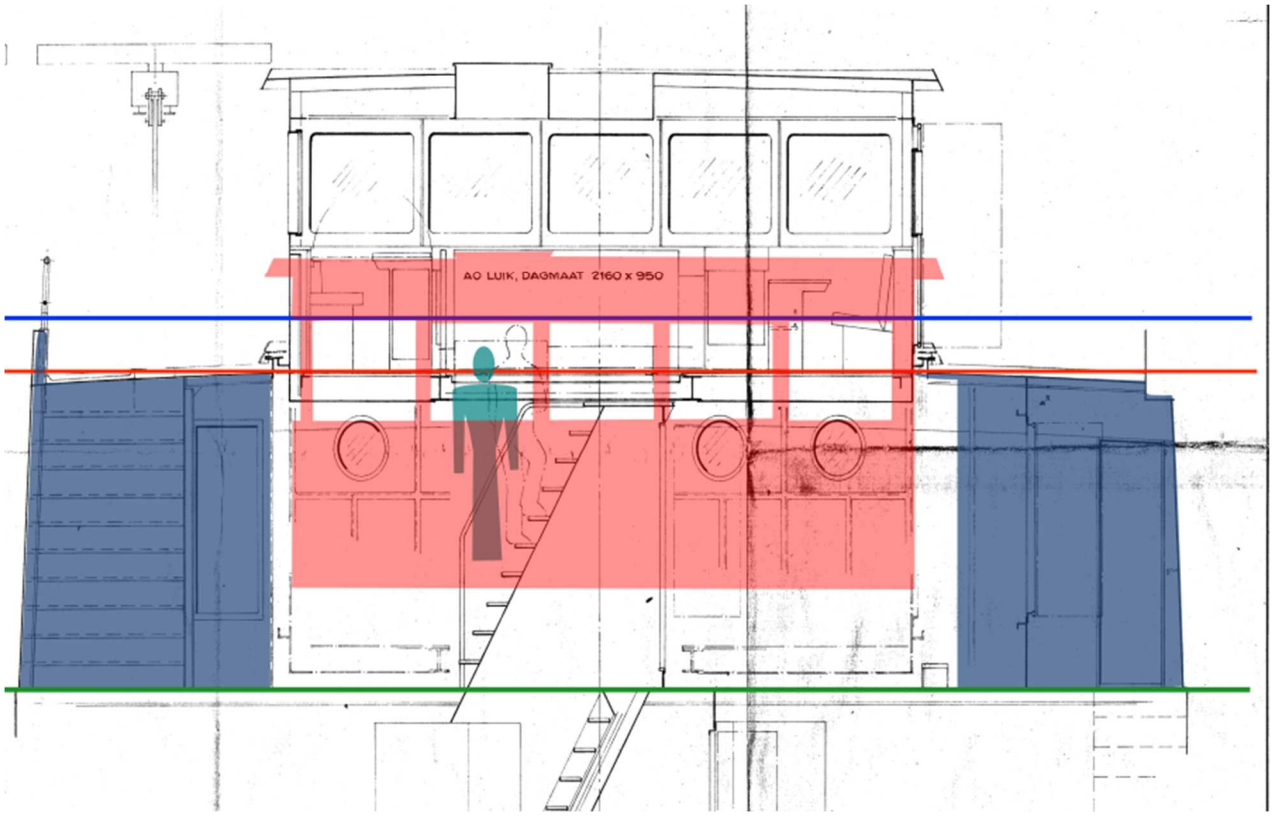


Illustration of visibility with a lowered wheelhouse, half of the window inserted in the upper deck.
Plan transmitted by ABCRM, captioned by BEAmer and BEA-TT

A first assumption is therefore that of a deliberate choice not to lower the wheelhouse too much in order to maintain good visibility. In this case, the river pilot clearly misjudged the vessel's air draught in relation to the available clearance under the bridge. Given the river pilot's familiarity with the vessel and the area of the accident, a strong perturbation could underlie this misjudgement.

The second assumption is that of human failure, as presented below, including the fact that:

- The river pilot may have been the victim of a blinding effect or inattentional blindness
- Or that he may have been the victim of a malaise

Moreover, it seems conceivable that a blinding effect or inattentional blindness could have played a role in any case: this effect could be followed by malaise and this effect could explain a problem of appreciation.

The master was on watch and therefore also present in the wheelhouse. This did not help to influence the situation positively.

Besides the difficulties inherent in this sector of navigation, the main factor that may have contributed to the accident concerns the characteristics of the vessel and in particular the visibility conditions from the wheelhouse.

4.2 Hypothesis of a human failure of the river pilot

4.2.1 Inattentional blindness, blinding effect

The area is known to be one of the main risk areas on the Rhône, due to its configuration. Difficulties in passing bridges can also be accentuated in poor visibility conditions. According to the testimonies collected by the BEAs investigators, boatmasters and river pilots must take particular care to align themselves parallel to the right bank when passing under the bridges in an upstream direction and, at night, by aligning themselves as accurately as possible with the bridge traffic lights.

The vessel ANDRE-MICHEL 1 approached the area at night and shortly before the bridge, she passed a downstream vessel. The attention of the river pilot had to be focused on this passage and on maintaining the correct axis to pass the two bridges in succession. The lights of the public works company located just before the bridge, on the left of the canal in the upstream direction, could also have been a nuisance.

The "tunnelling effect" or "inattentional blindness" can be evoked when too much attention is given to one element, mobilising all cognitive resources, to the detriment of the general analysis of the situation. This may have led, at some point during the sequence, to the river pilot focusing on passing the downstream boat and maintaining the correct course to pass the two bridges to the detriment of the risk of hitting the deck of the first bridge.

The river pilot may have wished to lower the wheelhouse partially (possibly somewhat late compared to his usual practice) and then stopped the manoeuvre, in order to delay its full lowering and thus maintain visibility, without fully taking into account the distance to the bridge. The fact that the river pilot did not react when the master shouted at him may suggest a blinding effect. The river pilot, whose attention was then focused on managing the course and finding accurately the centre line of the two bridges, may not have had the mental resources available in this stressful situation to react to the fact that the wheelhouse was not yet sufficiently lowered.

4.2.2 Hypothesis of malaise and other factors

Because of his age (68), the river pilot had to present a medical certificate each year to renew his certificate of competency to operate a commercial vessel. His last medical examination was carried out on 22/04/2021.

The river pilot was being cared for with heart conditions and type 1 diabetes. He was taking the medication indicated for prevention, as well as a medication for the treatment of type 1 diabetes, which rarely causes malaise.

According to the analysis carried out by the doctor assigned to the accident investigation bodies:

- The river pilot's risk factors that might have been involved in his malaise were well treated and well monitored medically. It is logical that his fitness to pilot on the river continued to be renewed.
- The autopsy did not show any coronary or cerebral vascular lesions that would be consistent with cardiac or encephalic malaise.
- However, the possibility that the river pilot was the victim of malaise cannot be excluded, as the situation described by the master regarding the river pilot's condition prior to the collision may suggest a malaise with partial or complete loss of consciousness during the lowering of the wheelhouse.

Although returning from a month-long holiday, given his age and the time he worked during the day, fatigue cannot be ruled out. The river pilot had taken the controls of the vessel in the morning between 7.00 am and 7.30 am and the accident occurred at 8.15 pm, so he had been working for just over 13 hours. During this transit from Port-Saint-Louis-du-Rhône to Donzère, his rest periods were possible when the vessel was in the locks. These breaks did not last more than 20 minutes each time.

During the investigation, the possibility of a psychological disturbance of the river pilot was also mentioned, but the testimonies of the family and the crew confirmed that the river pilot appeared to be in good spirits.

4.3 Safety deficiencies regarding the vessel

No technical fault was found to explain the accident. However, the configuration of ANDRE-MICHEL 1, with a very limited field of vision when the wheelhouse is fully lowered, poses a problem of compliance with the rules of visibility on the bridge. The characteristics of the vessel encouraged the river pilot to keep the wheelhouse at a high height, which was a contributing factor to the accident.

The trim of the vessel contributed to the degradation of the river pilot's visual capacity, as explained in 3.7. Moreover, with such a trim and from a certain degree of lowering of the wheelhouse, it would be difficult to comply with the rule[21] set out in the General Police Regulations for Inland Navigation, according to which "the area of non-visibility ahead of the vessel shall not exceed 350 m due to the load".

The fact that the vessel was light meant that the crew had to ballast heavily aft in order to reduce the air draught sufficiently. Sailing at a lower trim level would involve a large volume of ballast water and increased fuel consumption.

[21] Without prejudice to the provisions on technical regulations applicable to boats, the general police regulations for inland navigation have specified the rules on visibility from the wheelhouse, as set out in Article A4241-27 of the Transport Code.

With regard to visibility aids, one of the river pilots familiar with the vessel said that its relatively old searchlights provided just the correct amount of light. Finally, it was not possible to verify whether the vessel's river radar was in operation at the time of the accident and whether it was correctly set up, in particular due to the damage to the wheelhouse and the absence of on-board data recording.

Vessels operating on inland waters are not subject to the technical requirements for inland waterways as such. Technically, they are governed by maritime regulations (SOLAS), which do not include specific provisions on height-adjustable wheelhouses and the periodic verification of their proper operation.

Bureau Veritas was involved with ANDRE-MICHEL 1 as a classification society and as the recognised organisation for the issuance of the vessel's statutory certificates on behalf of the flag administration. Bureau Veritas indicated that the class certificate of this vessel did not cover the hydraulic system for operating the cylinder for raising and lowering the wheelhouse, nor did it cover the vessel's river equipment, such as the pilotage system and the radar dedicated to river navigation.
However, the perfect operation of these two pieces of equipment is essential when visibility conditions are poor and it is necessary to ensure that the correct route is maintained to cross the two bridges involved in the accident.These aspects are therefore not covered by the periodical surveys and examinations carried out by Bureau Veritas. . This situation is linked to the fact that there is no requirement for inland waterway equipment to be fitted to a vessel, either from a statutory or a class point of view.

When the wheelhouse is significantly lowered, the vessel no longer meets the approval of the SOLAS safety certificates it has been awarded. From a regulatory point of view, the vessel is in a grey area as she is not subject to the standards applicable to inland waterway vessels and the technical provisions are left to the sole discretion of the shipowner. In the case of an old vessel, this regulatory vagueness is particularly impactful.

Thus, concretely, in addition to the failure to comply with the general visibility rule ("a sufficiently clear view must be ensured in all directions from the steering position"), it appears that this vessel did not comply with some of the provisions that are currently applicable to all existing vessels equipped with height-adjustable wheelhouses, including the following provisions:

- It must be possible to access and leave the wheelhouse safely regardless of its position.
- Lowering the wheelhouse shall automatically trigger an optical warning signal and an acoustic warning signal.
- The wheelhouses and their associated equipment must be checked at least every twelve months by a specialist and at least every five years by an expert (the vessel's inspection authority).

The current regulatory principle that a vessel with valid maritime safety certificates is allowed to navigate on inland waters may therefore result in some vessels operating on rivers without complying with some of the essential requirements for boats.

An exception to this principle has historically been made for navigation on the Rhine. It has since been incorporated into the European Standard for Technical Requirements for Inland Navigation Vessels (ES-TRIN). This standard thus contains a specific chapter on the special provisions applicable to seagoing vessels on the Rhine. These provisions have the effect of making a number of standards applicable to inland waterway vessels de facto applicable to sea-going vessels. With regard to wheelhouses, they include the essential rules in terms of visibility but do not include the full set of more specific rules for height-adjustable wheelhouses as listed above.

This regulatory gap should be filled.
On the basis of an approach that could be taken at the national and European levels, the provisions applicable to vessels sailing on the Rhine could:

- for the relevant parts, be made equally applicable to inland waterways;
- be supplemented by the specific rules for height-adjustable wheelhouses which apply to boats.

This could allow the periodic checks of these vessels to also cover some of their river components, and not only their maritime components, as is the case today, both on the part of classification societies, inspection authorities and administrations. This would make it possible to ensure that, on the river, vessels are not sub-standard with regard to certain characteristics required for boats.

Finally, it is worth recalling the findings already made during the technical investigation into the accident involving the sea-river vessel ARAMIS:

- The organisation on board between the master and the river pilot has not made it possible to compensate for the latter's lack of attention. The current organisation on board sea-river vessels during river navigation and the underlying regulatory provisions leave a lot of responsibilities to the river pilot alone and do not guarantee co-involvement to ensure safe navigation.
- The arrangements between the crew and the river pilot on matters relating to the vessel's draughts and air draughts seem unclear.

It should be noted that the intervention of river pilots, whom ABRCM calls upon on a "mission" basis, is not the subject of any contract. The company even thought that these river pilots were part of a regulated profession, like the maritime pilots who must be used to pilot vessels in the vicinity of seaports. It, therefore, believed that the way in which their services were used was similar to that of marine pilots.

4.4 Safety of navigation in the two bridges area

Although the accident was primarily related to human and material factors, environmental factors in this tricky navigation area played a role in the sequence of events leading to the accident. The area is known to be accident-prone and several impact marks on the Donzère two bridges and their decks were identified by the structure managers during their inspections. This context led the accident investigation bodies to look for ways of making navigation safer in this sector.

The CNR plans to install panels to better indicate the restricted clearance of these bridges and has added the corresponding real-time data to its information site. Improvements are being studied as part of the development of the Rhône-Saône RIS. They would benefit from integrating the possibility of displaying, from electronic navigation charts and their ECDIS-type display systems, real-time data on clearances under bridges. This would facilitate the display of such data, particularly at night. Some boatmen have suggested to the accident investigation bodies that variable message panels be installed. However, this type of panel has not yet been developed on the French river network.

A development was carried out some years ago to mitigate the effect of the wind. The navigation channel inversion measure seems to have been taken before this development and to have been motivated, initially, by this same reason (it would allow a downstream boat to better fight against the wind). The relevance of this measure, with regard to the current and wind on this section of the canalised Rhône, would need to be confirmed and or could be re-examined, through an analysis of the manoeuvring conditions, visibility and trajectography. The reversal of the channel allows a boat to pass through the S-bend by following the first curve on the inside, before passing under the “double bridges”, while after the bridges it follows the second curve on the outside. On the contrary, it could be seen as providing an additional level of difficulty for the crossing of the two bridges.

Radar navigation is not very effective: echoes from the deck of bridges and those of the piers and beacons positioned in front of it are mixed up in the radar images, the display of the latter is saturated by the various echoes.

At night, some boatmen use spotlights at the front of the boat to illuminate the bridge piers, unless a boat is present in the other direction. The lights of the construction company on the right bank just downstream of the RN7 bridge can be a nuisance, but this does not seem to be the case for all boatmen.

In this type of configuration, boatmen may tend to lower the wheelhouse as late as possible.

The guide on signalling[22] draws attention to the care to be taken in marking the navigable passages and the areas at the approach to the bridges. It states that the basic requirement for safe passage through navigable fairways is to mark the direction of the fairway, and where necessary the sides of the fairway. While this condition seems to be met for daytime navigation, improvements should be made for night-time or low-light situations.

[22] Guide to Signs and Signals for Inland Navigation, CEREMA, November 2018

According to the testimonies collected in the profession, an important area for improvement would be the fitting of appropriate lighting on bridge piers.

The European guideline leaflet[23] mentions that in some cases night lighting can be provided (lighting of the lower part of a bridge, bridge piers, etc.) and thus be used to complement the marking. Although the lighting of river bridges (which can be done by backlighting) does not seem to correspond to an orientation adopted in France, this solution should be studied by the CNR for the bridge in question, particularly if there are precedents on the Rhône downstream of Lyon.

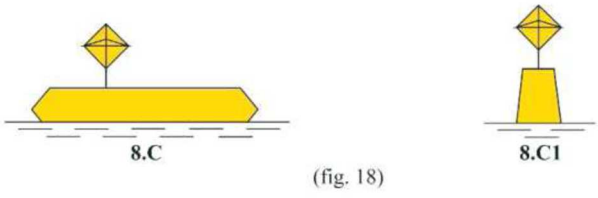
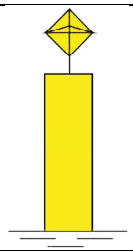
In addition, the use of reflective materials on the bridge could improve visual perception during sight-seeing navigation.

In order to better mark the direction of the passage under the two bridges, and in response to the difficulties expressed and presented at the beginning of section 4.2.1, the installation of a leading line made of lights could be considered. The current traffic lights at the level of the two bridges, located at the same altitude, do not allow for such a feature.

The General Police Regulations for Inland Navigation and the Guide to Signalling state that bridge piers are generally not separable from the deck echo on navigation radar screens. They indicate that it may be recommended, depending on the difficulties of passing bridges, to improve the radar detection of bridge piers by installing radar reflectors, on poles or equipped beacons, at a distance from the piers of the order of 10 to 15 m.

The *BEA*mer and the BEA-TT consider that it would be essential to study the possibility of improving radar detection at the level of the two bridges. Equipping the spars placed in front of the bridge piers with radar reflectors should make it possible, for example, to improve the detection of the beacon itself and of the signalled obstacle. The CNR has indicated that the metal mass of these beacons currently allows them to act as radar reflectors, but these are not the specific radar reflectors that are mentioned in the recommendations that may exist on the subject. The cylinder of these beacons, in particular, is not optimised to give a good radar echo.

It could also be interesting to equip these beacons with timed lights, which could be powered by photovoltaic panels.

 (fig. 18)	
Floats with radar reflectors placed upstream and downstream of bridge piers (signalling guide)	*Indicative illustration of existing spars if fitted with radar reflectors*

[23] European Code for Signs and Marking on Inland Waterways (SIGNI)

5 Conclusions

The direct cause of the striking of the bridges by the sea-river vessel ANDRE MICHEL 1, which caused the death of the river pilot, was the insufficient lowering of the wheelhouse.
No defective material element was retained to explain this.

However, other factors contributed to the occurrence of this accident.

When approaching this danger area of the two bridges, the river pilot's attention was probably focused on maintaining his alignment to the detriment of the air draught to be adapted according to the available clearance.

The river pilot may have been the victim of a blinding effect or inattentional blindness followed by a malaise and the master, who was also present on the bridge, did not have time to react accordingly.

The vessel was particularly difficult to steer due to her configuration, including poor visibility when the wheelhouse was lowered.

In consideration of the repeated accidents at the Donzère “double bridges”, this report recommends making navigation safer in the sector. Making navigation safer should make it easier and thus allow the river pilot to concentrate more on the subject of available clearance.

6 Measures taken by the charterer

The ABCRM company stated that it had begun the process of installing an electronic chart system (Inland ECDIS) on board the vessels it charters, covering in particular the Rhône-Saône basin.

7 Lessons learned

1. 2022-E-41: In certain navigation configurations, the vessel is no longer under the conditions for issuing her SOLAS certificates but no river provisions apply in compensation. The Rhine Navigation Regulations extend to sea-river vessels a number of standards applicable to inland navigation vessels.

2. 2022-E-42: It would be useful if the class societies, when they are also inspection bodies, in the context of the periodic examinations that they carry out on board a so-called river-sea vessel, paid attention to the more specifically river-related equipment with which they are equipped, even if this is not required by law.

3. 2022-E-43: The CNR and the vessels concerned should apply the provisions of the RPP on the obligation for sea-river vessels accessing the Rhône from the sea to communicate their draught and supplement this information with the air draught. (wheelhouse completely lowered and antennas folded).

4. 2022-E-44: It would be useful to consider making it compulsory, through the RPP, for sea-river vessels to be equipped with an electronic chart system (Inland ECDIS).

5. 2022-E-45**:** For some years now, there have been equipment fitted to vessels designed to prevent collisions with bridges, but they are not certified. This equipment, which uses laser detection, is designed to alert the river pilot if the wheelhouse is not sufficiently lowered when approaching a structure. Their development is desirable.

The investigation bodies recall that the two safety lessons learned in the technical investigation report on the ARAMIS accident are still valid.

This accident is a reminder of how important it is to follow up on them.

8 Safety recommendations

The *BEA*mer and the BEA-TT recommend:

To the Ministry in charge of inland waterway transports (DGITM) :

1. 2022-R-23: to bring within the European framework the approach aimed at extending the provisions applicable to vessels operating on the Rhine (Art 25.01 ES-TRIN), insofar as they are relevant, to vessels operating in inland waters and, furthermore, to supplement them so as to include some of the specific rules on height-adjustable wheelhouses that apply to boats.

To the Compagnie nationale du Rhône , within the framework of the existing navigation safety commission in the Rhône-Saône inland waterway transports basin

2. 2022-R-24: to study the possibilities of improving the safety of navigation in the sector of the two bridges of Donzère, during degraded visibility conditions, by means of signalling and marking (alignment of lights or other device to mark the direction of the channel, spars surmounted by radar reflectors and luminous lights, lighting of the bridge, reflective materials

3. 2022-R-25: to carry out, in conjunction with Voies navigables de France and the Direction départementale des territoires du département du Rhône (both responsible for supporting the Préfets in matters of navigation police), a trajectography study, in order to ensure that the reversal of the direction of navigation at the level of the sector of the two bridges of Donzère, remains relevant with regard to the current and the important wind on this section

Annexe A / Appendix A

Liste des abréviations / Abbreviation list

AIS	:	Automatic identification system (système d'identification automatique)
***BEA*mer**	:	Bureau d'enquêtes sur les évènements de mer - French marine accident investigation body
BEA-TT	:	Bureau d'enquêtes sur les accidents de transport terrestre - French land transportation accident investigation office
CEREMA	:	Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement - Centre for studies and expertise on risks, environment, mobility and development
CNR	:	Compagnie nationale du Rhône - Rhône National Company: French electricity generation company, mainly supplying renewable power from hydroelectric facilities on the Rhône.
DGITM	:	Direction générale des infrastructures, des transports et des mobilités - Directorate-General for Infrastructure, Transport and Mobility (French administration)
DIR CE	:	Direction interdépartementale des routes Centre-Est - French administration for Centre-East roads
ECDIS	:	Système de visualisation des cartes électroniques et d'information - Electronic Chart Display and Information System
ISM	:	Système de gestion de la sécurité (International Safety Management)
NGF	:	Nivellement général de la France - General levelling of France
OMI / IMO	:	Organisation maritime internationale - International Maritime Organisation
PK / KP	:	Point kilométrique - Kilometre point
RNPC	:	Restrictions à la navigation en périodes de crue - Restrictions on navigation in times of flooding
RPP	:	Règlement particulier de police - Special police regulations
SIF / RIS	:	Service d'information fluviale - River information service
STCW	:	Standards of Training Certification and Watchkeeping for Seafarers / Convention internationale sur les normes de formation et de délivrance des brevets de veille des gens de mer,
VHF	:	Appareil de radiocommunication (Very High Frequency)
VNF	:	Voies navigables de France - Waterways of France (French administration)

Annexe B

Décision d'enquête – Investigation decision **Appendix B**

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

Bureau d'enquêtes sur les événements de mer

BEA mer

BEATT
Bureau d'Enquêtes sur les Accidents de Transport Terrestre

Paris, **06 Oct 2021**

N/réf. : *BEA*mer **012**

DECISION

The Director of the *bureau d'enquêtes sur les événements de mer*,
(French Marine Casualties Investigation Office ***BEAmer***)

The Director of the *bureau d'enquêtes sur les accidents de transport terrestre*,
(French Land Transport Casualties Investigation Office **BEA-TT**)

Having regard to the Code of international standards and recommended practices for a safety investigation into a marine casualty or marine incident (Casualty Investigation Code);

Having regard to the directive 2009/18/EC establishing the fundamental principles governing the investigation of accidents in the maritime transport sector;

Having regard to the Transport Code, articles L1621-1 to L1622-2 and R1621-1 to R1621-38 relating to technical and safety investigations after marine and land transport casualties;

Having regard to the circumstances in which the vessel ANDRE-MICHEL 1 struck the piles of the road and rail bridges crossing the Rhône diversion canal at Donzère in the Drôme department of France;

DECIDE

Article 1 : a safety investigation is opened concerning the accident involving the Malta flag vessel ANDRE-MICHEL 1, IMO 8511914, which occurred on October 2, 2021 on the Rhône diversion canal at Donzère in the Drôme department of France (one fatality);

Article 2 : the purpose of the investigation is to research the causes and draw the lessons that this event can bring to maritime and river safety, and is conducted in compliance with the applicable texts.

François-Xavier RUBIN DE CERVENS
Director of the *BEAmer*,

Jean-Damien PONCET
Director of the BEA-TT,

Intertek
Arche Sud
92055 LA DEFENSE CEDEX

BEAmer : 33 (0) 1 40 81 38 24
bea-mer@developpement-durable.gouv.fr
www.bea-mer.developpement-durable.gouv.fr

BEA-TT : 33 (0) 1 40 81 21 83
bea-tt@developpement-durable.gouv.fr
www.bea-tt.developpement-durable.gouv.fr

Appendix C

Modelling of visibility in the wheelhouse

Modelling of visibility in the upper, lower position with draughts taken after the accident.
The intermediate visibility corresponds to the position at the time of the accident.
Plan transmitted by ABCRM, *captioned by* BEAmer and BEA-TT