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Nautical Aspects and Risk of Collisions for Offshore Structures

Environnement marin et risques de collisions avec des constructions en mer

Schiffsverkehrsaspekte und Risiken einer Kollision mit »Offshore«-Bauten

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SUMMARY
A group of oil exploitation platforms has been installed near Texel Traffic Separation Scheme. Before the platforms were installed it was necessary to assess their impact on the safety of shipping in this busy area and also to estimate the probability that a platform would be hit. The results of this study would be used to determine whether or not safety measures should be taken. The paper briefly describes the methods applied in this study and some of the results.

RÉSUMÉ
Un ensemble de plates-formes pétrolières a été réalisé près de Texel en Mer du Nord. Avant leur construction, il a été nécassaire de déterminer les effets des plates-formes sur la sécurité du trafic maritime dans la région et d'estimer la probabilité qu'une plate-forme ne soit touchée. Les résultats de l'étude devait déterminer les mesures de sécurité. L'article présente les méthodes et résultats de l'étude.

ZUSAMMENFASSUNG
Eine Gruppe von Bohrplattformen für Explorationszwecke wurde in der Nähe von »Texel Traffic Separation Scheme« aufgebaut. Vor deren Aufbau war es nötig, die Auswirkungen dieser »Offshore«-Bauten auf die Sicherheit des Schiffsverkehrs in dieser verkehrsreichen Gegend zu berechnen und die Wahrscheinlichkeit einer Kollision mit einer Bohrinsel abzuschätzen. Die Resultate der Studie haben zu Sicherheitsmaßnahmen geführt. Es wird über Methoden und Resultate berichtet.

A few years ago oil was found on the Dutch part of the Continental shelf in the North Sea.
The area where it was discovered was right in the weaving zone of Texel Traffic Separation Scheme where many vessels a day pass through and a rather complicated traffic pattern already exists. At least two production platforms were planned to be installed in this field with the possibility of two additional ones (Figure 1.).
The smallest distance between the platforms would be two miles. This distance is large enough to expect that some vessels may plan to pass right through the group of platforms while others may judge it safer to proceed around them. In the past, observations have been made with respect of traffic behaviour around offshore constructions. However, these obstructions were isolated ones whilst near Texel there would be a cluster of obstructions.
The Dutch Ministry of Transport and Public Works needed an answer to the following questions:

i) what is the risk of a platform being hit by vessels (excluding fishing vessels) passing through.
ii) what is the effect of the platforms on the risk of collisions between vessels passing through.
iii) if necessary what measures can be taken to reduce these risks.

MARIN was asked to provide answers to these questions.
To get some insight in the traffic pattern which might be expected after installation of the platforms, simulations were carried out on the radar training simulator of the Nautical College at Amsterdam.
Visual simulation on this simulator is not possible and restricted visibility generally creates a more dangerous situation. Therefore it was decided to simulate restricted visibility when navigation is primarily done by Radar and Decca Navigator.
Vessels proceeding along pre-programmed tracks were generated on the simulator. Four independently operated vessels, each manned by its own navigator, were added. Orders given for course, speed, power and rudder, were recorded.
The tracks and speeds of the preprogrammed vessels were such that a realistic impression of the average traffic near Texel T.S.S. was presented to the navigators of the 4 independent vessels.
The independent vessels were of the following types:

containership	37.600 ton dw.	(ship nr. 1)
coaster	3.000 ton dw.	(ship nr. 2)
tanker in ballast	250.000 ton dw.	(ship nr. 3)
bulkcarrier	54.600 ton dw.	(ship nr. 4)

The navigators of the independent vessels had Radar and Decca at their disposal. Altogether 4 runs were made. In each run the 4 independent vessels proceeded simultaneously, each manned by an experienced navigator. For each run different navigators manned the vessels.

The navigators had to carry out the following tasks:

Ship nr. 1:	To proceed from Texel T.S.S to North Hinder T.S.S.
Ship nr. 2:	To proceed from South of Texel T.S.S. (coming from North Hinder T.S.S.) to Wilhelmshaven.
Ship nr. 3:	To proceed from Texel T.S.S. to Maas Center T.S.S.
Ship nr. 4:	To proceed from South of Texel T.S.S. (coming from the Thames area) to Wilhelmshafen.

Figure 2 shows the general direction of these tracks.
The navigators were asked to plot their intended track on the chart before the simulation run started. The positions of the four platforms were shown in the chart. Figures 3 and 4 give the tracks which the navigators intended to follow.

Conclusions arrived at were:
i) in the same situation different navigators planned different course lines. Some planned to go through the group of platforms others preferred to pass around them.
ii) Although the traffic situation was complicated and visibility was supposed to be poor some navigators planned their course lines rather close to the platforms (e.g. ship 1 of run 1 planned to pass a platform at 0,3 miles which is barely more than the minimal allowed passing distance).

Figures 5 through 8 show the intended and actual tracks during each run. It appears that:
i) All navigators took some action for collision avoidance.
ii) Because of the traffic situation some navigators had to deviate considerably from their planned course line.
iii) Two navigators actually passed a platform at a rather close distance. One (run 3 ship 1) planned to pass a platform at a distance of 1,1 mile but eventually the distance turned out to be 0,2 mile.

After the simulation runs the navigators were asked to give their opinion on the situation. The results were:

Objections to the future situation	:	4
No objections to the future situation	:	5
Neutral response (w'll accept it)	:	6
No answer	:	1
		16

Some navigators gave suggestions to improve the situation. Most of them favoured the creation of a sort of traffic separation zone which contained the whole group of platforms. The results of the simulation led to the conclusion that unless measures were taken some traffic could be expected to pass right through the group of platforms at rather close distances whilst other traffic would pass around the group. This would create a rather complicated traffic pattern. Also it could be expected that a seizable part of the navigators passing through the area would consider it an annoying situation.

To determine the risk of collision for the platforms various methods are available. The choice of method was determined mainly by the question whether there would be sufficient data to apply it.
The method chosen was to use data from other situations where offshore objects have been exposed to the risk of being hit by passing traffic.
For each situation the collision ratio is determined from traffic data giving the number of passing ships and the number that hit the object.
From the beginning it was clear that a comparable situation would be difficult to find. Therefore it was decided to try to find situations which could be considered safer than the situation in Q-1 and ones which could be considered unsafer. Thus an optimistic and a pessimistic estimate of the actual collision risk could be found.

1. The situation which can be expected to be safer than the one in Q-1.
In our opinion this situation existed in the vicinity of five light vessels in Dover Strait and the Southern North Sea, namely the three Goodwin lightvessels and the lightvessels West Hinder and Sunk.
The situation near these lightvessels can be considered safer because:
- Except one (West Hinder), the lightvessels lie in an area where a great part of the traffic is local and is well aware of the situation.

- In the area near the Goodwin and Sunk lightvessels, many ships which are not local traffic take a pilot. Therefore an even greater part is familiar with the situation.
- The situation near Texel T.S.S. is worse because a great part of the traffic visits the area less frequently and few vessels have a pilot on board.

Based on traffic and collision data for these lightvessels a collision ratio was found of 1 in about 100.000 vessels passing at less than ½ mile distance.

2. The situation which can be expected to be less safe than the one in Q-1.
We assume that in the present traffic situation in Q-1 the ship-ship collision risk, given an encounter, is higher than that to be expected for the platforms. Reasons are:
i) the traffic pattern is complicated and busy
ii) in the period 1973-1977 three collisions took place. The number of encounters during that period was calculated to be about 35.000. The collision-encounter ratio thus found was about 1 in 12.000 which is considerably higher than the ratio usually found for fixed structures in busy areas.

3. The situation which is comparable with that of the future platforms.
We assume that in the period 1961-1972 the Texel lightvessel which is situated in Q-1, was in a situation which is comparable with that of the platforms as far as collision risk per encounter is concerned.
The reasons is, that in the period 1961-1972 (which was before the implementation of the Texel T.S.S.) the lightvessel was situated in a traffic pattern which was similar to that in which the platforms will be located, namely in an area where the traffic from Northern Europe and the Southern North Sea meets.
A difference between a platform and a lightvessel is that the former is surrounded by a safety zone (radius 500 m) and the latter not. It is, however, another matter whether in open seas these safety zones reduce the number of throughgoing vessels passing at less than 500 m. Reason is that when en route in open sea it is normally not the custom to plan to pass objects at less than 500 meters. Vessels passing at distances less than 500 m do so more likely because of an error of judgement or insufficient look out. Therefore we suppose that in similar circumstances at open sea the traffic distribution of throughgoing traffic within ½ mile distance of a platform with a safety zone around it is about the same as that around a lightvessel.
It should be mentioned here that it is not our opinion that safety zones are useless. Platforms do attract fishing vessels because the amount of fish in their vicinity. Also in more confined waters vessels will tend to pass closer to obstructions.
Without a safety zone around platforms it would probably be rather busy in their vicinity.
It was estimated that during the period 1961-1972 about 80.000 vessels passed the lightvessel Texel at a distance of less than ½ mile. Three ships collided with the lightvessel. The collision ratio was therefore 1/27.000 encounters.
Summarising: the collision ratio is expected to lie between 1/100.000 and 1/12.000 and is probably about 1/27.000 encounters.

Effect of weather conditions on collision risk
In the table below the effect of weather conditions on collisions and near misses with Dutch Light Vessels and Light platforms are stated.

Collisions and near misses with Dutch Lightvesssels and Light platforms Period 1961-1975.

	no. of collisions	no. of near misses	no. of collisions and near misses	% of total	% of time during which weather condition prevails
Good visibility [1])	3	1	4	30	98
Bad visibility [2])	2	1	3	20	2
Wind Bft 7 of more[3])	0	1	1	10	4
Condition unknown	3	3	6	40	-
Total	8	6	14		

[1]) Visibility of ≧ 0,5 mile
[2]) Visibility of < 0,5 mile
[3]) In wind Bf 7 or more visibility is most times 0,5 mile or more. Off the Dutch Coast the condition of ≧Bf 7 and bad visibility occurs for only 0,1% of the time.

Even if one assumes that collisions and near misses under unknown conditions took place during good visibility the relative share of them in the total number is smaller than the percentage of time during which good visibility prevails.
Admittedly the numbers are small. However they indicate a trend which is found in many other collision and grounding statistics. Namely that under conditions of bad visibility the collision and grounding risk per unit of time and also per vessel movement is higher than during other weather conditions.

To determine the expected collision frequency, the number of passages within half a mile of the platforms had to be estimated.

A high estimate was found by supposing that the traffic pattern would remain the same and that the number of vessels which presently passes within half a mile of the future position of the platforms remains the same.
A low estimate was found by considering the traffic measurements made near an isolated platform in the North sea which were carried out by the North Sea Directorate of the Department of Transport and Public works (Figure 9).
This picture gives the actual and theoretical passing distance of nearly 350 vessels passing the exploration platform.
The theoretical passing distance is the distance at which the vessels would have passed if they had continued on their original course and had not taken any avoidance action. From this picture we can conclude that within 0,5 mile distance the traffic intensity is reduced by about a factor 3. This figure is considered optimistic because the platform was an isolated one, in an area where plenty searoom was available. Near Texel there is a group of platforms. The traffic passing through this group has less space available and some of the the traffic passing around them may wish to cut corners. Therefore more vessels may be expected to pass within half a mile than in the case of an isolated platform. For these reasons we expect that a realistic estimate of the traffic within half a mile of the platforms is found by supposing that the number of vessels presently passing withing this distance is reduced by a factor 1.5.
Because of the small difference between the low and the high estimate of the encounter values we considered the realistic estimate of the encounters more reliable than the realistic estimate of the collision ratio.
Therefore the realistic estimate of the encounter rate was multiplied by the optimistic, pessimistic and realistic values of the collision ratio to obtain the estimates of the collision frequencies.

For one of the platforms the collision frequencies thus found were as follows: (rounded off figures).

Optimistic estimate:	once in 50 years
Realistic estimate:	once in 10 years
Pessimistic estimate:	once in 5 years

Because of these values it was decided to change the Texel T.S.S. in such a way that the platforms would be situated in the separation zone.

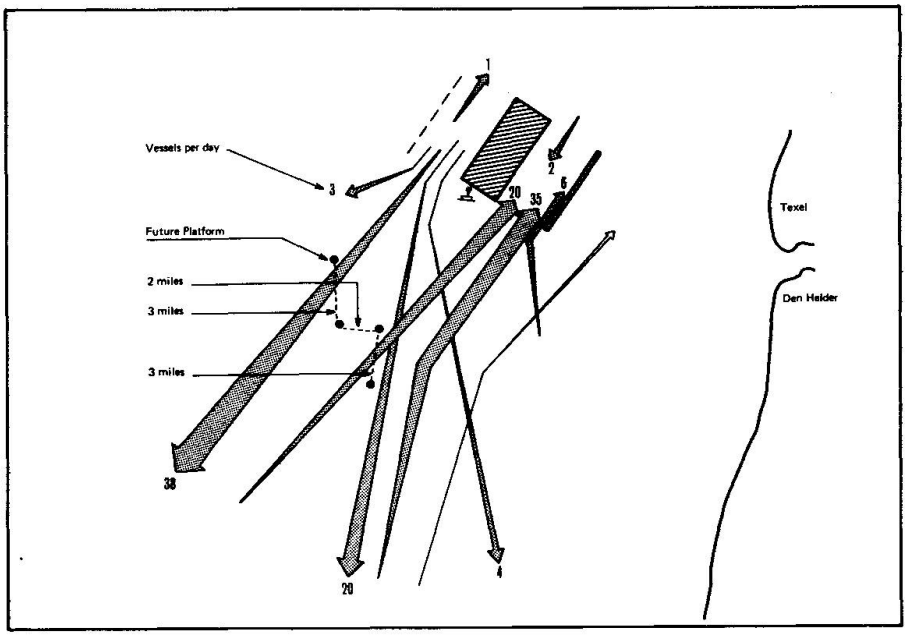

Figure 1.: Traffic Pattern South of Texel T.S.S.

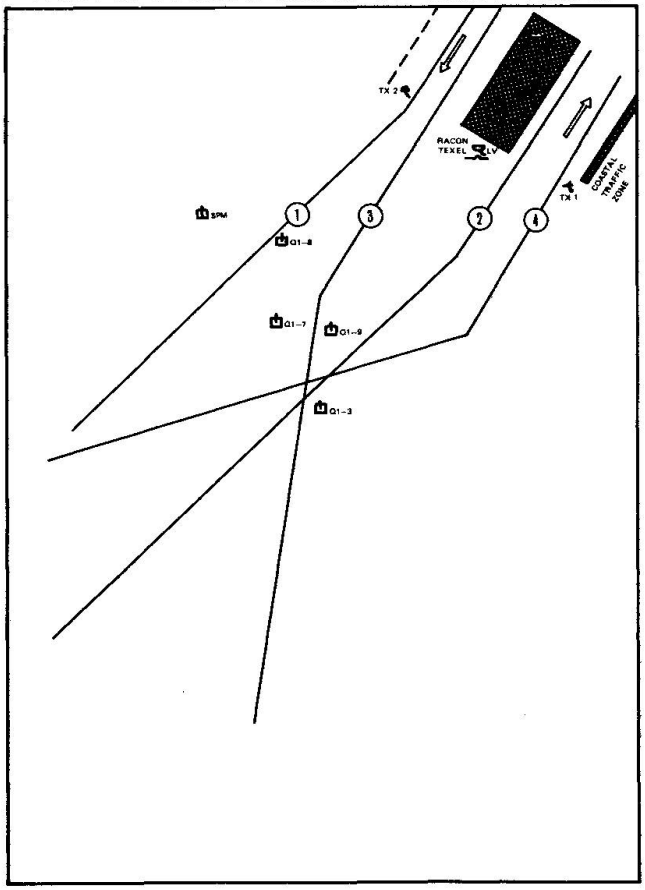

Figure 2.: General direction of tracks to be followed.

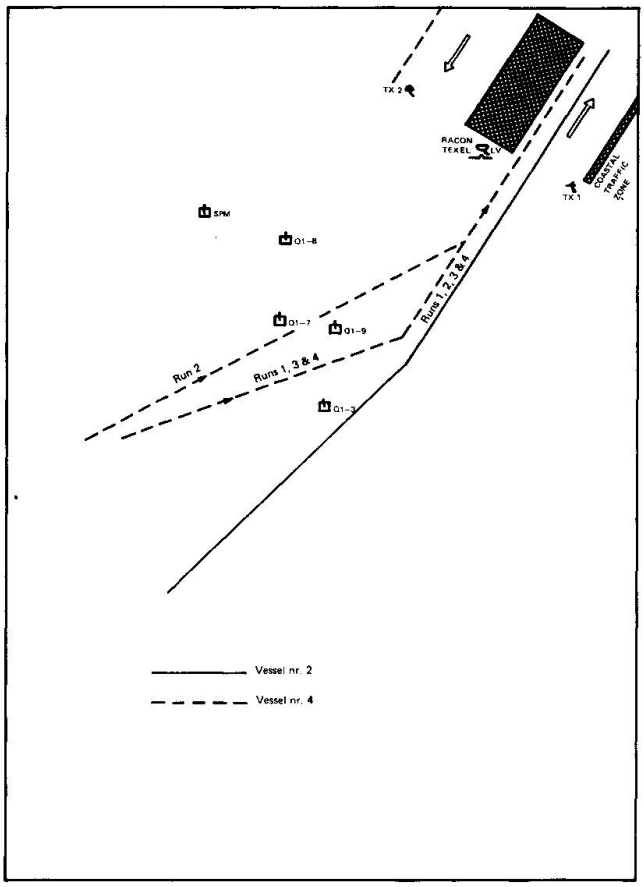

Figure 3.: Intended tracks.

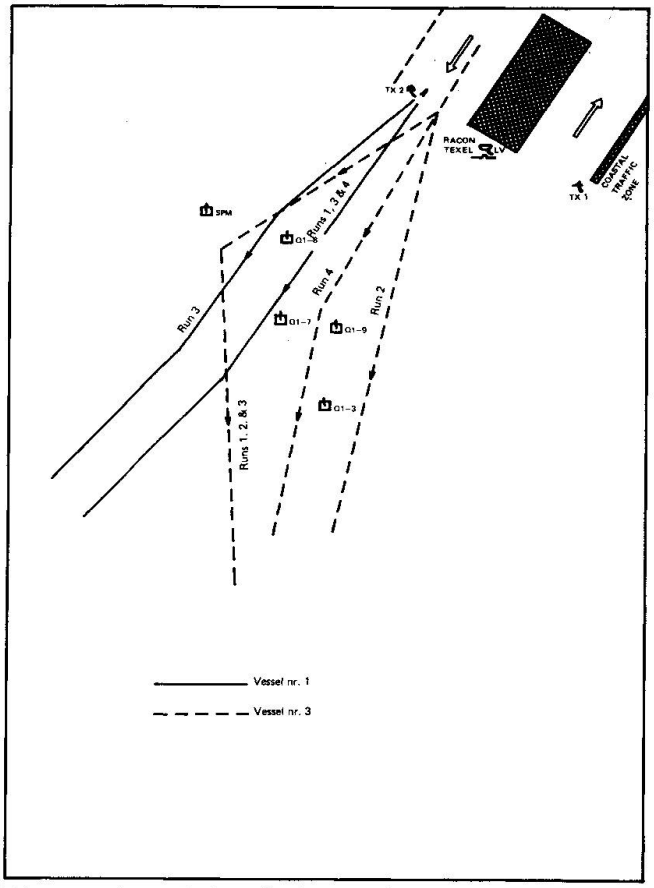

Figure 4.: Intended tracks.

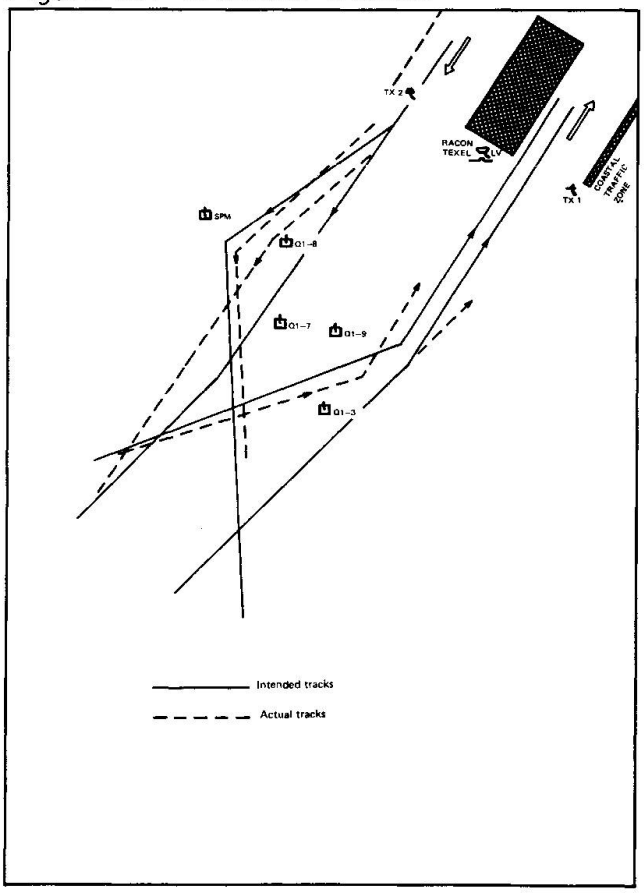

Figure 5.: Simulation run nr. 1.

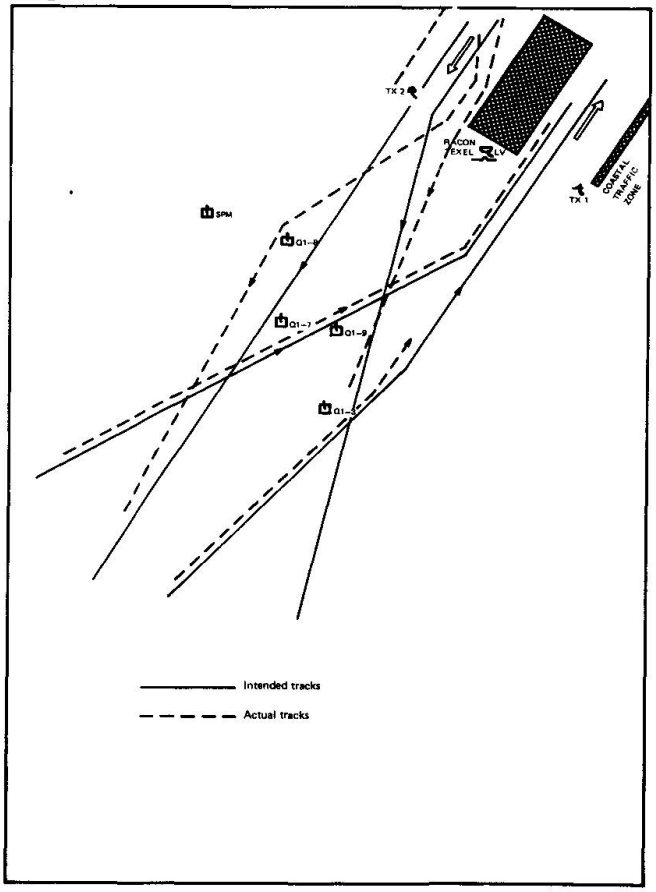

Figure 6.: Simulation run nr. 2.

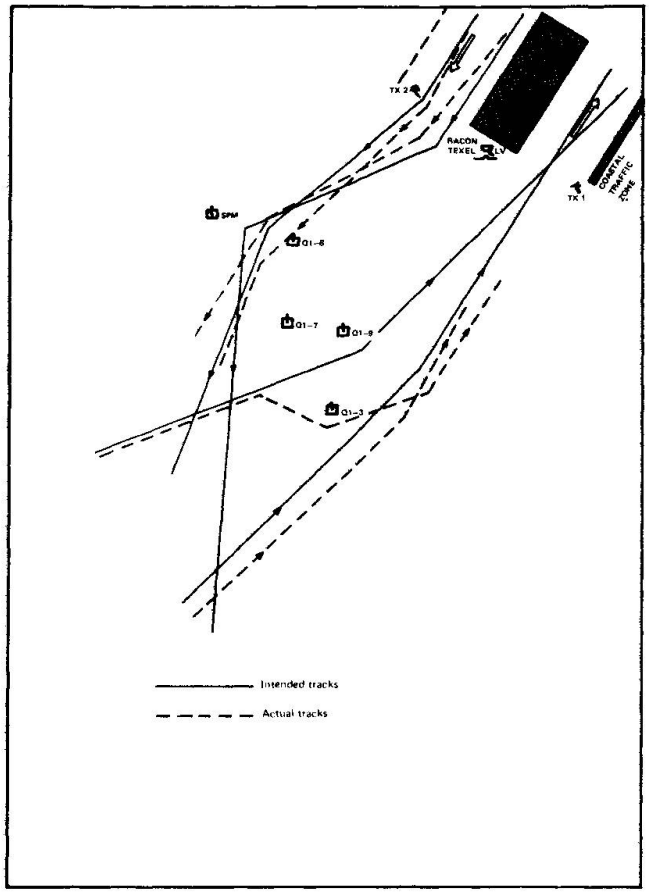

Figure 7.: Simulation run nr. 3.

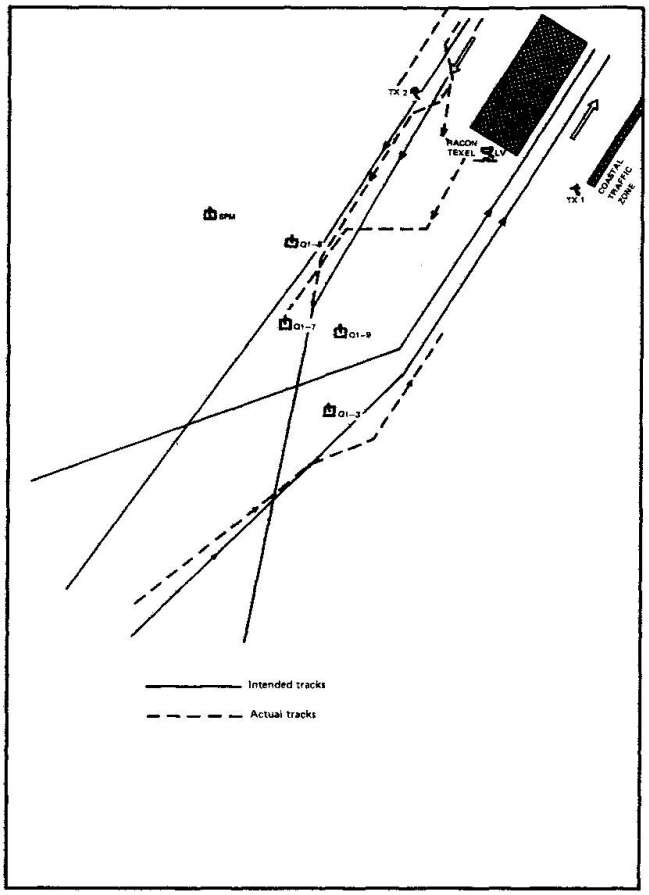

Figure 8.: Simulation run nr. 4.

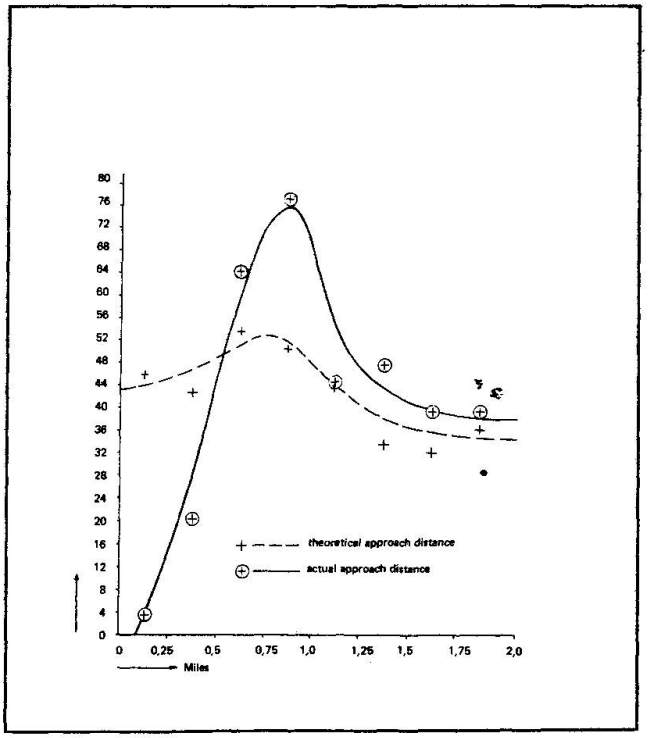

Figure 9.: Theoretical and actual approach distance of 343 vessels passing the Divy Gamma platform.