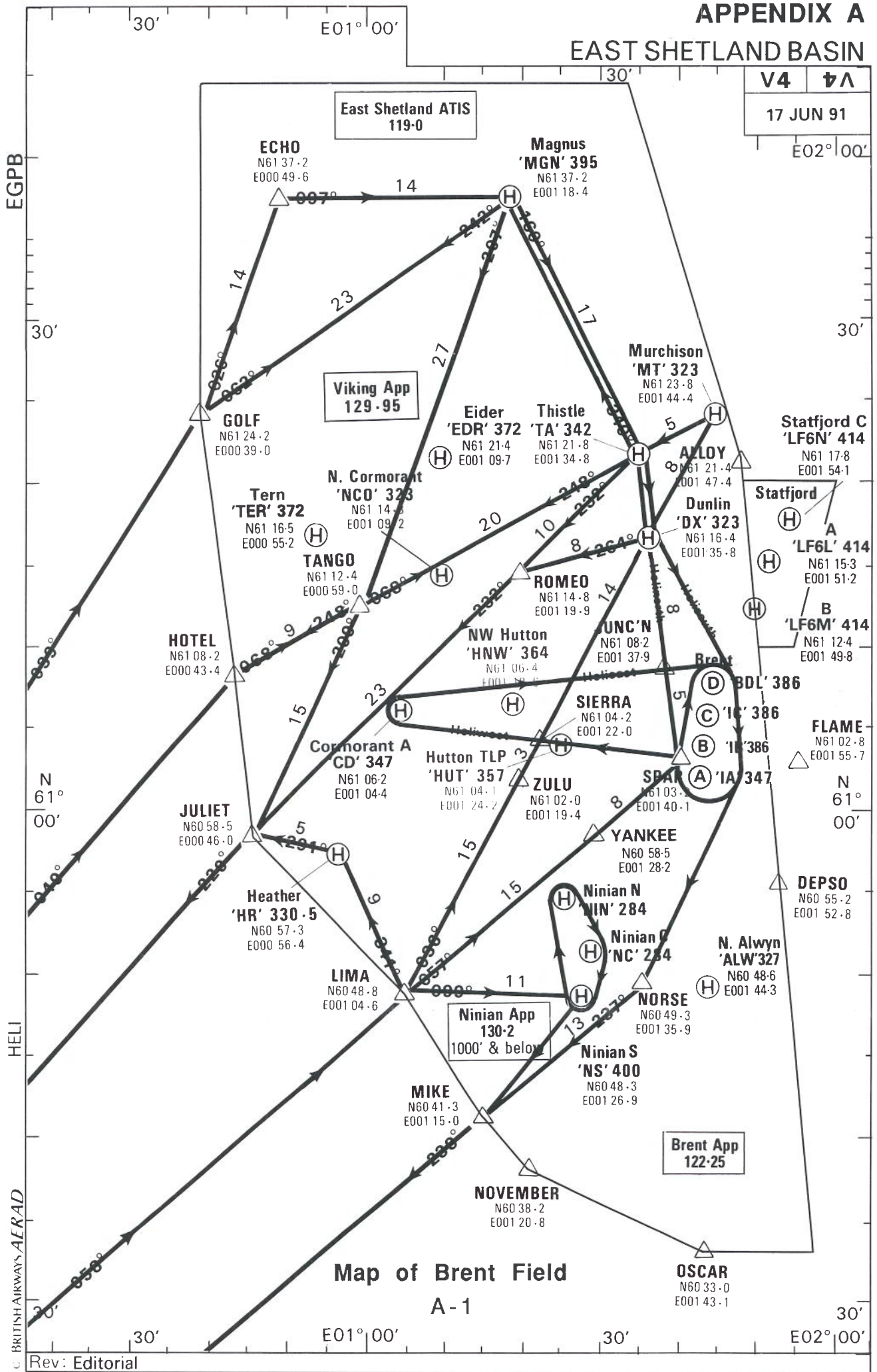


APPENDIX A

EAST SHETLAND BASIN

V4 7A
17 JUN 91



Map of Brent Field
A-1

HELIDECK
ELEV 105

Var
6°W

Position
N61 03.2
E001 40.1

BRENT SPAR SPM

HEIGHT OF INSTALLATION: Crane - 144
HIGHEST OBSTACLE WITHIN 5NM: Brent C-492
FUELLING INSTALLATION: No
STARTING EQUIPMENT: No
HELIDECK APPROVED FOR: See below

VHF
122.25

NDB
'FX'
386

D1
LD
30 MAY 88

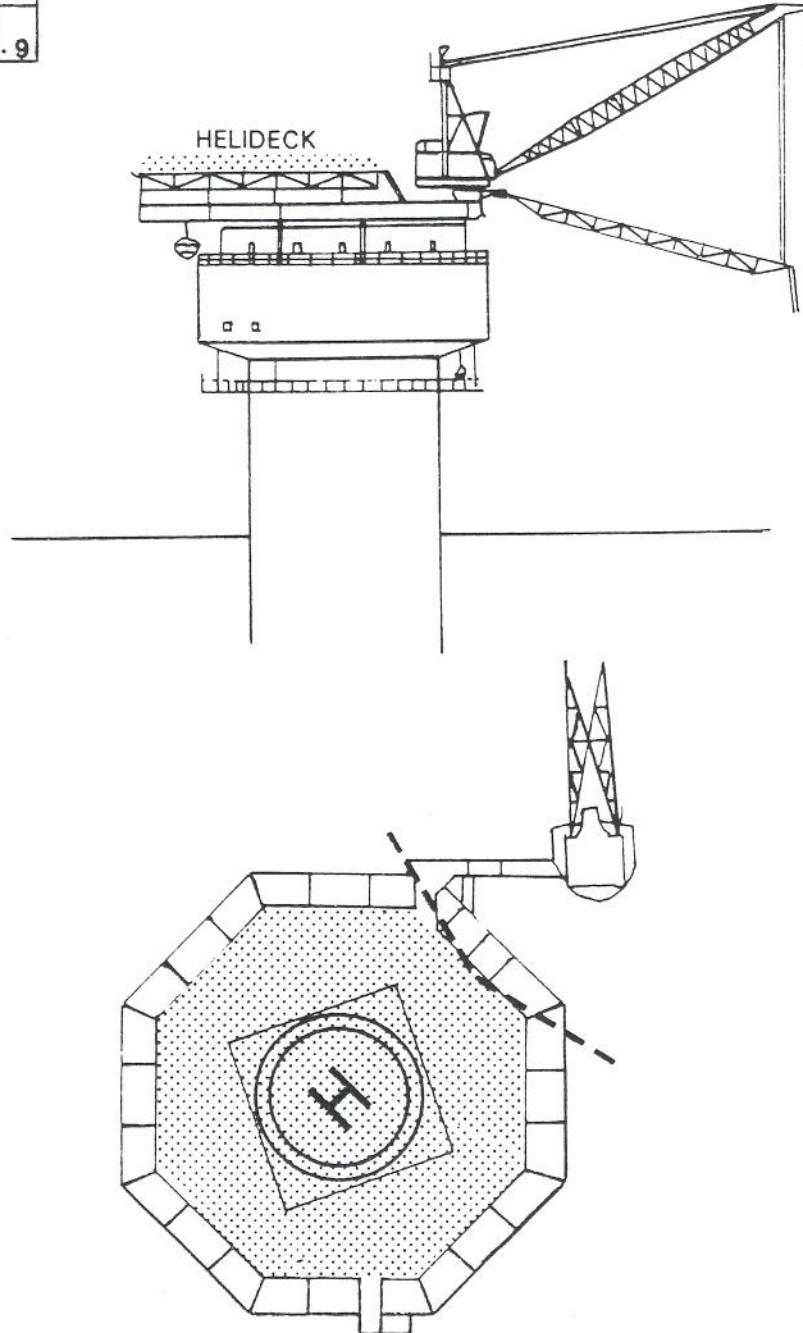
OPERATING COMPANY
Shell Expro

APPROVAL AGENCY
CAA

DECCA
Chain 6C

A	F	E
10.2	46.8	75.9

brs

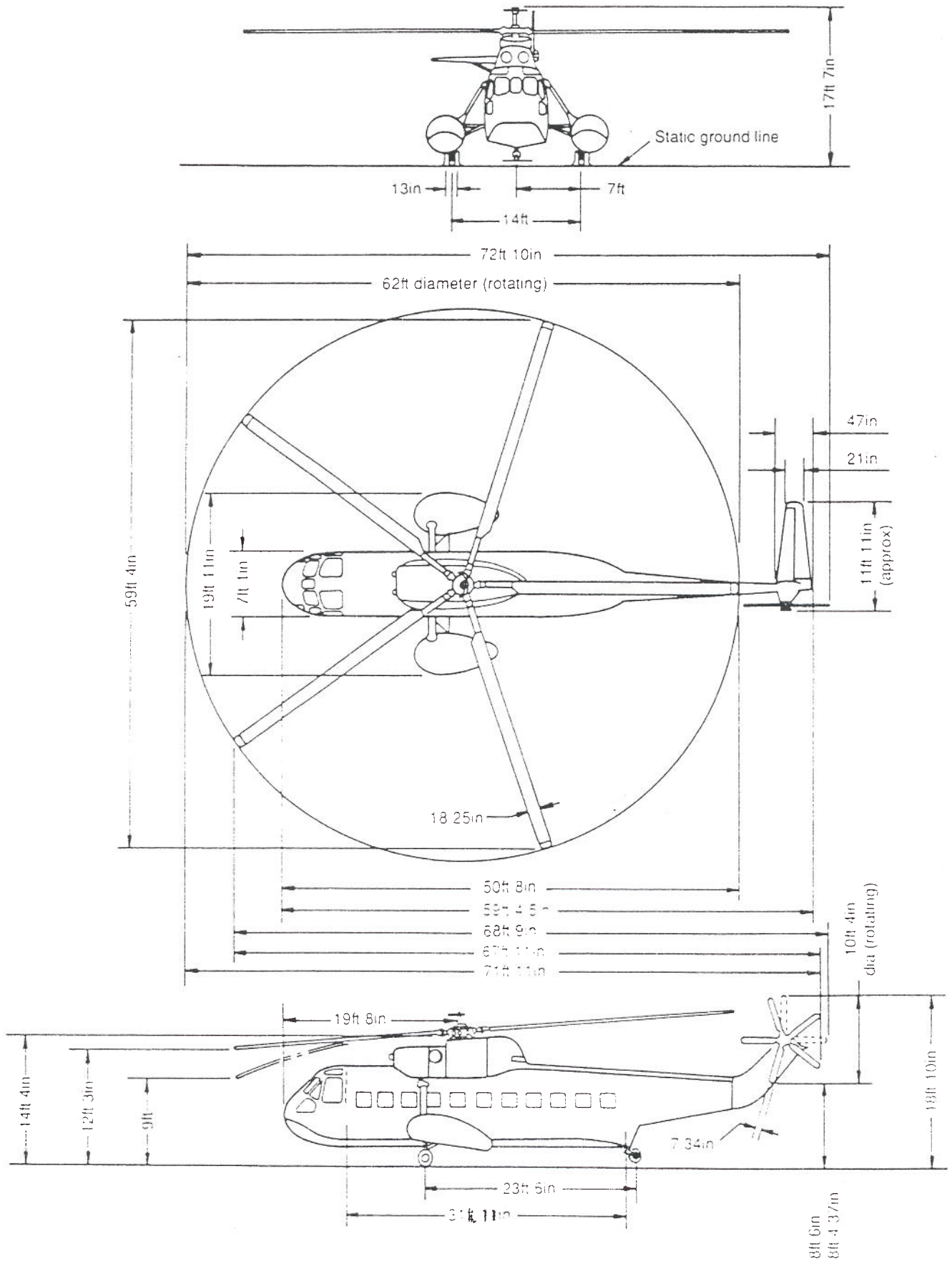


Helideck 19.8m diameter

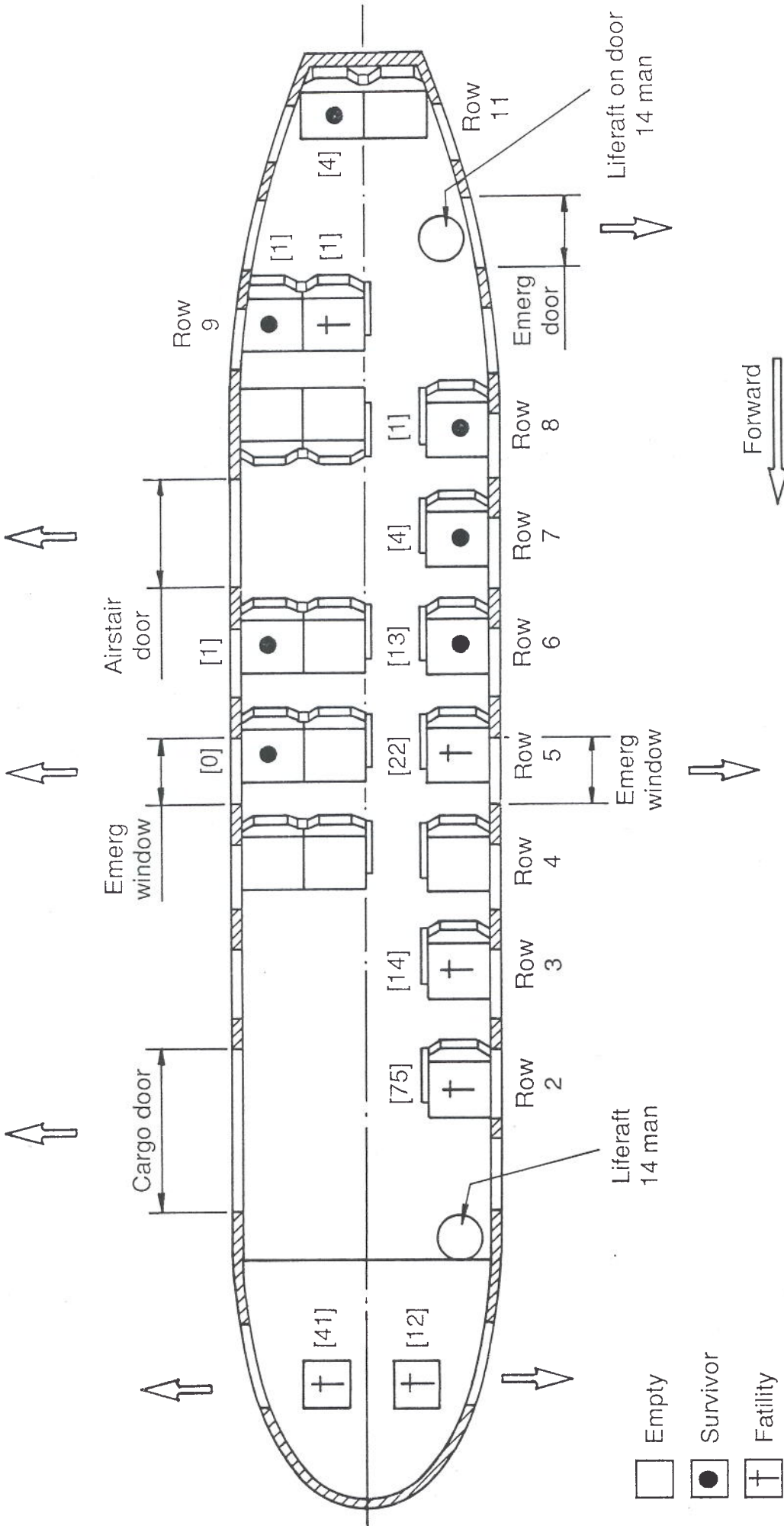
1. Helideck unrestricted up to B214ST/ AS332L. S61N may operate subject to CAA operating conditions.
2. Helideck rotatable through 360° when tanker loading taking place.

BRITISH AIRWAYS AIRAD

Rev. Nil



S-61N General Arrangement



C-1

G-BEWL Seating Arrangement and Injury Severity Scores (ISS)



G-BEWL after recovery to the deck of MSV Stadive



Seat 5L - left side of passenger cabin



Seat 9R - right side of passenger cabin

ATC transcript

Transcript of communications on Brent Approach (B APP) 122.25 mhz from 0938 hrs 25 July 1990. The final two and a half minutes of the CVR have been superimposed. Words that are unclear are shown by question marks. Time is shown to the nearest second. Time to impact is shown in brackets.

To	From	Recorded intelligence	
G-BEWL	B APP	Whisky Lima if you'd like to advise when you're ready to lift Poly for the Spar	
B APP	G-BEWL	Roger	0938:00
B APP	G-BEWL	Brent Approach Whisky Lima	
G-BEWL	B APP	Whisky Lima go	
B APP	G-BEWL	Eh I don't actually like the eh approach and the take off here today from the Polycastle with the eh the structures around I wonder if it might be possible as we're going off heavy on the next run to come back on to the Alpha	
G-BEWL	B APP	Yeah I don't see there be any problem at all so you'd like to go from the Poly to the Spar then back to the Alpha confirm	
B APP	G-BEWL	Yes please and eh we'd like another fuel on the Alpha please	
G-BEWL	B APP	Yeah okay and you're obviously aware that Delta India upstairs is sitting on the Alpha deck at the moment	
B APP	G-BEWL	Yes okay he should be off eh before we're ready	
G-BEWL	B APP	Yeah okay fine	
B APP	G-DI	Yeah Delta India be about two minutes	
G-DI	B APP	Okay Delta India what are you looking for departure ??????	
B APP	G-DI	Eh two thousand five hundred feet Mike please	
G-DI	B APP	Roger two five zero zero feet and to the Mike gate will be approved advise when you're ready to lift	0939:00
B APP	G-DI	Will do	
B APP	G-BEWM	Whisky Mike's on the Bravo	
G-BEWM	B APP	Whisky Mike	0940:00
B APP	G-BEWL	Whisky Lima lifting the Polycastle for the Spar with thirteen on board	0940:25

To	From	Recorded intelligence	
G-BEWL	B APP	Roger Whisky Lima report landing Spar	
B APP	G-BEWL	Whisky Lima	
Spar	G-BEWL	Brent Spar helideck Whisky Lima for a deck clearance	0941:18
G-BEWL	Spar	Whisky Lima Spar deck good morning Spar deck is clear	0941:22
Spar	G-BEWL	Whisky Lima	0941:26
	P1 ¹	Just put the bug down a bit I think now	0941:30
	P2 ²	OK	
	P1	? hundred	0941:36
	P1	Off of there four one was it	0941:43
	P2	Yeah	0941:46
B APP	G-DI	Eh Brent approach eh golf Delta India ready for take off	
	P1	No wind at all really that smokes going straight up from the er	0942:25
G-DI	B APP	Roger Delta India break	
G-BEWL	B APP	Whisky Lima are you visual with the Spar	0942:28
	P2	Yeah	
	P1	Yeah	
B APP	G-BEWL	Whisky Lima roger we're turning finals	0942:34
G-BEWL	B APP	Thank you	
	P1 smoke is going straight up on the(tanker ?).	
G-DI	B APP	Delta India just to be on the safe side can you hold thirty seconds and let him get on the Spar first	
B APP	G-DI	Eh Roger Delta India holding	0942:41

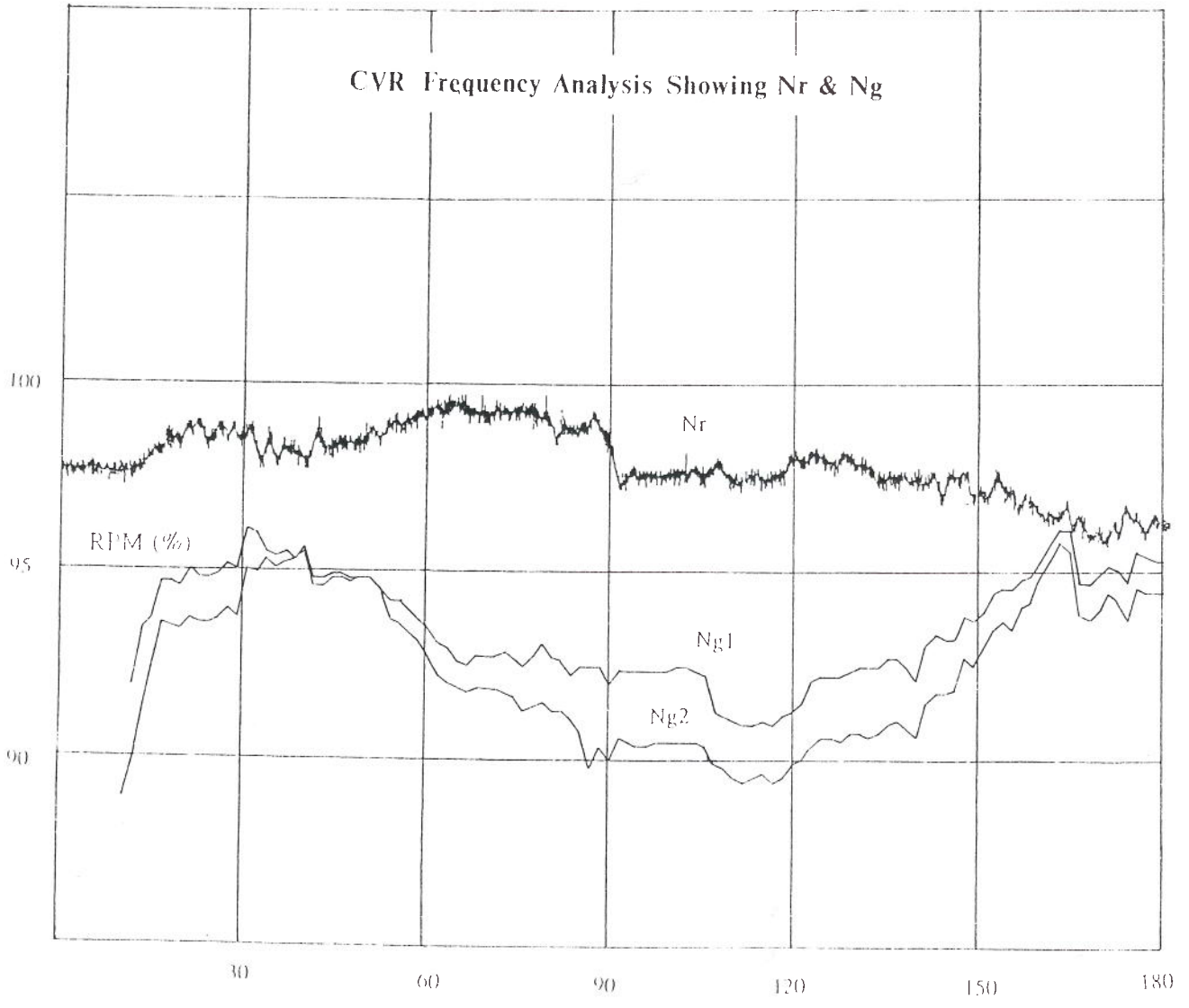
¹ G-BEWL Commander.

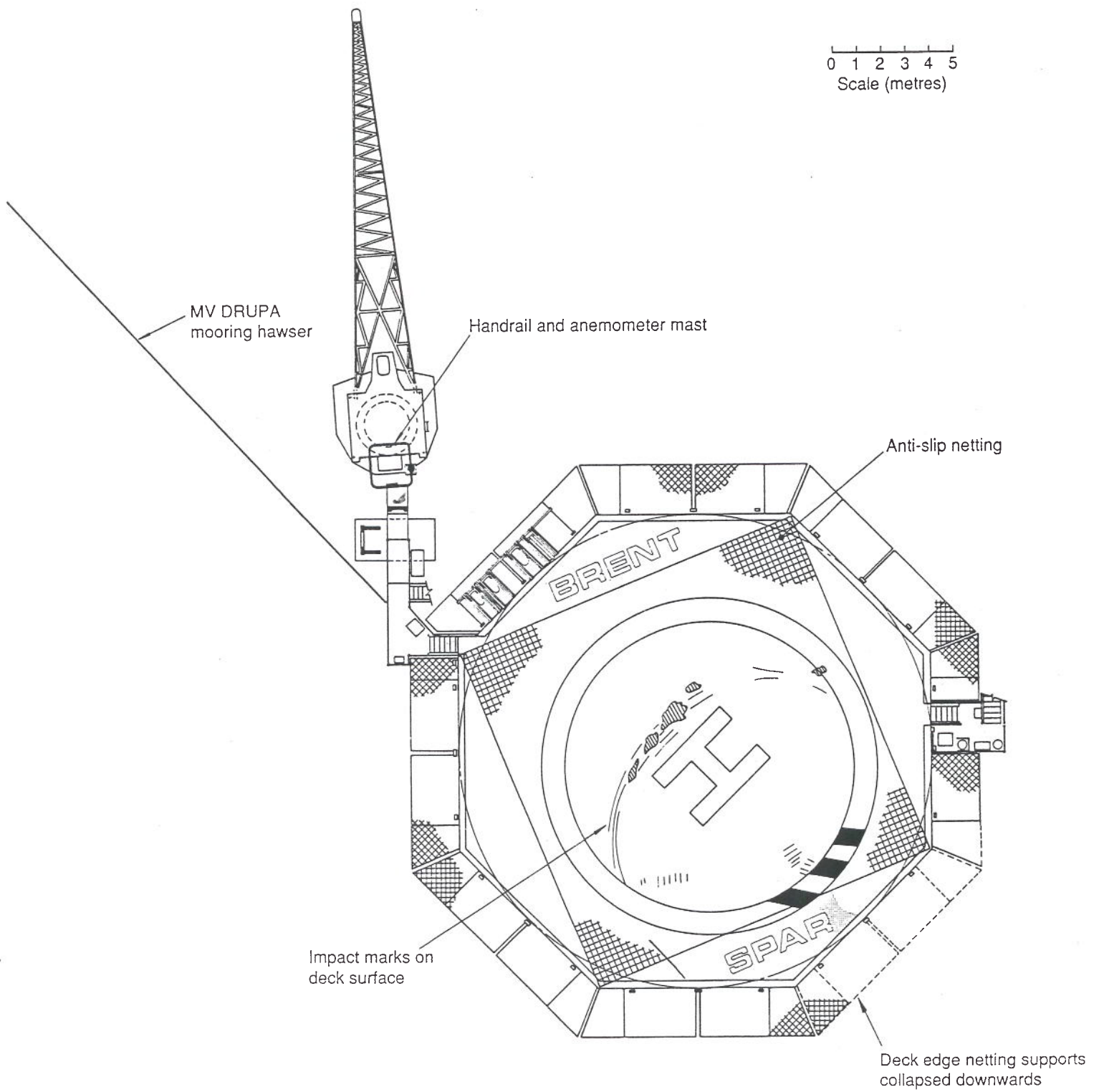
² G-BEWL Co-pilot.

To	From	Recorded intelligence	
	P1	The(crane ³) is er nice isnt it	0942:56[-33]
	P2	Yep	0942:57[-32]
	P1	(?) what sort of power we're using	0943:03[-26]
	P2	Sixty five seventy five	0943:07[-22]
	P1	OK	0943:09[-20]
	P1	Going across now	0943:12[-17]
	P2	'kay	
	AVAD	"CHECK HEIGHT"	0943:25[-4]
			0943:29[0]
			0943:36:18
			0944:00
G-BEWL	B APP	Whisky Lima Brent	
G-BEWL	B APP	Whisky Lima Brent	
G-BEWL	B APP	Golf Whisky Lima Brent do you read	
G-BEWL	G-DI	Whisky Lima this is Delta India do you read	0945:00
G-DI	B APP	Delta India Brent	
B APP	G-DI	Yeah we hear you loud and clear we can't pick him up	
G-DI	B APP	Roger we appear to have a Sixtyone in the water alongside the Brent Spar could you disengage passengers please and eh advise on the Alpha deck when you're ready to lift	
G-BEWM	B APP	Whisky Mike Brent	

³ It is not certain that the word spoken was 'crane' but it was considered the most likely.

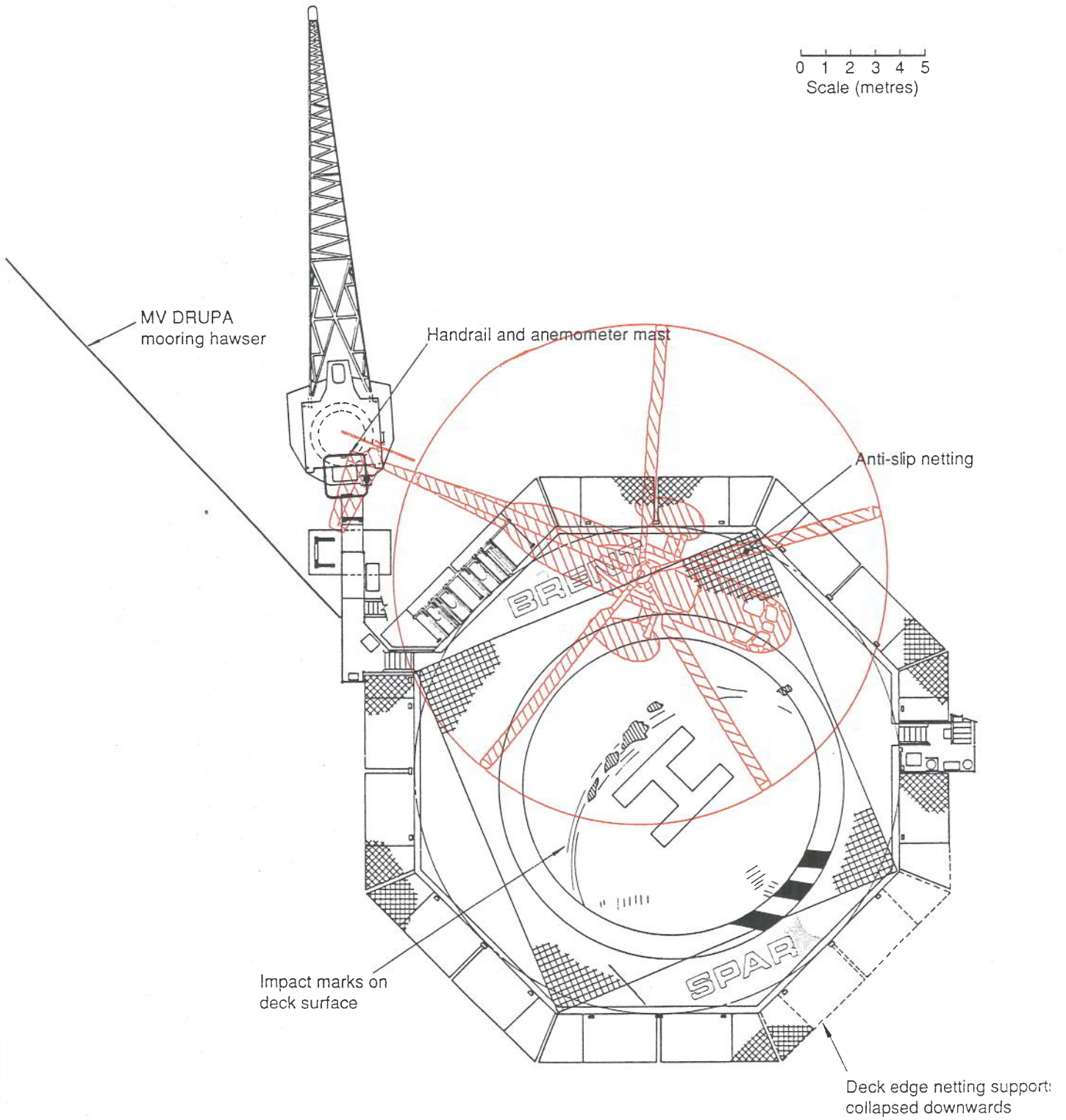
CVR Frequency Analysis Showing Nr & Ng





Brent Spar helideck showing impact marks and damage

0 1 2 3 4 5
Scale (metres)



Overlay depicting relative position of G-BEWL at moment of tail rotor impact

Offshore helicopter landing areas: guidance on standards

1 Certificate of fitness

CAP 437 'Offshore helicopter landing areas: guidance on standards' was published by the CAA in September 1981 (ISBN 0 86039 140 X). Criterion in this publication relating to fixed and mobile installations in the area of the United Kingdom Continental Shelf were based upon the helicopter landing area standards of the Department of Energy (DEn) as set out in the document 'Offshore installations: Guidance on design and construction'. Chapter 2 of CAP 437 listed the following General Considerations:-

"1.1 The following standards for helicopter landing areas on offshore installations or vessels result from the role of the Authority in ensuring that an aircraft for which a British Certificate of Airworthiness has been issued is able to operate safely in accordance with the performance data in the aircraft flight manual, and in the operational circumstances pertaining. United Kingdom aircraft operating for Public Transport are covered in the latter respect by material in the aircraft operator's Operations manual, which has to be submitted to the Authority as part of the requirements for the grant of an Air Operator's Certificate (AOC).

1.2 The main criteria, therefore, embody the principles which the Authority believes should be associated with the operation of British registered helicopters in offshore operations around the United Kingdom. Some less demanding criteria for infrequent operations by British registered helicopters on vessels are included in Chapter 6 for completeness and may also be applied to operations on installations which do not come under the jurisdiction of the Department of Energy."

CAP 437 defines the minimum size of helideck to satisfy specified criteria for civil operations and is based upon a value 'D' which is the overall length, including rotors, of the largest helicopter for which the deck is intended. For single main rotor helicopters the helideck should be large enough to contain a landing area circle of diameter 'D'. If this criterion cannot be met by an existing helideck, whether due to the actual size of the helideck or to the obstacle environment, the CAA will consider whether any compensatory operational restrictions should be imposed.

Under the Offshore Installations (Construction and Survey) Regulations 1974 a Certificate of Fitness for an installation may be issued by a Certifying Authority subject to their review of the design and construction of the installation. The Certificate of Fitness is to state, for each helicopter landing area, the maximum size 'D' for which that area is considered suitable. The 'D' value is based upon certain criteria which if they cannot be met in full for a particular size of helicopter, the

CAA will advise on any operational restrictions that are considered necessary to compensate for minor shortfalls from the criteria. The 'D' value required for a Sikorsky S-61N is 22.20 metres. The current Certificate of Fitness for the Brent Spar contained a 'D' value of 19.18 metres and it was therefore classed as 'Restricted' by the CAA who wrote to DEn on 2 December 1982 stating that the helideck could accommodate a 'D' value of 19.8¹ metres. The letter included this information: "However, approval is also given such that S-61N helicopters may operate to this helideck provided that the maximum weight of the S-61N is restricted to 19,000 lb or such lesser weight as may be calculated from the operating company's performance graphs, and the pitch and roll limits of the platform do not exceed +/- 1°. Additionally, installation personnel will be required to position the crane in a manner acceptable to the S-61N captain before an aircraft movement takes place. An obstacle-free approach and take-off sector of 210° is declared. Equipment on the east porch should not exceed the maximum authorised height of 250 mm. Within the 0.83'D² arc of the 150° sector, essential equipment can be located only close to the dividing line between the 210° and 150° sectors. Therefore, to ensure greater security for the tail rotor, a segment of the aiming circle directly opposite this equipment and over an arc of at least 45°, is red and yellow hatched to indicate headings on which landings are prohibited".

The content of this letter was used by the operating company in compilation of its Operations Manual Supplement containing details of Platforms North of 56° North. Some of the information was also included by AERAD in its Helicopter Offshore Route Guide (HORG). These two sources of information were available to the crew of 'WL' but in neither case was the 45° prohibited landing arc specifically mentioned. The aiming circle and 'H' which were depicted on the AERAD approach chart of Brent Spar were not drawn to scale and was incorrectly positioned.

2 Helicopter Landing Area Markings

CAP 437 defines standard landing area markings. The boundary of the 210° obstacle free sector was correctly marked using the alternative method of two black arrows pointing to the origin of the sector at the perimeter of the landing area circle together with a 'D' value of 19.8 metres. A single yellow aiming circle of 6 metre internal radius and 7 metre external radius had superimposed on it three red hatched markings to indicate the 45° prohibited landing direction. The centre of the circle was to be located 9 metres from the outboard edge of the landing area. The aiming circle contained a white painted 'H' which, in accordance with CAP 437 paragraph 6.2.5 (d), was "orientated so

¹ The difference of 0.62 metres between this figure and the one stated in the Certificate of Fitness LR 0027/80/1 dated 17 January 1983 was the result of a typographical error in the letter of limitations. Distance from centre of the deck to the nearest obstacle remained unchanged.

² 0.83'D' delineates the extent of the 150° obstacle sector from the centre of a minimum sized deck in which obstacles should not exceed deck level by more than 0.05'D' in height. It was calculated on the 'D' value required for a S-61N i.e. 22.2 metres to give a distance of 18.50 metres.

that the central horizontal bar of the 'H' is on the bisector of the obstacle free sector, unless that sector has been swung when it should be parallel to the bisector of the obstacle-free sector". (Brent Spar sector had not been swung). The landing area was covered by an appropriate rope net 15 by 15 metres and the deck markings would not have been obscured to the crew of a helicopter which was hovering over or close to the deck.

3 Inspection of helideck

The Certificate of Fitness was issued after an independent review of the design and construction of the installation by a Certifying Authority. In the case of Brent Spar, the Certifying Authority was Lloyd's Register of Shipping and a Certificate of Fitness of Offshore Installation (LR GBI 00319/85) was issued by them on 17 March 1988. It was valid, "subject to annual and additional surveys in accordance with the Regulations" until 17 September 1990. The DEN last inspected the installation in January 1990 when no comment concerning the helideck was made. The CAA were not required to make routine inspections of offshore landing areas.

Article 76 of the Air Navigation Order 1989 (ANO) stated, among other conditions, that helicopters engaged on "scheduled journeys for the purpose of the public transport of passengers" were required to operate to and from licensed aerodromes. However, helicopter support to the offshore oil and gas exploration and production industry in the United Kingdom was not deemed to constitute a scheduled service. Accordingly, there was no requirement for offshore landing areas to be licensed by the Authority but the operator's responsibility was stated in Article 28 (1) (c) of ANO 1989 thus:

"The operator of an aircraft registered in the United Kingdom shall not permit the aircraft to fly for the purpose of public transport without first:

"28(1)....

(c) satisfying himself by every reasonable means that the aerodromes at which it is intended to take-off or land and any alternate aerodrome at which a landing may be made are suitable for the purpose and in particular are adequately manned and equipped (including such manning and equipment as may be prescribed) to ensure the safety of the aircraft and its passengers:

Provided that the operator of the aircraft shall not be required to satisfy himself as to the adequacy of fire fighting, search, rescue or other services which are required only after the occurrence of an accident."



Damage to Brent Spar helideck and crane "A" frame.



Damage to tail rotor.



Damage to crane "A" frame handrail.

Helicopter collisions with offshore installations

(Based on data recorded by CAA since 1 January 1976)

Date	Type	Occurrence
18 Mar 77	S-61	<i>All rotor blades apparently struck by crane jib.</i>
11 Sep 77	Bell 212	<i>Tail rotor struck crane jib cable.</i>
		The helicopter was approaching rig deck parallel to, but to one side of normal approach path because of obstructing crane jib. When abeam jib No 2 engine oil pressure warning illuminated so captain made an immediate landing. As he did so he heard a noise from the tail and yaw control became difficult. The tail rotor had struck the crane jib cable, removing about one foot from each blade. No 2 engine oil cooler gasket was also leaking. (AAIB Bulletin 11/77).
16 Feb 78	Bolkow 105	<i>Tail rotor struck mesh of safety net.</i>
		During an approach for the pilot's sixty third landing that day a down draught struck the helicopter as it was about to land on the helideck. Before he could react the tail rotor caught the safety netting around the deck.
15 Jun 78	S-58T	<i>Tail wheel contacted safety rail of helideck.</i>
		Pilot reports contact caused by too steep a flare.
18 Nov 80	S-61	<i>Tail rotor struck rig prior to landing.</i>
		The tail rotor blades were broken. The manoeuvre was being carried out in strong winds 45-50 kts. The approach was made into wind with a requirement to drift the A/C over the deck. Whilst manoeuvring at about 20 feet the rotor struck a hand rail on a walkway.
13 Feb 81	S-61	<i>Two bags sucked through rotors, one entered engine.</i>
		In low hover. A/C immediately landed, No 2 engine shut down. Sack removed from intake. A/C examined no damage. A/C flown back to base.
13 Aug 81	S-61	<i>Near miss with flare boom on overshoot.</i>
28 Mar 82	S-61	<i>A/C struck deck edge netting on landing.</i>
		Approach made under nil wind conditions to platform. Excessive rate of descent at 25-30 ft. Full power did not arrest it. Rig flare is close to helideck which produced high temperatures particularly with no wind. A/C was 350lb over max landing weight due to standard weights being used for pax. Weather 10 km vis, overcast 1000 ft, OAT + 7°C W/V variable at 4 kts. AAIB Bulletin 6/82 indicates that in light winds radiated heat can increase temperature over deck inducing up and down draughts A/C OAT read +16°C after

Date	Type	Occurrence
		engine shut down. Steep angle descents advised in similar conditions to ensure deck edge clearance.
15 Jul 82	Bell 212	<i>A/C tail boom struck outboard safety net edge.</i>
		On take-off A/C encountered sudden swirling fog, descended to maintain VMC, struck deck edge. Damage to radio altimeter aerials, dents to body panels. A/C landed on destination rig OK. Rig safety boat now positioned upwind of platform to provide visibility datum when intermittent fog or mist is expected.
28 Jun 85	S-76	<i>After Touchdown A/C rolled off rig and landed inverted in water.</i>
	(Foreign)	A/C had just landed on drilling platform when it rolled backwards and right rear wheel caught in a safety net. The pilot attempted to lift off but the wheel would not release causing A/C to flip over and fall 100ft into the water. There were no fatalities.
09 Sep 85	Bell 412	<i>A/C crashed on oil rig. 4 fatalities.</i>
	(Foreign)	
24 Oct 85	Bell 222	<i>Fell off landing-pad onto lower deck.</i>
	(Foreign)	Broke in two. Fire. Two fatalities.
13 Dec 85	SA 330 Puma	<i>Rollover & fire.</i>
	(Foreign)	Attempted landing after reported engine response problems. 13 on board. Four pax suffered minor injuries A/C destroyed. Handling co-pilot was very inexperienced and captain lacked recent flying practice. On site investigation showed that tail rotor probably struck safety box while still airborne causing an imbalance which made landing difficult. Reported lack of response from collective lever.
20 Mar 90	Bell 212	<i>Positioning for landing.</i>
	(Foreign)	Tail rotor struck windssock mast. Hard landing.

Attentional and perceptual aspects

AN ANALYSIS OF THE APPROACH AND LANDING BY HEAD OF PSYCHOLOGY DIVISION RAF INSTITUTE OF AVIATION MEDICINE

There can be little doubt that the handling pilot was attempting to land on the Brent Spar in a conscientious and professional manner. Indeed, it is likely that he would have been particularly concerned to give a good demonstration of how the task should be tackled given that he was acting in his role as a supervisory captain. Given this, some consideration of the factors that may have led to his mishandling or misjudgement is appropriate.

The direction of approach to the rig, and possible remarks on the CVR (Appendix D) leave no room for doubt that the pilot was aware of the presence of the crane and had seen it. It can safely be assumed therefore that either the crane's presence had dropped from the pilot's awareness after he had passed it, or he remained aware of it, but believed himself to be farther away from it than he actually was. Some factors that may have influenced these possibilities are rehearsed below.

The first concerns the possibility of a general shift in the commander's attention once he had passed the crane, and began manoeuvring the aircraft to touchdown. The entire landing area of the Brent Spar is small and would have demanded the bulk of the pilot's visual attention in the late stages of the approach. The Brent Spar is also well known to the North Sea pilots as a demanding structure on which to land, and this factor is likely to have concentrated further the commander's attention. In concentrating on this aspect of his task, the presence of the crane may well have dropped entirely from the pilot's mind even though he may well have intended to give some continued consideration to this hazard. The two photographs shown At Appendix K illustrate that, although the crane would have been a conspicuous hazard early in the final approach, it would be easy for it to fall from conscious awareness in the later stages.

The second is that the commander may have believed that there was more margin for manoeuvre around the aiming circle than actually existed, and may not have been fully aware of the nature and implications of the restrictions on landing imposed by the orientation of the H and the orientation of the 150° obstacle sector and the 45° prohibited landing sector of the aiming circle.

The third is that the commander (like any other) may have had poor awareness of the length of his aircraft. Since it is not possible for a helicopter pilot to witness the degree of clearance between his tail rotor and obstacles, he can be made aware of the degree of clearance only by being given feedback from another observer. Since there is no crewman or ground observer to provide such feedback in these operations, the pilot is compelled to rely on the adequacy of the aiming circle to provide him with the clearance he requires.



Right-hand pilot's eye view of Brent Spar landing area.