CONTENTS

SUMMARY

The Hong Kong registered motor bulk carrier *Mineral Diamond* of 141028 tonnes summer deadweight, sailed from the Western Australian port of Dampier on 11 April 1991 for the Netherlands port of Ijmuiden, by way of the Cape of Good Hope. On sailing the vessel filed a voyage plan and indicated that it would participate in the Australian Ship Reporting System (AUSREP).

Six routine AUSREP messages were received by the Marine Rescue Co-ordination Centre, Australia (MRCCAUS), from the *Mineral Diamond*. The last of these messages at 0600 UTC (1400 Western Australian Standard Time) on 17 April reported that the vessel had reduced speed to six knots in force 9 to 10 winds (45 to 50 knots) in six metre seas, in position 30 degrees 21 minutes South 087 degrees 48 minutes East. When the *Mineral Diamond* failed to send her next scheduled message officers of the MRCCAUS initiated routine procedures to establish the safety of the ship and crew. When routine procedures failed to establish the ship's safety an air search was launched early on 20 April, coordinated by MRCCAUS and conducted by the Royal Australian Air Force, centred on a position 1500 miles west of Perth. When no trace of either ship or survivors was found the search was abandoned on the evening of 24 April.

It is assumed that the *Mineral Diamond* foundered with the loss of all hands in a position some 1500 miles to the west of Perth.

The Australian Marine Investigation Unit, in accordance with the International Maritime Organization Resolution A440 (XI) "Exchange Of Information for Investigations into Marine Casualties" and under the provisions of the Navigation (Marine Casualty) Regulations, undertook an investigation of the evidence that was available within Australia to assist the Hong Kong Authorities.

PERSONS INTERVIEWED

1 MAY 1991

Captain D W Walker	Executive Manager, Pilbara Harbour Services
G R Stanmore	Shipping Officer,Pilbara Harbour Services
P Constantine	Sub-Collector of Customs
S R Luxford	Customs Officer
K Nuttall	Fitter, Hamersley Iron/Diver
T R Maxwell	Diver
R I Elverd	Australian Quarantine Inspection Service
J D Triglone	Superintendent Blending/Port Operations, Hamersley Iron
T E Dye	Manager Operations, Hamersley Iron

2 MAY 1991

D L Holt	PI Club Representative

3 MAY 1991

F C Awty	Production Supervisor, Hamersley Iron
D Melville	Boiler Maker/Welder, Hamersley Iron
K L Britton	Manager Analytical Services, Hamersley Iron
R F Madden	Loader Operator, Hamersly Iron
Captain G Whitfield	Pilot
Captain V R Justice	Draught Surveyor

THE *MINERAL DIAMOND*

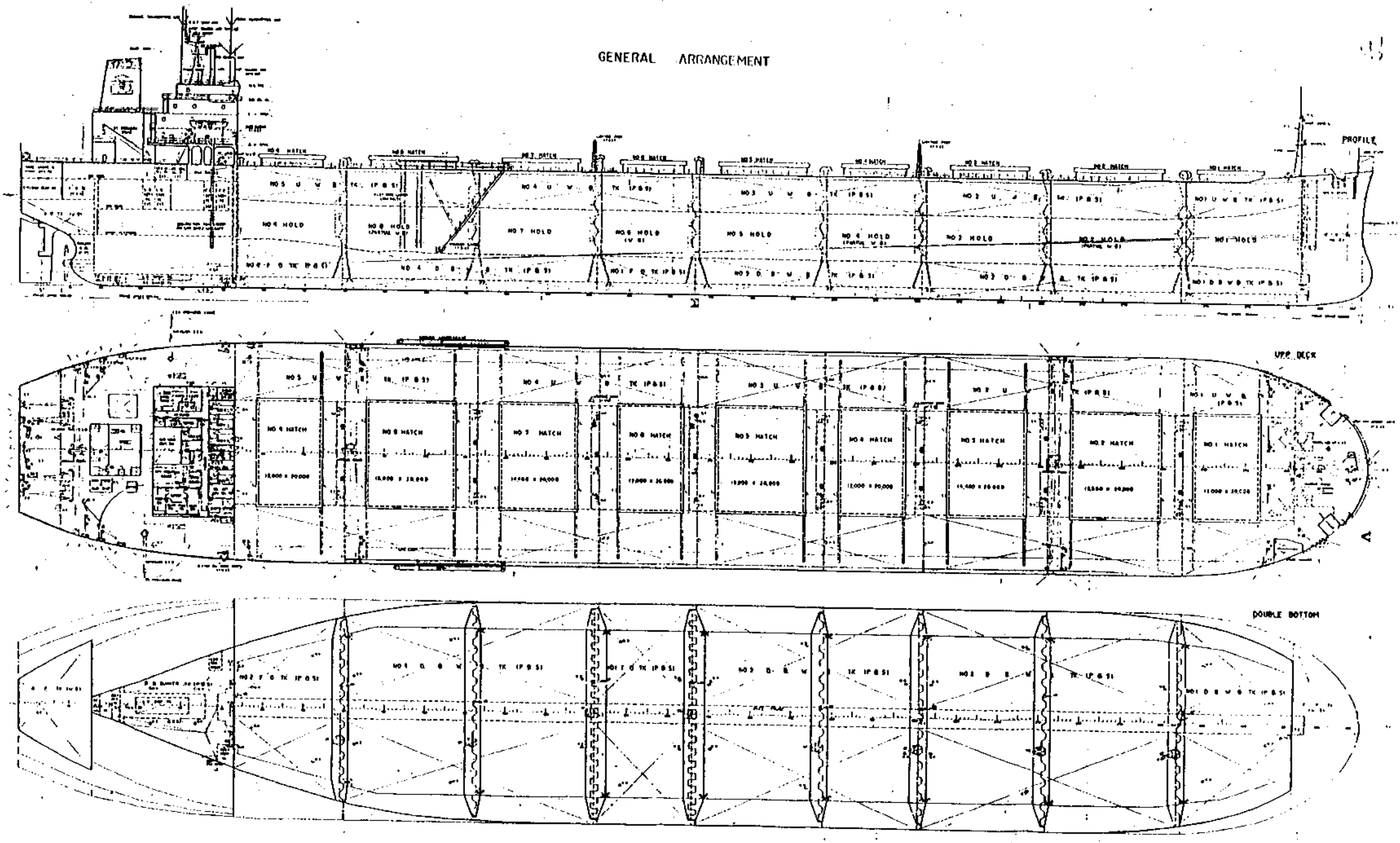
The Hong Kong registered *Mineral Diamond* was a bulk carrier of 141028 tonnes summer deadweight, 265 metres in length, with 9 holds, being specially strengthened for heavy cargoes and alternate hold loading. The vessel was classed with Det Norske Veritas and built at Ulsan, Korea by Hyundai Heavy Industrues Co. Ltd.. She was launched as the *Mountain Thistle* in December 1981 under the Hong Kong flag. In 1984 the vessel changed ownership to Diamond Shipping Ltd., was renamed *Mineral Diamond* and came under the management of Anglo-Eastern Shipping Management Ltd, of Hong Kong.

The *Mineral Diamond* was powered by a B&W diesel engine operating on heavy or diesel oil, developing 13534 kW and a service speed of 13 knots.

On May 8 1986 the *Mineral Diamond* grounded in the Kattegat whilst on a voyage from Abbot Point, Queensland, to the Danish port of Aabenraa, with 140000 tonnes of coal. The vessel was refloated on 15 May 1986 having sustained damage to the bottom plating at the forward end of the ship. The vessel dry docked in Rotterdam on 2 June 1986 and extensive repairs were undertaken (Attachment 16). The *Mineral Diamond* is not known to have been involved in any other casualty.

Whilst in Dampier on 9/10 April 1991 the ship's statutory certificates were routinely inspected by officers of the Australian Customs Service during Inward Clearance procedures and all certificates were found to be current.

GENERAL ARRANGEMENT



BALLAST PASSAGE - APRIL 1991

The previous cargo carried by *Mineral Diamond* had been grain which was discharged at Wakayama, Japan, where harbour water had been taken on board as ballast during the cargo discharge.

Whilst on passage from Wakayama to Dampier the ballast water was changed in compliance with the Australian Quarantine Service (AQIS) Voluntary Guidelines on arrival ballast, contained in AQIS Notice GENERAL QUARANTINE 90/1 (Attachment 17). The ballast change operation commenced at noon local ship's time (UTC + 9) on 3 April 1991 in position 12 27N 131 33E, with ballast contained in No.6 hold being discharged first. The Double Bottom Tanks and Upper Ballast Tanks were discharged and refilled in a patterned sequence (Attachment 14) and finally the Aft Peak Tank was discharged and refilled, completing at 0330 hours on 5 April in position 02 53N 129 57E. During the ballast operation the *Mineral Diamond* was proceeding on a course of 188(T) at a speed of between 14.5 and 14.9 knots. The weather conditions, as noted in the Deck Log Book, were wind south easterly force 5 (17 - 21 knots), with moderate sea and swell conditions.

No. 6 Hold was refilled with ballast on 8 April 1991 in position 13 26S 120 45E, bringing the total quantity of ballast on board for arrival Dampier to 49,763 tonnes.

CARGO LOADING

Mineral Diamond arrived off the Port of Dampier at 1630 WST on 9 April 1991 to load a full cargo of approximately 137,000 tonnes of hematite fine iron ore for Ijmuiden, The Netherlands. The pilot boarded on arrival, conducting the ship to the Parker Point loading berth, where the ship was all fast port side alongside at 1947 WST. Berthing operations proceeded smoothly, with no reported heavy contacts with either the tugs or the berth, however mooring took longer than normal due to problems with the electric winches.

On arrival at the berth the Master was handed a "Declaration by Shipper" (Attachment 2) describing the physical properties of the cargo to be loaded, as required by Marine Orders, Part 34 (Solid Bulk Cargoes), made under provisions of the Navigation Act 1912 and in accordance with the International Maritime Organisation's Code of Safe Practices for Solid Bulk Cargoes. A letter (Attachment 3) defining the responsibilities of the ship's staff during the loading operations was also provided to the Master and countersigned by him.

The Master provided the Terminal with the loading sequence to be followed for the safe loading of the ship:

1ST RUN		2ND RUN		3RD RUN		4TH RUN		5TH RUN	
HOLD	QTY	HOLD	QTY	HOLD	QTY	HOLD	QTY	HOLD	QTY
7	8000	1	5000	3	5000	3	5000	3	5380
5	8000	5	8000	7	5000	9	5000	5	5000
8	4200	3	5000	1	5000	1	5000	9	7000
3	8000	7	8000	9	5000	7	7500	1	5500
9	5000			5	5000				
2	3500								

TRIMMING	
HOLD	QTY
1 }	
5 }	3220
9 }	

Loading commenced at 2135 9 April, proceeding in accordance with the agreed sequence through until the start of the fifth run, when the pours into Holds 3 and 5 were interechanged, the fifth run commencing in No. 5 hold instead of No. 3. This change had been requested by the Chief Officer at 1900 10 April and was as a result of a four and a half hour interruption in the deballasting caused by an oil pollution incident.

One comment of interest by one of the loader operators was that *Mineral Diamond* tended to list easily, even when loaded and that he had difficulty keeping it upright. From this aspect he described it as the "weirdest ship I ever loaded". The draught surveyor, however, considered that the ship was unremarkable.

Trimming operations commenced at 0508 11 April and consisted of five pours :

HOLD	QTY
5	520
1	675
9	1320
9	375
1	215

Loading completed at 0642 11 April 1991, the total cargo loaded per Terminal weightometer being 136065 tonnes, with hold distribution:

HOLD	1	2	3	4	5	6	7	8	9
QTY	21380	3490	28335	-	26470	-	28515	4190	23685

From the Terminal Ship Loading Report the actual pour amounts and rates of loading for respective holds were :

SEQUENCE	HOLD	AMOUNT	START	FINISH	RATE
1	7	8015	2132	2303	5283
2	5	7990	2307	0042	5047
3	8	4190	0048	0134	5463
4	3	8005	0140	0329	4406
5	9	5005	0337	0423	6525
6	2	3490	0431	0545	3124
7	1	5005	0549	0639	6001
8	5	8000	0654	0828	5102
9	3	4985	0832	0923	5865
10	7	8010	0930	1105	5047
11	3	5005	1111	1212	4921
12	7	4985	1219	1304	6647
13	1	5010	1313	1408	5463
14	9	5010	1419	1554	3165
15	5	4960	1600	1659	5025
16	3	4920	1743	1833	5899
17	9	5005	1840	1934	5561
18	1	4955	1940	2044	4644
19	7	7505	2123	2258	4691
20	5	5000	2301	0043	4169
21	3	5420	0051	0151	5420
22	9	6970	0156	0323	4807
23	1	5520	0331	0439	4885
24	5	520	0508	0514	5200
25	1	675	0518	0532	2897
26	9	1320	0539	0556	4599
27	9	375	0618	0624	3750
28	1	215	0632	0636	3209

The overall rate achieved for the loading was 4120 tph, the nett loading rate being 4904 tph. The maximum loading rate was 6647 tph, with a rate in excess of 6000 tph being achieved on 3 occasions; otherwise the loading rate was mainly between 4500 and 5500 tph.

The cargo quantity ascertained by draught survey and used for Bill of Lading purposes was 136,425 tonnes. The resulting quantity differential is 1.0026457, which applied to the individual Hold quantities provides the following corrected figures:

HOLD	1	2	3	4	5	6	7	8	9
QTY	21437	3499	28410	-	26540	-	28590	4201	23748

Draught on completion of loading, as noted by the Draught Surveyor, was:

FWD	16.354 m		
Aft	16.856 m		
Mean	16.605 m	Stern Trim	0.502 m
Mid Port	16.650 m		
Mid Stbd	16.640 m		
Mid Mean	16.645 m	Sag	0.040 m

OIL POLLUTION INCIDENT

At 1330 10 April a Terminal employee working on the jetty noticed a thick expanse of oil on the water between dolphins Nos 6 & 7 (Attachment 4). He advised the supervisor, who in turn advised the ship. The Master and Chief Officer immediately went to the ship's side and noted a patch of black oil lying aft of the ballast discharge. According to the Master this oil was becoming mixed with the discharging ballast, giving the effect that the oil was being discharged with the ballast. The ballast pumps were immediately stopped and for a while no further oil was observed, then a globule of oil rose to the surface abreast of No.9 Hold. After a while more globules were observed rising to the surface some 10 to 15 feet away from the ship's side.

The engineroom overboard discharges were checked by the Chief Engineer and all were reported to be closed, other than the generator cooling water discharge, which was situated right aft.

Terminal and other personnel arriving to investigate the incident stated that a slight oil slick spread from the stern of *Mineral Diamond* towards the Service jetty, with some thick oil lying around the stern of the ship. The Executive Manager, who drove to the Service Jetty, stated that he could smell fuel oil, but that there did not appear to be much oil, a few buckets only. The tidal flow at this time was stated to be no more than a quarter of a knot, in an easterly direction.

Globules of oil continued to rise to the surface, concentrated between the ship's side aft of the ballast discharge pipe and the jetty piles between Dolphins Nos 6 & 7. According to one observer the Bridge front of *Mineral Diamond* was aligned with the after side of No.6 Dolphin.

At 1755 deballasting was resumed and the ballast discharge observed to be clear of oil. However globules of oil continued to surface, one observer stating that the globules quickly spread to a sheen before being dispersed by the wind.

Divers were called in to undertake an underwater inspection of the ship, but were unable to dive until the following morning. Visibility was poor and time available for the inspection limited, however the divers were able to carry out a quick inspection of the shell plating welds in way of No. 9 Hold/ fuel oil Double Bottom tank and also the forward section of the engine room. No damage or leaks were located, although small globules of oil were still being observed rising to the surface.

Whilst *Mineral Diamond* was leaving and proceeding down the departure channel the ship was observed from a helicopter, but no discernible oil was visible. After the ship had left the berth the globules of oil stopped appearing between Dolphins 6 & 7 and an inspection by the divers failed to discover a source of pollution on the seabed.

SEA PASSAGE

Mineral Diamond sailed from the Parker Point wharf at 0945 11 April with a total crew of 26 Indian Nationals. All hatches were reported as being closed for departure, although it is not known whether the hatches were actually secured.

The ship sailed from Dampier with 2445 tonnes of heavy oil and 143 tonnes of diesel, the vessel also had on board 305 tonnes of fresh water. The ship was therefore adequately provisioned with fuel and water for the voyage.

On departure the Master filed a Sailing Report with the Marine Rescue Coordination Centre Australia (MRCCAUS) in Canberra, detailing his proposed route and nominating a time for daily position reports.

Mineral Diamond then proceeded to pass regular routine daily reports to MRCCAUS until 16 April, advising position, course and speed. On 16 April the Master included a change of reporting time, to 0600 GMT for later reports.

At 0600 GMT 17 April the Master filed a "Deviation Report" (Attachment 8) advising a position of 30 21S 87 48E and that *Mineral Diamond's* speed was reduced to 6.0 knots, reporting a wind of 9/10 on the Beaufort scale (around 45/50 knots) direction WxS and a swell height of 6.0 metres with a direction described as various. Barometric pressure was reported as being 1006 hps.

At 1217 GMT 17 April *Mineral Diamond* was in contact with Singapore Radio, after which nothing more was heard from the ship.

After *Mineral Diamond* had failed to report on schedule on 18 April 'ship overdue' procedures were initiated at MRCCAUS, which included air searches from 20 April through to 24 April evening. Due to the distance of the last known position of *Mineral Diamond* from the nearest air bases flying time over the search area was limited. However, a total of three P3 Orion aircraft of the RAAF and one P3 Orion of the US Navy from Deigo Garcia carried out both day and night searches. These air searches failed to locate either *Mineral Diamond*, survivors, flotsom or an oil slick, which may have indicated what might have befallen the ship.

Mineral Diamond was due to pass the Cape of Good Hope on 30 April 1991, but failed to do so.

COMMENT

Iron ore (fines and lumps) is listed under appendix C, "List of bulk materials which are neither liable to liquefy nor to possess chemical hazards", of the International Maritime Organisation's "Code of Safe Practice for Solid Bulk Cargoes" (the Code).

The certificate provided to the Master indicated an average moisture content of 2 - 6%. A requirement of the cargo receivers was for a minimum moisture content of 5%, this being an environmental protection precaution against dust. The angle of repose for the cargo was given as 37 degrees and from all accounts the cargo was trimmed 'reasonably level', in accordance with paragraph 5.1.1 of the Code.

The bill of lading stipulated that the cargo of iron ore fines should be less than 6 millimetre diametre. Examination of the stockpiles and samples taken from the loading belt showed that much of the cargo was made up of very small particles and dust. In view of the fine nature of the cargo a sample of Hamersley Iron ore fines was submitted for flow moisture tests, as prescribed in the Code, by an approved laboratory, Griffith W A Services. The tests showed an indeterminate flow moisture point, possibly due to iron ore fines not having a flow moisture content as defined in the Code.

The moisture content of the fines loaded into the *Mineral Diamond* was within normal limits. Further, no rain fall had been recorded at Karratha Airport (adjacent to Dampier) in the time that the stock pile had been formed, or whilst loading.

The loading sequence was carried out in accordance with the Master's requirements. It is therefore considered that the cargo was presented and loaded in a correct manner.

The cargo distribution, as loaded, was entered into the loading computer of a 'near sister ship', the *Orinoco* (Attachment 7). Sheer stress loadings in the harbour condition were all well within the limits; however in the sea condition a high sheer stress loading of 104 was evident at the engineroom forward bulkhead (frame No. 53). Aboard the *Orinoco* this condition was well known and the practice aboard that ship was to ballast the Aft Peak tank. Applying this to the *Mineral Diamond* loading reduced the sheer stress loading at frame 53 to 96.

During topping-off operations the Draught Surveyor over-heard the Master and Chief Officer make mention of the Aft Peak when discussing the exact quantity of cargo to be loaded, although in what context he was not sure.

The total quantity of ballast on board *Mineral Diamond* on departure, according to the "Draft Survey Report and Certificate of Weight" was 300 tonnes (Attachment 6). If the Aft Peak tank was not filled after departure from Dampier then there is a strong possibility that there may have been a high sheer stress loading at the bulkhead at the forward end of the engineroom. In abnormal sea conditions the sheer stress loadings could be expected to be much greater.

It is considered that the cargo as loaded, resulting in the high sheer stress loading at frame No. 53, may have been a contributing factor to the loss of *Mineral Diamond*.

The comment by one of the loader operators that the *Mineral Diamond* took a list easily and was difficult to keep upright would indicate that the ship was tender. Had this observation been made whilst deballasting operations were in progress the phenomenon could be ascribed to free surface effect of the slack ballast tanks. However the operator was on duty during the later stages of loading

including the topping off, by which time the majority, if not all, of the ballast should have been discharged.

The recollection of the Draught Surveyor on the other hand was that *Mineral Diamond*, during topping off/trimming operations, did not pivot about the keel when removing a list, rather the low side draught remained constant whilst the high side draught slowly increased.

Neither of the Pilots who piloted the ship noticed any particular tenderness of the ship during arrival and departure. *Mineral Diamond* is therefore not considered to have been unduly tender.

When the oil pollution incident was first reported according to the Master's statement the oil was lying aft of the ballast discharge and that the oil (at the forward edge) was being drawn into the discharging ballast water. As the tidal movement was stated to be less than a quarter of a knot it is considered unlikely that the source of the oil was forward of the ballast discharge.

Although the oil remaining around the stern was thick, black oil, that which was drifting towards the service jetty was described as being a sheen on the water.

The globules of oil that continued to rise to the surface were described by one witness as breaking the surface as a black spot which quickly spread to a sheen, which was then dispersed by the wind.

Heavy fuel oil rising to the surface would not disperse as a sheen, but would tend to remain in a mass.

The incident as described is more indicative of a discharge, accidental or otherwise, from a bilge pump and containing various types of oil.

The oil pollution incident is not considered to be pertinent to the loss of *Mineral Diamond.*

The general impression of all persons interviewed was that the *Mineral Diamond* was a well maintained ship, the paintwork was said to be in good condition and the ship was considered to be better than most.

The ocean weather forecasts transmitted by Perth Radio (Attachment 9) first mentioned the developing Low at 04160600Z. This described a "developing complex of Lows near 40S 090E with the main low 994HPA near 39S 096E with associated front to 29S 088E moving ENE at 20 knots. This would have indicated to the Master of *Mineral Diamond* in position 28 52S 092 49E at that time, that he was approaching a front, which would be encountered in 7 or 8 hours and that he could expect stronger, although not necessarily gale force, winds.

The Secondary Low of 992HPA near 33S 088E was not defined until the forecast of 04170001Z and was not depicted on the synoptic chart until 171200Z. Neither the synoptic charts issued by the Bureau of Meteorology Melbourne nor those issued by the French Bureau in Mauritius indicated the Secondary Low.

Study of the infrared satellite photographs indicates a Low pressure system centred around 35S 085E at 161200Z and which moved slowly in a northeasterly direction.

At 170600Z *Mineral Diamond* in position 30 21S 087 48E, although approximately 500 miles northwest of the Main Low near 37S 092E was only some 160 miles north of the reported

Secondary Low and was obviously experiencing similar conditions as given in the Gale Warning issued at 04171031Z for the area around the Main Low.

The Special Services Unit of the Australian Bureau of Meteorology was tasked to re-analyse the meteorological conditions existing in the South Indian Ocean around the time of the loss of the *Mineral Diamond* with a view to ascertaining the sea conditions likely to have been encountered by the *Mineral Diamond*.

The re-analysis indicates that the low pressure system at that time was very complex and that the main and secondary lows rotated in a clockwise direction, the main low moving to the northeast whilst the secondary low moved southeast. Thus the *Mineral Diamond* was therefore close to the Main Low, not the secondary.

The report of the Special Services Unit (Attachment 13) concludes that the significant waves in the vicinity of the last known position of the *Mineral Diamond* would have been in the order of 9 metres with a period of 11.0 seconds and that the maximum wave height for the occasional wave would have been in the order of 18 metres.

Had the *Mineral Diamond* straddled one of the larger waves (Attachment 14) then considerable stress loadings would have occurred.

As *Mineral Diamond* failed to arrive off Capetown and as neither the ship nor survivors were located by the search aircraft it is considered that the ship foundered with the loss of all hands due to the forces of the seas sometime between 1217 UTC 17 April 1991 and 0600 UTC 18 April 1991.

With the absence of survivors it is not possible to determine what caused the *Mineral Diamond* to founder.

Had there been a hatch cover failure, resulting in gradual progressive flooding it is considered that the crew would have been aware of the situation and so able both to transmit a distress message and to take appropriate action.

A number of bulk carriers have suffered fractures to shell plating and also loss of shell plating, however these have in general been much older ships.

As no distress message was received by any station either ashore or afloat and as there were no survivors it is considered that the foundering must have been sudden, caused by some catastrophic structural failure, possibly in way of frame number 53.

CONCLUSIONS

It is considered that:

1. The cargo of iron ore fines was correctly presented for loading.

2. The cargo of iron ore fines was loaded in accordance with the Master's requirements.

3. The loading rates experienced were consistent with loading rates at other iron ore loading ports.

4. There is no evidence that there is any inherent quality in the cargo loaded that would suggest any specific hazard peculiar to iron ore fines.

5. The cargo as loaded in the ship resulted in a high sheer stress loading at the bulkhead at frame 53, which would have been greatly increased in abnormal sea conditions and therefore may have been a contributing factor to the loss.

6. The oil pollution incident of 10 April 1991 was not pertinent to the loss of *Mineral Diamond.*

7. The ocean weather forecasts and synoptic charts issued by the Meteorological Bureaus on 15 and 16 April provided no indication of the storm conditions encountered by *Mineral Diamond* on 17 April 1991.

8. The *Mineral Diamond* succumbed to the forces of the sea sometime between 1217 UTC 17 April 1991 and 0600 UTC 18 April 1991 with the loss of all hands.

9. The most probable cause of the loss would have been sudden catastrophic structural failure, resulting in rapid foundering.

ATTACHMENT 1

DETAILS OF SHIP

Name:	MINERAL DIAMOND
Port of Registry:	Hong Kong
Builder:	Hyundai Heavy Industries, Ulsan, Korea
Year Built:	1982
Type of ship:	Bulk Carrier, strengthened for heavy cargoes
Number of Holds:	9
Classification Society:	Det Norske Veritas
Owner:	Diamond Shipping Ltd, Hong Kong
Manager/Operator:	Anglo-Eastern Ship Management Ltd HK
Charterer:	N V Bocimar SA
Length overall:	265.01 metres
Beam:	43.02 metres
Moulded Depth:	23.77 metres
Summer Draught:	16.68 metres
Tonnages: Gross	75,330
Nett	51,471
Deadweight	141,028
Service Speed:	13 Knots

International Safety Certificate Expiry Dates

Safety Construction:	30.06.95
Load Line:	30.06.95
Safety Equipment:	20.06.91
Safety Radio:	27.07.91
Oil Pollution:	30.06.91

Bulk Cargoes
Declaration by Shipper

The commodity to be shipped on your vessel is IRON ORE.

The following properties have been ascertained by the use of recognized international procedures as specified in the IMCO Bulk Cargoes Code.

Physical Proportions

Transportable Moisture limit NOT APPLICABLE.

Average moisture content of shipment 2% to 6% Date of test CONTINUOUS.

The average moisture content will not be confirmed by tests carried out during the loading process.

Angle of repose 37 DEGREES determined for the commodity with an average moisture of 2% to 6%.

Stowage factor 2.35 to 2.50 tonnes/cu.metre.

This commodity is not considered to be a cargo which may liquify during the voyage.

Chemical Hazards

This commodity can present a hazard during transport due to its chemical nature and properties.

Classification	Nil
Description of hazard	Nil
Precautions to be taken	Nil
Emergency Procedures	Nil

It is certified that for the bulk cargo nominated in this certificate any relevant hazards attendant upon its marine transportation have been properly described and that the information given is based upon the latest available including experience in storage prior to shipment.

ATTACHMENT 3

HAMERSLEY IRON PTY. LIMITED

(INCORPORATED IN VICTORIA)
P.O. BOX 21, DAMPIER,
WESTERN AUSTRALIA 6713
004 828 978
AUSTRALIAN COMPANY NUMBER

TELEPHONE · DAMPIER
(091)43 8000 · DAMPIER OPERATIONS
(091)43 6077 · RAILWAY COMPLEX

TELEX · DAMPIER
89529 · DAMPIER OPERATIONS
89043 · RAILWAY COMPLEX
89151 · PORT ADMINISTRATION

CABLES — "SOHAMIRON DAMPIER"

The Master
M.V. " MINERAL DIAMOND "
Berthed at
DAMPIER WA

5/4/91

Dear Captain

In the interest of safety and the correct loading of your vessel, we would like to draw your attention to the following essential points:-

1. Dampier is situated within a Summer Loadline Zone. Vessels are therefore not permitted to load beyond drafts that, with due allowance of water density, would enable them to float at the Summer loadline.

   1a. With the alteration of the boundary of the seasonal tropical area in NW Australia certain governments will permit own flag vessels to load to tropical line marks at the Port of Dampier, between 1st May and 30th November each year. This permission is granted under Article 8 of the International Convention of Load Lines.

2. Throughout loading, a Ship's Officer must be on duty to ensure correct hatch by hatch loading.

3. A continuous check on the ship's draft must be maintained.

4. Mooring lines are to be adjusted to ensure that the vessel remains safely secured alongside and does not range.

5. The gangway must not be left unattended and adjustments made to ensure safe access is possible at all times.

6. Communications: One English speaking crew member must be available to answer the telephone so that the shiploader operator may give and receive messages promptly.

7. Tonneages indicated by shore belt weighiometers are to be taken as approximate, and no reliance is to be placed on these figures for determining accurate stress loading of the vessel or final draft conditions.

Whilst the Company and its shiploading personnel are available to assist vessels in every way possible, we can accept no liability or responsibility whatsoever in regard to vessels loading to their correct marks.

Masters are therefore advised to ensure that their Officers maintain a continuous check on the draft throughout the loading operation and thereby obviate the very serious consequences attending an overloaded vessel.

Your attention is drawn to the contents of the ARRIVAL INFORMATION sheet and your co-operation to above is sought. (Please refer to the Hamersley Iron (Port of Dampier) Bylaws, which details the conditions of use of the Company's facilities. Your Agent has this information).

Acknowledgement of receipt of letter

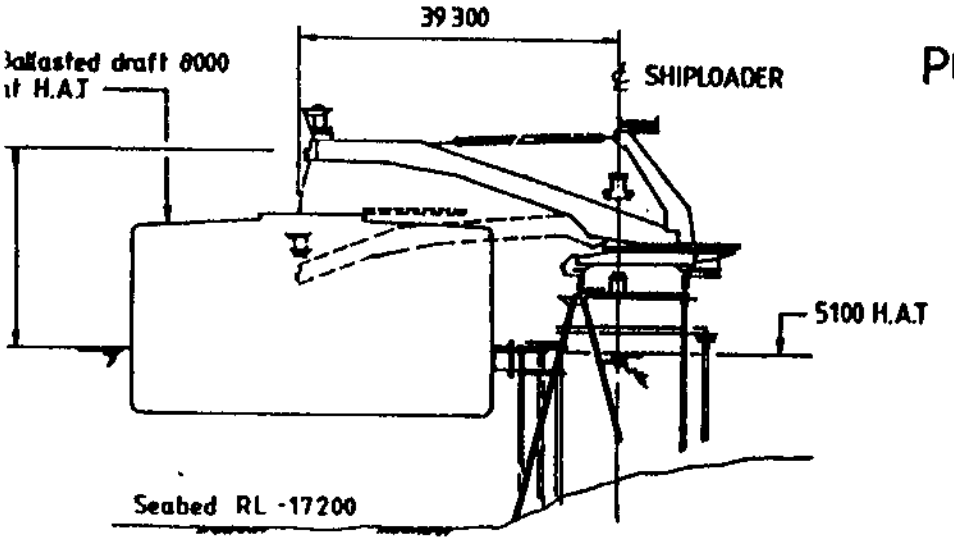
.....
Signature of Master

Date: .....

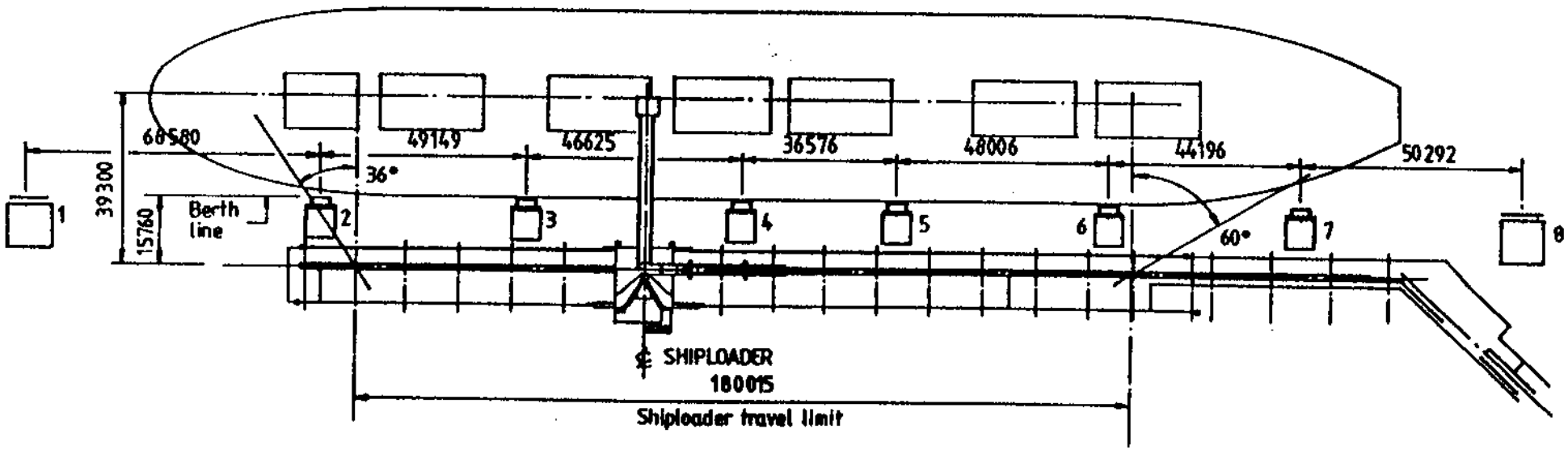
Yours faithfully,
HAMERSLEY IRON PTY LIMITED

.....
MANAGER PORT OPERATIONS

HAMERSLEY IRON PTY LIMITED
PORT OF DAMPIER PARKER POINT WHARF

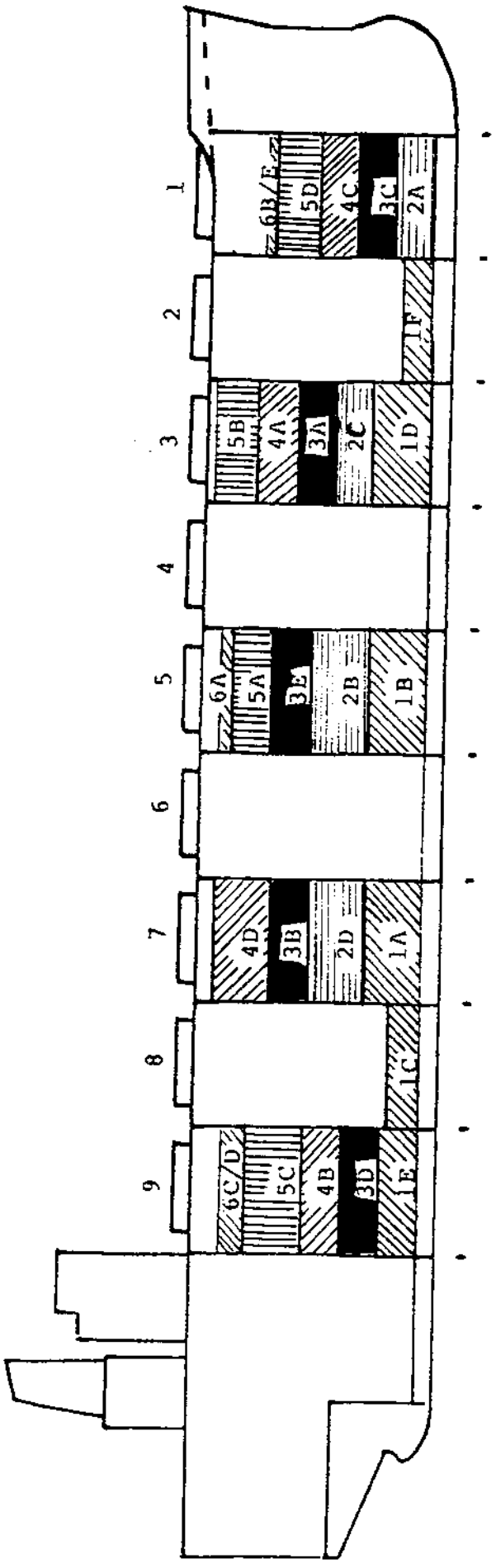


Vessels over 100 000 DWT will normally be required to moor with
- 4 lines Head & Stern
- 2 lines each Breast
- 1 line each Spring



ATTACHMENT 4

ATTACHMENT 5



LOADING SEQUENCE

ATTACHMENT 6

MARINE SERVICES OF W.A. PTY. LTD.

(INCORPORATED IN WESTERN AUSTRALIA)

DRAFT SURVEY REPORT AND CERTIFICATE OF WEIGHT

Vessel: MINERAL DIAMOND **No.** 8202 FPH **Date.** 11/04/1991 **G.R.T.** 75,330
Owners: DIAMOND SHIPPING LIMITED. **Captain:** K.H.KHARAS
Port from: DAMPIER ,WESTERN AUSTRALIA. **Port to:** IJMUIDEN
Description of Cargo: HAMERSLEY HEMATITE FINE IRON ORE MINUS 6mm

Berth loaded: PARKER POINT
Date of Initial Survey: 9/4/91 **Date of Final Survey:** 11/4/91
Consignee: HOOGOVENS GROEP,
IJMUIDEN, THE NETHERLANDS.

	INITIAL SURVEY	FINAL SURVEY
Density of seawater at the berth	1.023	1.023
Ship's draft, Fore	7.50 metres	16.354 metres
Ship's draft, Aft	8.38 "	16.856 "
Ship's draft, Port midship	8.28 "	16.65 "
Ship's draft, Starboard midship	7.90 "	16.64 "
Ship's draft, Mean of Means	8.0525 "	16.635 "
Corresponding displacement (Corrected for density, etc.)		
-	(A) 73,985 tonnes	(B) 160,917 tonnes

ESTIMATED WEIGHTS OF FUEL AND WATER

Bunkers	2,588 tonnes	2,581 tonnes
Slop tanks	nil	nil
Fresh water	328 "	305 "
Ballast	49,763 "	300 "
Stores	450 "	450 "
TOTAL WEIGHT	(a) 53,129 tonnes	(b) 3,636 tonnes
	(A-a)= 20,856 tonnes	(B-b)= 157,281 tonnes

From above figures obtained by initial and final survey of the ship's draft, I determine that the weight of the cargo aboard the ship was at the time of the final survey or (as the case may be) the initial survey:-

When discharging:- (A-a) - (B-b) =

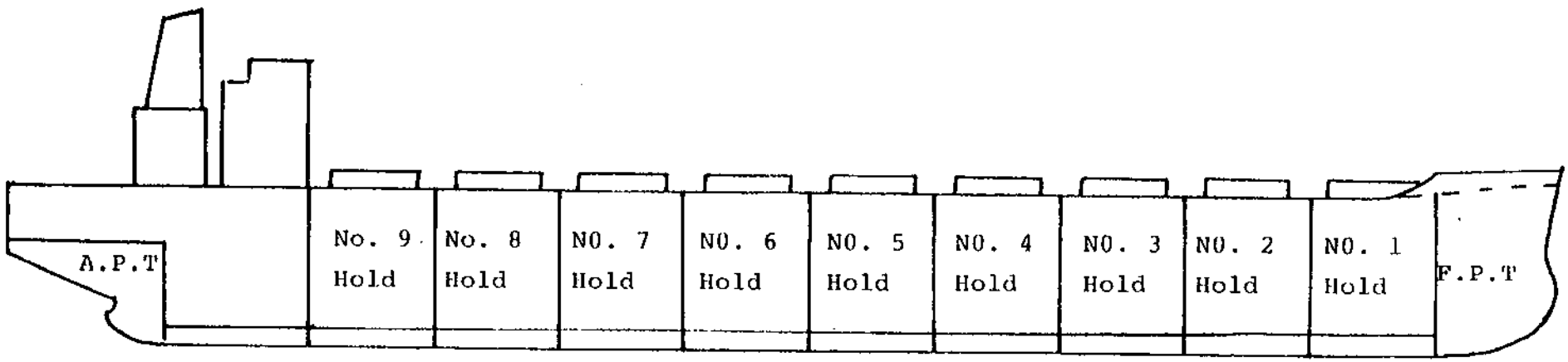
When loading: (B-b) - (A-a) = 136,425 metric tonnes = 134,270 long tons

That is:-

ONE HUNDRED AND THIRTY SIX THOUSAND FOUR HUNDRED AND TWENTY FIVE METRIC TONNES OF FINE IRON ORE TO IJMUIDEN FOR HOOGOVENS GROEP.

(Based on the ship's scales provided on board)

Signed: _____
for Surveyor



Frame No.	53	80	113	143	167	199	223	253	286	313
Harbour Condition	85	48	37	34	15	43	32	44	58	37
Sea Condition	104	63	48	43	18	52	40	60	76	41
Aft Peak Added	96	65	49	41	23	47	43	56	79	40

ATTACHMENT 7

Sheer Stress readings ascertained by entering MINERAL DIAMOND loaded condition in computer aboard 'near sister ship' ORINOCO BUILT Hyundai 1982 LOA 266.50 Beam 42.47 Deadweight 140,784.3

ATTACHMENT 8

LAST MESSAGE FROM MINERAL DIAMOND RECEIVED BY AUSTRALIAN MARINE RESCUE COORDINATION CENTRE CANBERRA

Received at 09:28 17 April 1991

A/ MINERAL DIAMOND/VRNL//

MRCCAUS AA622349
SEATEX AA0191
MRCCAUS AA62349
ZCZC 045493
48734 VRNL
TO : SEA SAFETY CANBERRA
FM : MASTER MINERAL DIAMOND
AUSREP/DR//
A/MINERAL DIAMOND/VRNL//
B/170600Z//
C/3021S/08748E//
E/259//
F/06.0//
K/200600Z/3232S/07500E//
S/WIND: BF 9/10 DIR:WXS/SWELL HT:6.0m DIR:VAR/PRES:1006MB//
X/SPD ADV AFFECTED, PASS TO AMVER//
=RGDS/MASTER
NNNN
SEATEX AA0191
MRCCAUS AA662349
SENT VIA SYDNEY RADIO

ATTACHMENT 9

OCEAN FORECASTS TRANSMITTED BY PERTH RADIO

Ocean forecast 30/50S 90/129E for 24 hours commencing 04160001Z

Part 1 = Gale/Storm Warnings NIL

Part 2 = Situation 1800Z
Ridge 22S090E 37S112E 37S129E
Weak Front 31S090E 47S095E 47S129E
Developing LOW in SW of Area; LOW 996HPA expected near 40S100E at 04161200Z

Part 3 = Forecast
Within 150NM ridge
Variable winds 10/15KN slight seas low swell
Remainder North ridge
N/NE winds 10/20KN slight/mod seas low/mod swell
Remainder South ridge
W/NW winds 15/25KN mod seas mod swell grading 20/30KN rough seas mod/heavy swell South Front and East 120E. Winds NW/SW 20/30KN within 200NM of developing LOW. mod/rough seas mod swell.

Ocean Forecast 10/50S 90/125E in North, 90/129E in South for 24 hours commencing 04160600Z

Part 1 = Gale/Storm Warnings
Gale warning current for tropical cyclone FIFI
Storm Warning current for tropical cyclone MARIAN

Part 2 = Situation 0001Z
Refer warnings
Ridge 20S090E 38S114E 35S129E
Ridge developing between 50S105E 35S129E
Developing complex of LOWS near 40S090E, Main LOW 994HPA near 39S096E with associated front 40S090E 35S091E 29S088E moving ENE 20KT.

Part 3 = Forecast
Within 180NM Ridges
Variable winds 10/15KN slight seas low/mod swell
SE Ridges
W/SW winds 12/22KN mod seas mod swell
West Ridges
NW winds 15/25KN mod seas low/mod swell. winds tending clockwise around LOW to 30KN within 150NM centre mod/rough seas mod swell

Within 120NM storm warning area
clockwise winds 25/30KN mod/rough seas mod swell gusts to 50KN in thundersqualls
Within 120NM gale warning area
clockwise winds 20/33KN mod/rough seas mod/heavy swell
Remainder
E/SE winds 15/25KN mod seas low swell.

Ocean Forecast 30/50S 90/129E for 24 hours commencing 041612002

Part 1 = Gale/storm warnings **NIL**

Part 2 = Situation 0600Z
Ridge 50S110E 36S129E
Weak Front 31S090E 47S095E 47S129E
Front 30S90E 38S93E to LOW 993HPA 40S88E moving E/SE 25KN

Part 3 = Forecast
Within 300NM Front
NW/SW winds 18/30KN tending clockwise within 80NM LOW mod/rough seas mod/heavy swell
Remainder North ridge
N/NW winds 12/25KN mod seas low swell
South ridge
W/SW winds 15/28KN mod seas mod swell.

Ocean forecast 30/50S 90/129E for 24 hours commencing 041700012

Part 1 = gale/storm warnings **NIL**

Part 2 = Situation 1800Z
Ridge 50S110E to HIGH 1025 near Adelaide moving east 15KN
LOW 990 42S097E with SECONDARY LOW 992 33S088E and front 25S095E 35S100E 40S100E moving east 20KN

Part 3 = Forecast
North ridge, East front
Northerly wind 15KN slt sea grading 25/30KN rough sea within 150NM front low/mod swell
South ridge
W/SW wind 15/25KN mod sea/swell
Remainder
Wind NW/NE 18/28KN mod/rough sea **grading SW/SE 28/33KN rough sea West of LOW CENTRES mod/heavy swell**

Ocean Forecast 10/50S 90/125E in North, 90/129E in South, for 24 hours commencing **04170600Z**

Part 1 = gale/storm warnings
Storm warning current for tropical cyclone MARIAN
Gale warning current for tropical cyclone FIFI
Gale warning current for LOW 37S092E at 0001Z

Part 2 = Situation 0001Z
Refer warnings
First ridge 50S115E 35S129E
Second ridge 20S090E 35S090E moving East 15KT
LOW 993HPA near 37S092E moving East 15KT associated
Front near 22S090E 40S103E 45S090E to LOW moving East/SE 8KT

Part 3 = Forecast
Within 100NM ridges
Varuable winds 10/15KN slight seas low/mod swell
Southeast of first ridge
west/SW winds 10/20KN salight/mod seas low/mod swell
North second ridge outside warning areas
NE/SE winds 15/25KN mod seas mod swell grading 25/33KN rough seas mod well within 100NM warning area
Rest outside warning area
N/NW wind 15/25KN mod seas low/mod swell. Winds grading 25/33KN rough seas mod/heavy swell within 100NM warning area

Gale warning issued 04171030Z
Area Affected
Between latitiudes 34South and 45South west of 95E. Area moving southeast 15KN
Complex LOW 996HPA near 38S093E moving southeast 15KN is producing clockwise winds 30/40KN around centre, very rough seas mod/heavy swell.

Ocean Forecast 30/50S 90/129E for 24 hours commencing 04171200Z

Part 1 = gale/storm warnings
gale warning current

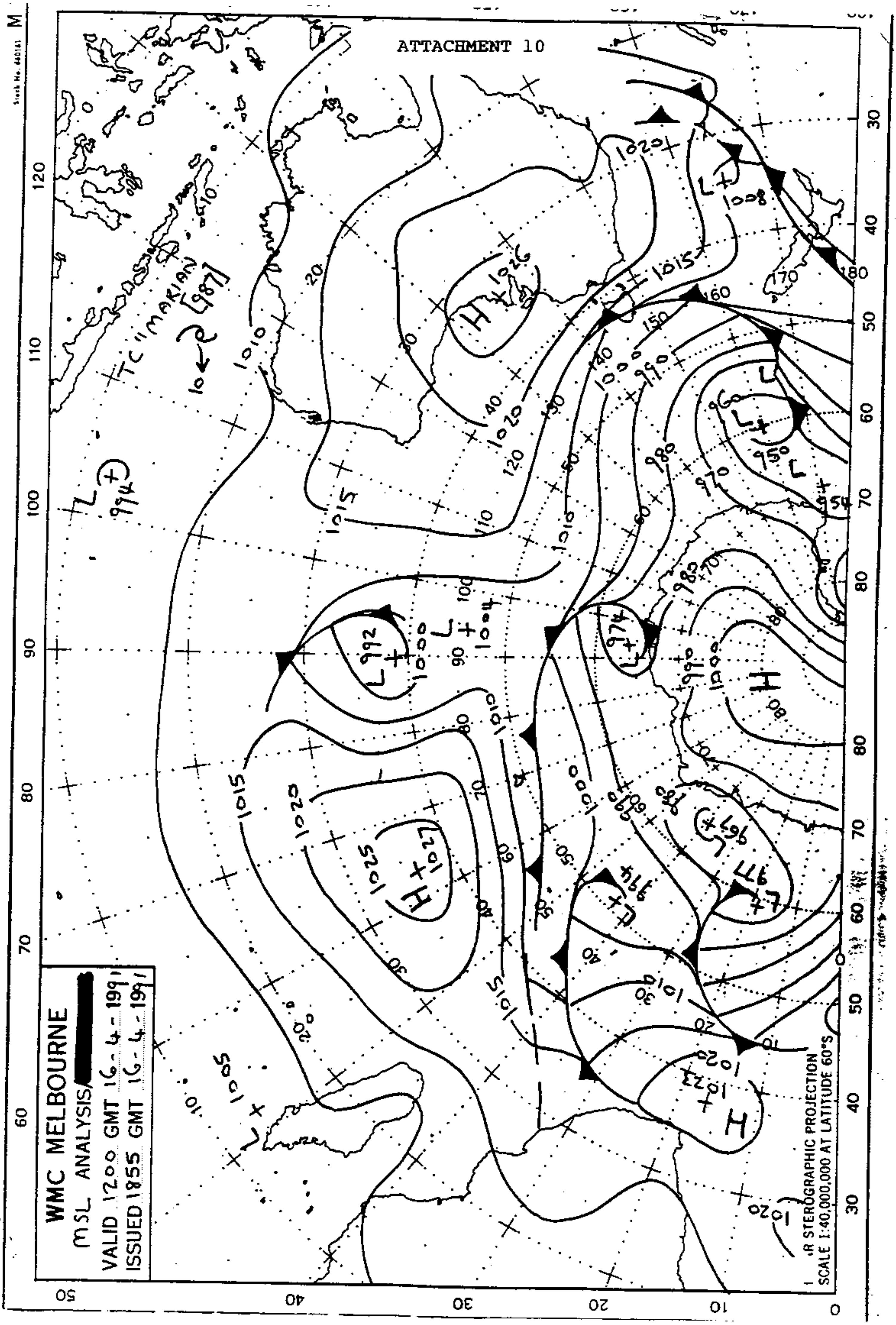
Part 2 = Situation 0600Z
Refer warning
Ridge 50S119E 37S129E moving east 10KN
First Front 30S100E 48S108E moving SE 10KN
Second Front 30S096E 40S095E moving SE 10KN

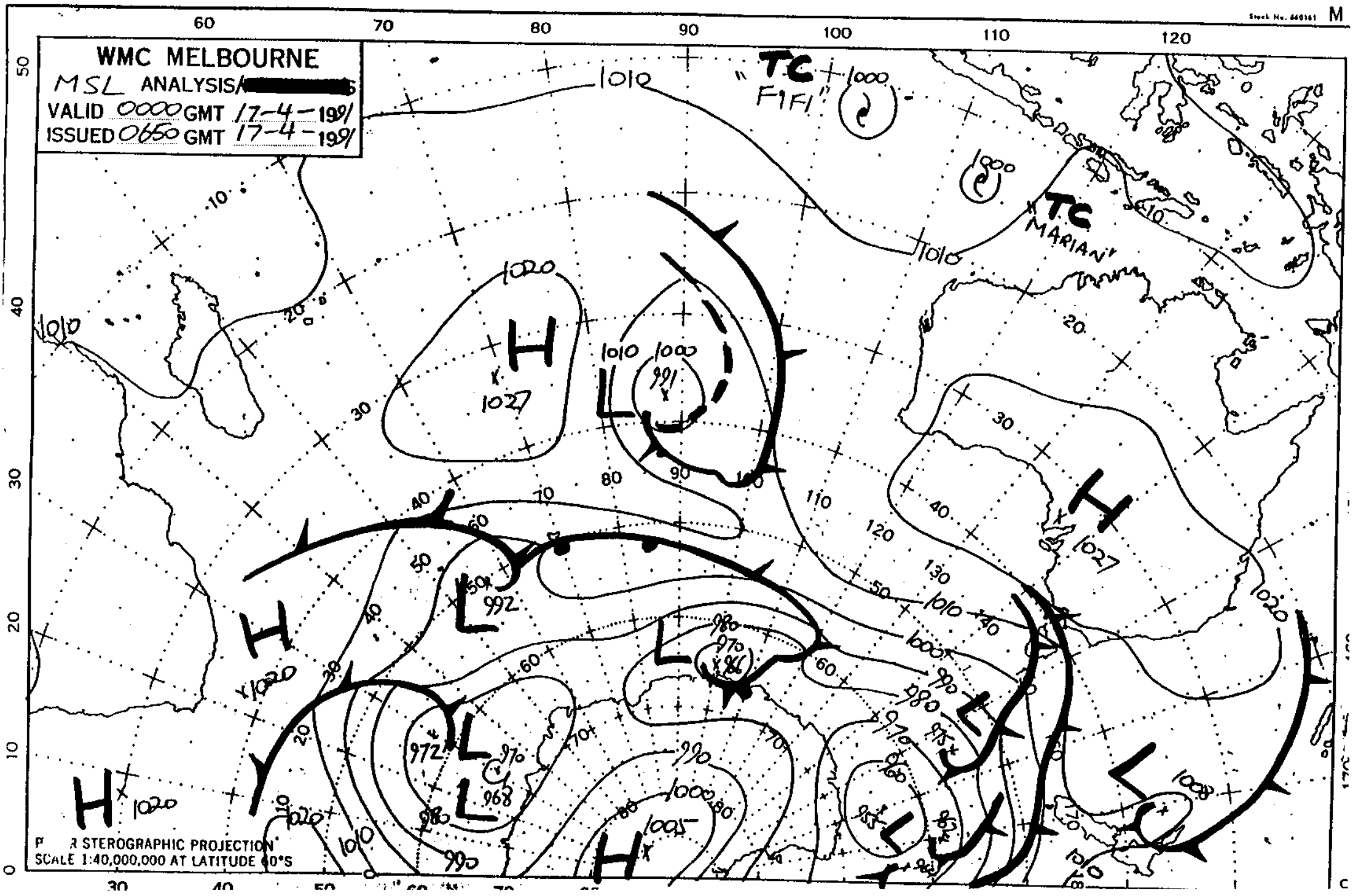
Part 3 = Forecast
West of first front outside warning area
NW/SW wind 18/28KN mod/rough sea mod swell grading 25/33Kn rough/very rough sea mod swell within 80NM Fronts and 100NM warning area.
East of Ridge
SW wind 15/25KN mod seas low swell
Remainder outside warning area
Wind NW 15/25KN mod/rough sea mod swell.

Gale warning issued 04171630Z
area Affected
Between latitudes 34South and 45South west of 100E.
area moving southeast 15KN
Complex LOW 996HPA near 38S094E moving southeast 15KN
is producing southerly winds 30.40KN west of centre
very rough seas mod/heavy swell.

Gale warning issued 04172215Z
Area affected
Between latitudes 33South and $%South west of 100E area moving southeast 10KN
Complex LOW 998HPA near 36S095E moving southeast 20KN
is producing southerly winds 30/40KN west of centre
very rough seas mod/heavy swell.

ATTACHMENT 10

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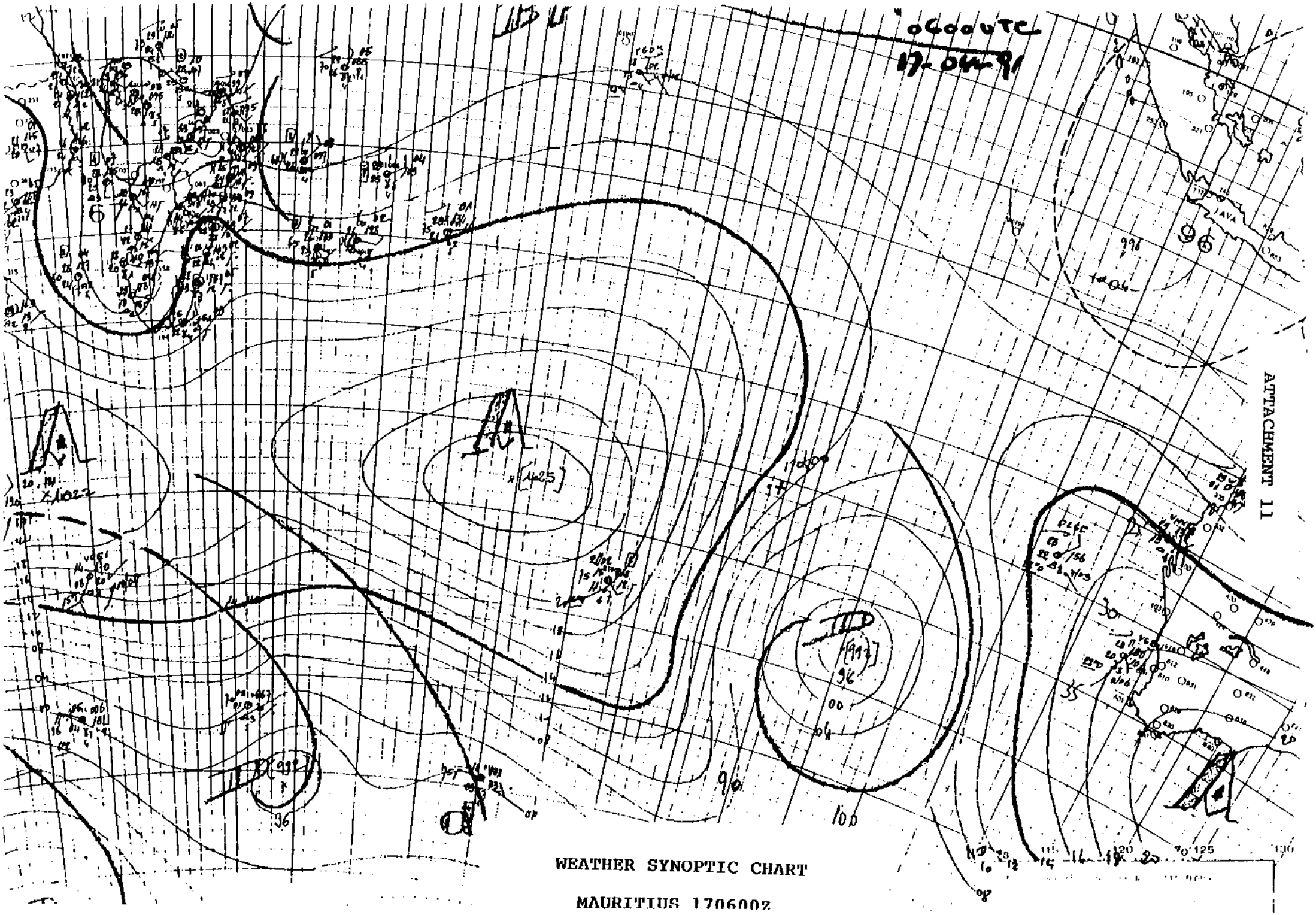
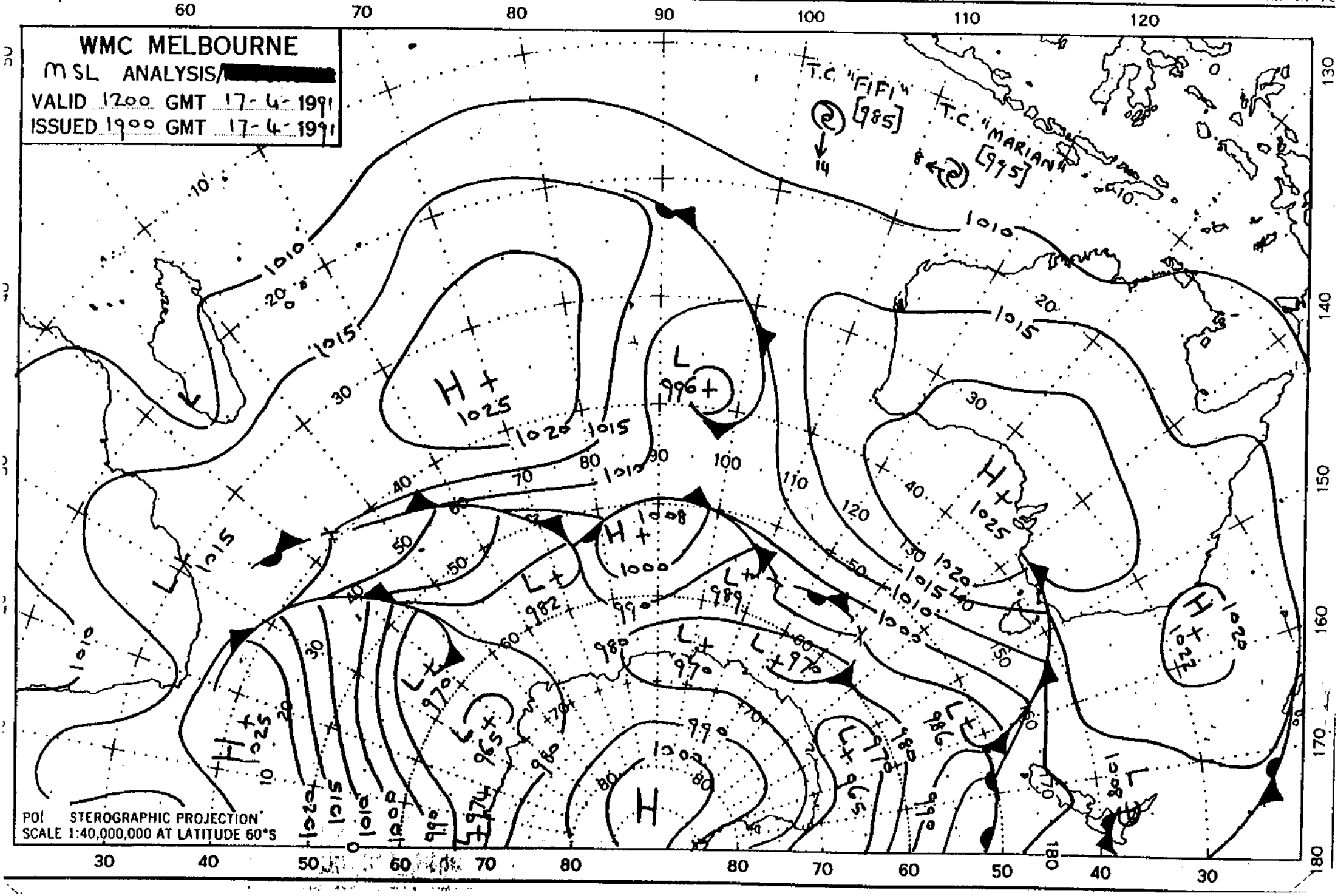
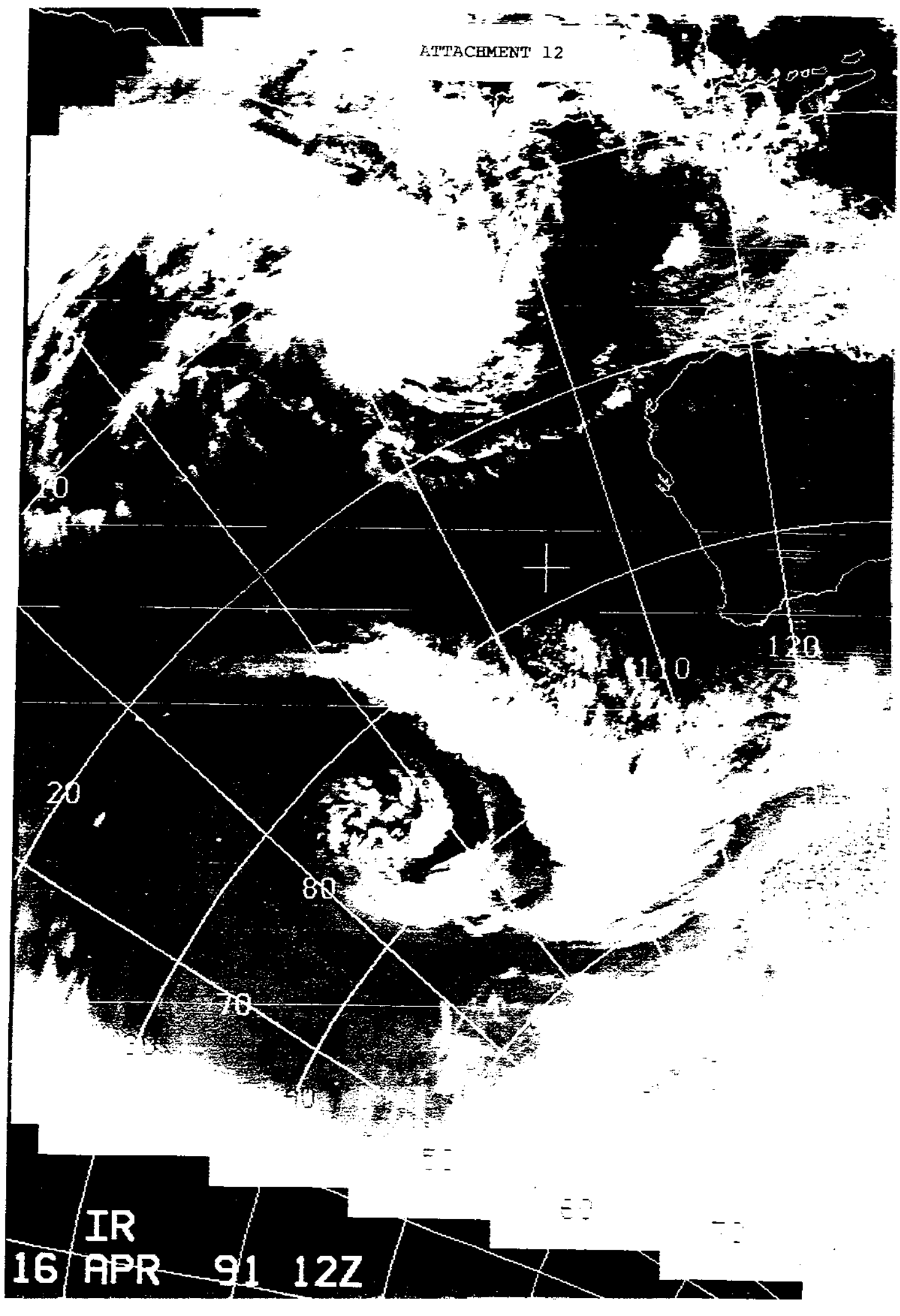
MSL ANALYSIS/[redacted]
VALID 0000 GMT 17-4-19
ISSUED 0650 GMT 17-4-19
"TC FIFI"
TC MARIANI
POLAR STEROGRAPHIC PROJECTION
SCALE 1:40,000,000 AT LATITUDE 60°S

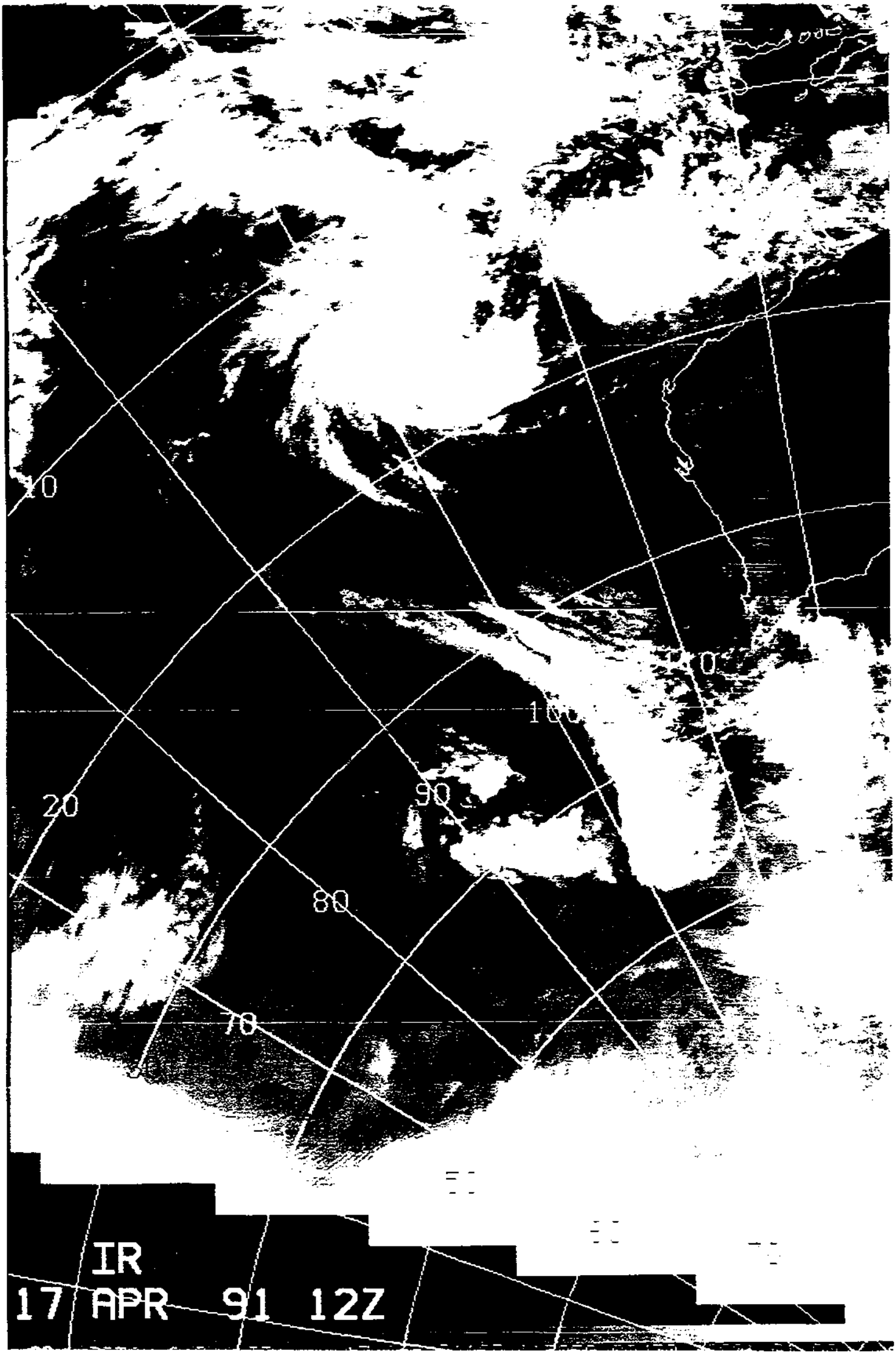


ATTACHMENT 11


WMC MELBOURNE
MSL ANALYSIS/[redacted]
VALID 1200 GMT 17-4-1991
ISSUED 1900 GMT 17-4-1991
T.C. "FIFI" [985]
T.C. "MARIAN" [995]
POI STEROGRAPHIC PROJECTION
SCALE 1:40,000,000 AT LATITUDE 60°S

ATTACHMENT 12




10
0
10
20
90
80
70
IR
17 APR 91 12Z

ATTACHMENT 13

METEOROLOGICAL CONDITIONS IN THE CENTRAL INDIAN OCEAN BETWEEN 14 AND 18 APRIL 1991

SPECIAL SERVICES UNIT

BUREAU OF METEOROLOGY

September 1991

CONTENTS

1. INTRODUCTION:

The bulk carrier "Mineral Diamond" failed to make contact after 1217 UTC on 17 April 1991. The vessel last reported from position 3021 S 08748 E at 0600 UTC on 17 April 1991.

In order to investigate the conditions prevailing at this time, the Special Services Unit of the Bureau of Meteorology conducted a re-analysis of the meteorological conditions reported in the central Indian Ocean during the period 14 to 18 April 1991. These data were subsequently used as input to a numerical wave model which gave predictions of the conditions likely to have been experienced at the point of last contact.

2. METHOD:

The realtime, operational charts used by the Perth Regional Forecasting Office were re-analysed with particular emphasis on the area around the point at which "Mineral Diamond" last reported.

These synoptic charts illustrate the meteorological conditions over the Indian Ocean during the period in question; they are analysed at 4 hPa (Hectopascal) intervals and indicate the position of high and low pressure systems.

The actual observations, upon which these charts are based, were received from a variety of sources including islands, Automatic Weather Stations, ships at sea and drifting buoys (see Appendix 1). A listing of the observations from the significant drifting buoys in the central Indian Ocean is shown in Table 2; the observations from the ship Mee May in Table 3.

Satellite imagery was available from the GMS 4, the geostationary satellite located above the equator near longitude 140 E and also from the polar orbiting NOAA satellites 10 and 11.

Wind speeds and directions were then extracted at one degree intervals and input to the Numerical Wave Model. The re-analysis was carried out to produce six-hourly Mean Sea Level Pressure and Velocity Vector/Isotach charts which were subsequently input at 12 hour intervals.

The isobaric and wind analyses are shown at Attachment A and B respectively, wind speed is given in knots.

3. METEOROLOGICAL PATTERN

The synoptic pattern early on 14 April 1991 indicated a cold front between Amsterdam and Kerguelen Islands with a low pressure centre of 1000 hPa just to the east of Kerguelen. To the west of this front a ridge of high pressure extended well into polar latitudes. Pressures in this ridge were high (1016 hPa at Crozet Island) with the consequence that a cold south to southwest airstream was evident behind the cold front.

A recognised mechanism for the strong development of cold frontal systems is the situation with a strong mobile meridional ridge of high pressure to the west of an existing front. This structure was evident as early as 0600 UTC on 14 April 1991; the pressure at Marion Island was falling strongly ahead of the high pressure ridge to the east setting the stage for the low just east of Kerguelen to move to the northeast and deepen.

Other features of the synoptic chart at this time were a rather weak cold front just east of Amsterdam Island and a strong high pressure system south of continental Australia, the latter extending a ridge westward into the eastern Indian Ocean. Tropical Cyclone Marian was located to the northwest of the Kimberleys whilst a tropical low was developing near Christmas Island.

By 0000 UTC on 15 April 1991, the cold front of interest in the south central Indian Ocean had passed through Amsterdam Island and the accompanying low pressure centre had moved approximately 500 nautical miles to the northeast and deepened. A second low was beginning to develop on the weak front about 500 nautical miles northeast of the primary low.

During the following 24 hours ongoing cyclogenesis was apparent and the primary low tracked to the northnortheast at around 20 knots. By this time the central pressure of the low was down to about 992 hPa. The intensification of the system was illustrated by the pressure at Amsterdam Island continuing to fall despite being well west of the low. Amsterdam Island's mean wind at this time was 30 knots from the south.

The secondary low mentioned previously continued to deepen due to strong warm air advection but it was tracking to the southeast under the influence of a northwest steering flow.

A significant feature by this time was the cutting off of the low pressure complex by a high pressure ridge to the south.

Upper air information received from Amsterdam and Kerguelen Islands is detailed in Table 1. It is evident that a polar front jet stream was located over Amsterdam Island and the presence of this upper air wind jet directing cold polar airnorthward was further support for continued cyclogenesis.

By 0000 UTC on the 17 April 1991, the primary low had tracked a further 400 nm tothe northeast and deepened; the central pressure was estimated to be 990 hPa. It was atthis time that the low was near maximum intensity. Satellite imagery indicated that the cold air had reached its most northward point and the low itself had become multicentred. Within the cold air field it became apparent that frontogenesis was underway and a newly

developed cold front was about to begin moving to the northeast. This dual effect of the furtherest northward penetration of the cold air and development of a new front suggests that surface winds would have been at their strongest for about 12 hours from this time. An initial estimate of 10 minute mean winds of the order of 50 knots is not unreasonable. The previously mentioned secondary low had been steered well away to the southeast and was no longer of any interest.

From 1200 UTC on 17 April 1991, the low pressure complex began to slowly weaken and move to the southeast. Pressures to the west of the low began to rise steadily but a significant isallobaric effect would have caused the strong winds to be maintained for some period after the pressure gradient had eased.

4. NUMERICAL WAVE MODEL:

The numerical wave model used to simulate conditions at the time in question is based on a modification of a third generation ocean wave prediction model (Hasselmann, 1988). The grid used was the area bounded by 23° S to 47° S and 75° E to 99° E; winds were input to the model at one degree intervals.

The model was run with the wind fields inputted at 12 hour intervals. A time-step of 30 minutes was used to compute the wave spectra at each grid point. For time-steps between inputs, a simple linear interpolation scheme was used.

Wave forecast output can be examined in two ways:

(i) Output for particular locations for each time-step, with detail of significant wave height, direction and period, (the period given, T_p, is the period associated with the peak enery in the wave spectrum). In this case output has been produced for two locations, 30.56°S 84.23°E and 31.2°S 88.8°E, these being positions of the "Mineral Diamond" and the "Mee May" at 0600 UTC on 18 April 1991.

Figure 2. shows a graphed time series of significant wave height for the two locations.

(ii) Figure 3. shows significant wave heights over the domain of the model at six hour time time steps. Vectors represent wave direction and isopleths are the wave heights in metres.

The significant wave height for the "position" of the "Mineral Diamond" peaked at 8.9 metres at 0630 UTC on 17/05/91 and then only gradually declined. This peak in wave height obviously corresponds well with the wind maximum. By 1200 on 18 April, waves were still above 6 metres. Given that the maximum wave during a six hour period is usually taken as twice the significant height, it is likely that individual waves up to about 16 metres would have been experienced during the peak of the storm during 17 April and perhaps up to about 13 or 14 metres through during 18 April.

5. CONCLUSION:

The re-analysis of the surface pressure field indicates that the strongest surface winds would have been experienced in the 12 hour period from about 0000 UTC 17 April 1991. Satellite pictures indicate a northward surge of cold air and the development of a new front in the vicinity of "Mineral Diamond" at about 1200 UTC leading to very squally conditions. The estimated 10 minute mean winds are in the order of 50 knots. Accordingly, significant waves to about 9 metres can be expected to have developed at this time in the vicinity of "Mineral Diamond" with a maximum wave to around 18 metres. Although the winds then eased, significant waves to 7 metres would have persisted through 18 April with a maximum wave up to 14 metres.

REFERENCES:

HASSELMANN K. et al. "The WAM Model - a Third Generation OCEAN wave Prediction Model", Journal of Physical Oceanography, Vol 18, December 1988, pp 1775-1810.

APPENDIX 1

Meteorological observations available in the Indian Ocean for use in synoptic analysis.

1. Island observations, including Amsterdam, Kerguelen, Crozet and Marion.

2. Automatic Weather Station at Heard Island.

3. Drifting buoy network. There was a relatively good array of buoys available for analysis. The 3 most significant buoys at the time were
   WMO No 17803 located near 40S 91E buoy drogued
   WMO No 17804 located near 38.5S 86.5E not drogued
   WMO No 17805 located near 32.5S 77E not drogued
   Data from these buoys is shown in table 2.

4. Ship observations. The most critical was the MEE MAY which was approximately 6 degrees of longitude east of the Mineral Diamond.

TABLE 1

250Hpa UPPER WIND DATA FROM AMSTERDAM AND KERGUELEN
(wind speed in knots)

Date/time (GMT)	Amsterdam	Kerguelen
13/1100	WNW 45	W 50
14/1100	W 70	SW 55
15/1100	SSW 85	SSW 70
16/1100	S 90	W 80
17/1100	SSW 25	WNW 105

The above table indicates a southerly jet stream at 250Hpa becoming apparent at Amsterdam Island between April 14/15.

TABLE 2

DRIFTING BUOY DATA IN THE CENTRAL INDIAN OCEAN 14-18 APRIL 1991

* Wind speed low ?

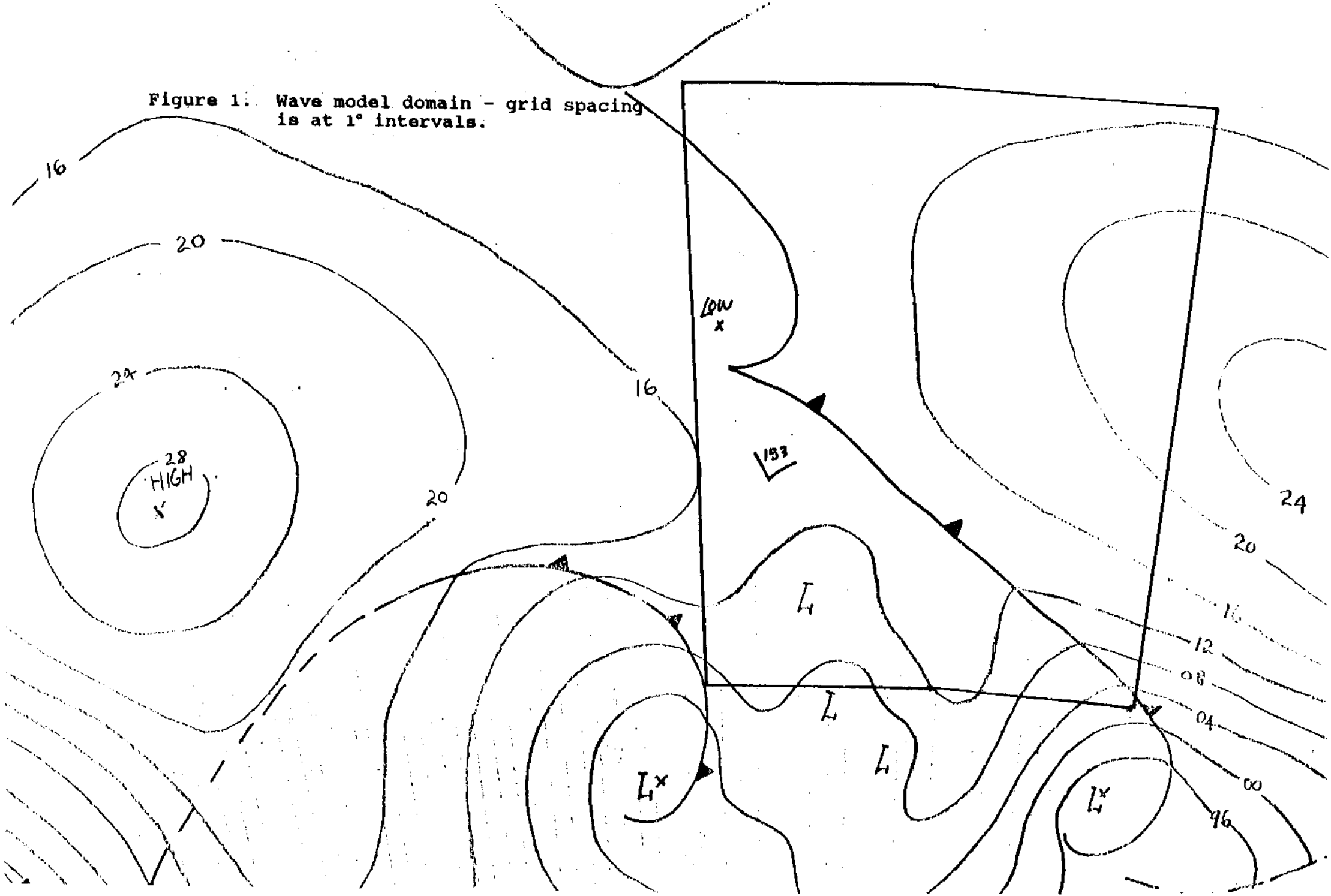
		No. 17805		No. 17804		No. 17803		
DATE UTC	TIME UTC	POS Lat S Long E	PRESSURE HPA	POS Lat S Long E	PRESSURE HPA	POS Lat S Long E	PRESSURE HPA	WIND * KT
14.04.91	0000	33.6/077.3	1016.0	38.3/085.6	1013.8	39.6/091.8	1017.6	NW 05
	0700						1015.8	NW 05
	0800						1014.4	NW 05
	1000		1013.3				1013.9	WNW 05
	1600		1015.2		1010.3		1012.7	NW 10
	2100		1016.0	38.4/085.9	1008.3	39.5/091.7	1009.0	NW 05
	2200				1007.9			
15.04.91	0000	33.5/077.2	1016.2		1007.7		1007.8	NW 05
	0300		1018.2					
	0600						1004.3	WNW 05
	0800	33.2/077.2	1016.4	38.5/086.0	1003.2	39.6/091.7	1003.7	NW 02
	1000		1016.4		1003.4		1002.9	NW 02
	1100		1016.2					
	1500	33.1/077.2	1018.8		1001.7		999.6	NNW 02
	1800				1000.3		997.9	SSW 05
	1900		1018.8		999.7			
	2100	33.0/077.2	1018.2		998.9		996.3	SSE 05
	2300		1018.0		998.5			
16.04.91	0300		1018.6		998.9			
	0600						994.1	SW 10
	0800		1018.0	38.5/86.3	998.1		994.3	SW05
	1000		1017.8		997.9		994.7	WSW 10
	1500		1019.7			39.7/091.4	999.0	WNW 05
	1800				996.9			
	1900		1019.9	38.5/086.4	996.6		1001.0	NW 02
	2100	32.7/077.2	1020.1		994.8		1000.2	N 02
	2300				993.2		1000.4	NE 02
17.04.91	0100		1020.9	38.5/086.5	998.5	39.7/091.4	1000.8	E 05
	0800		1022.5		1004.6		1001.2	SE 10
	1500			38.4/086.6	1010.5		1004.3	SE 10
	1700				1011.1		1004.3	S 10
	1900		1024.8		1011.6	39.8/091.2	1004.1	SSW 05
	2100		1024.6		1011.8		1004.3	S 10
	2200		1024.4					
	2300				1012.4		1004.3	S 10
18.04.91	0700		1026.4	38.3/086.6	1016.0		1008.8	SSE 15
	1100		1025.4		1017.3			
	1600	32.3/077.0	1026.4					
	1700						1015.8	SSE 15
	1900				1020.5	39.7/091.0	1017.4	SSE 10
	2100		1025.8	38.2/086.7	1020.3		1017.8	S 10
	2200	32.3/076.9	1025.2				1018.4	SSE 05
19.04.91	0000		1025.4		1021.2	39.8/090.9	1019.7	SSE 05

TABLE 3

MEE MAY WEATHER DATA 17 - 19 APRIL 1991

DATE (UTC)	TIME (UTC)	POS Lat S Long E	PRESSURE (HPA)	WIND (KT)	SEA (M)
17.04.91	0400	31.3/095.1	1007	NW 22/33	4 - 6
	1000		1005	NW 28/40	8 - 11
	1200	31.3/093.5			
	1400		1004	WNW 34/40	9 - 14
	1800	31.3/092.0	1006	W 34/40	9 - 14
	2200		1009	W 34/40	9 - 14
18.04.91	0000	31.2/090.4			
	0200		1012	SW 34/40	9 - 14
	0600	31.2/088.8	1015	SW 34/40	9 - 14
	1000		1016	SW 28/33	6 - 9
	1200	31.1/087.0			
	1400		1018	SSW 22/27	4 - 6
	1830	31.1/085.1	1019	SW 22/27	4 - 6
	2300		1019	SW 8/14	1 - 2
19.04.91	0100	31.0/082.8			
	0300		1021	SSE 8/14	1 - 2
	0700	31.0/080.8	1022	SE 11/16	1.25 - 2.5

Figure 1. Wave model domain - grid spacing is at 1° intervals.



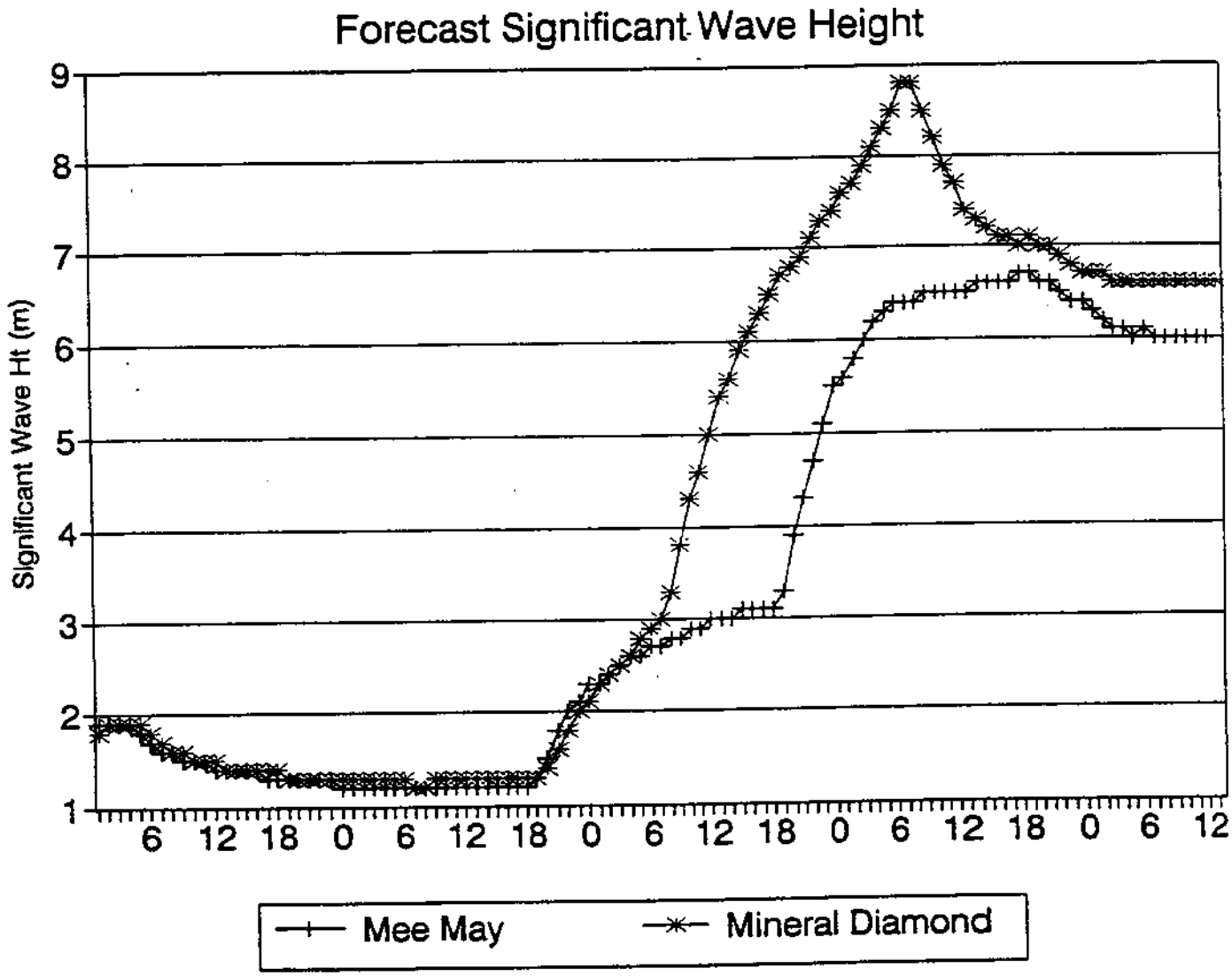
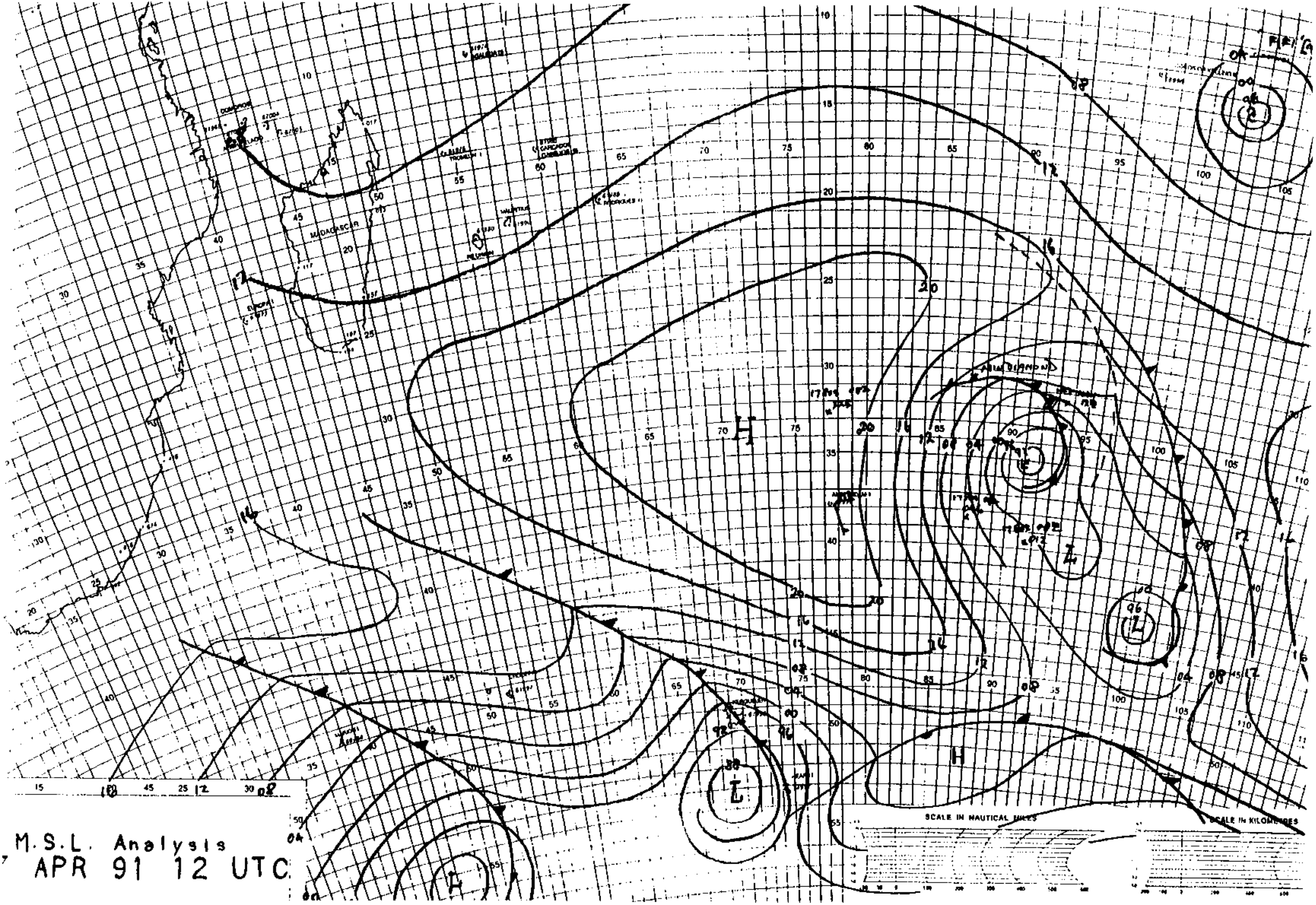
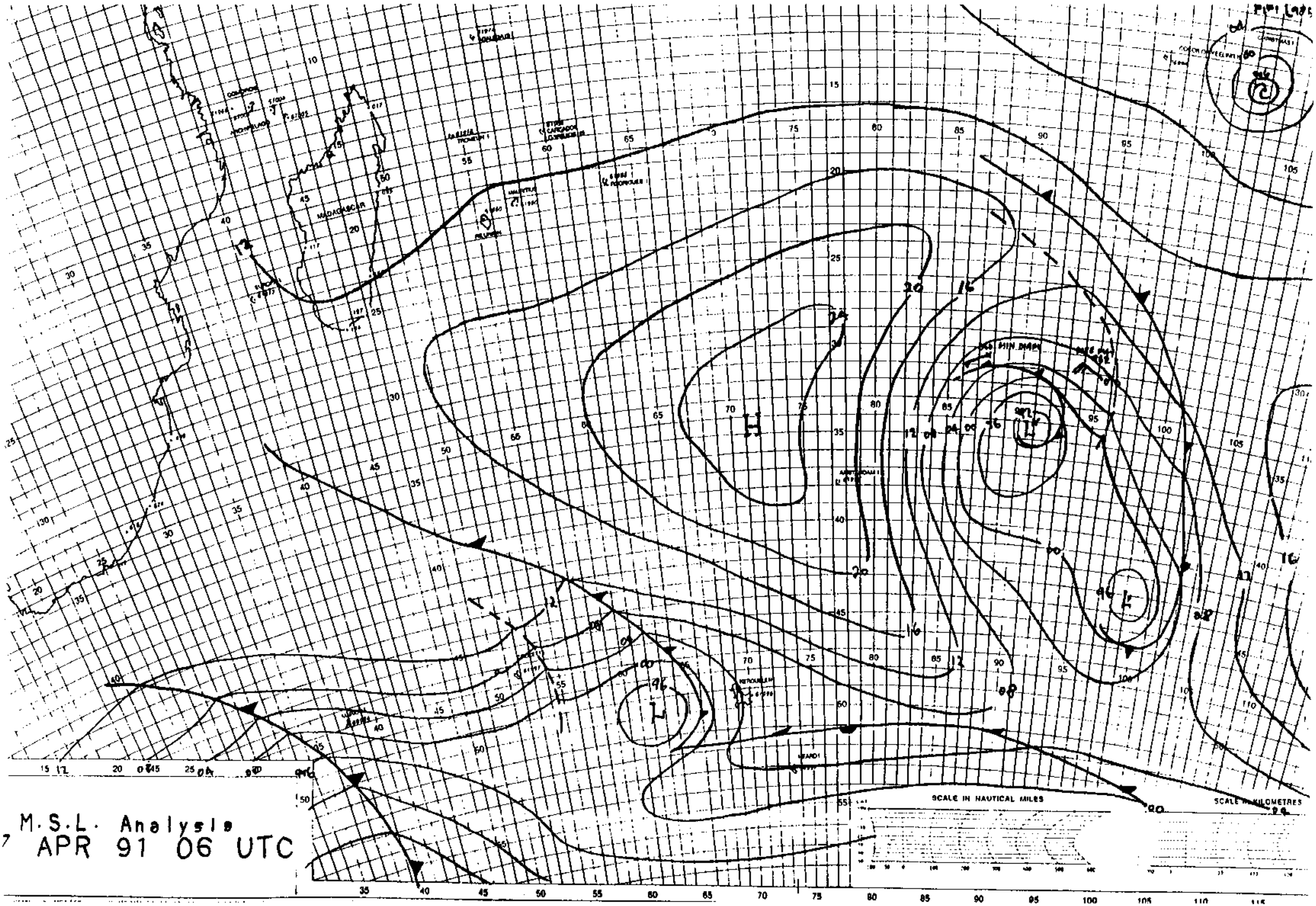


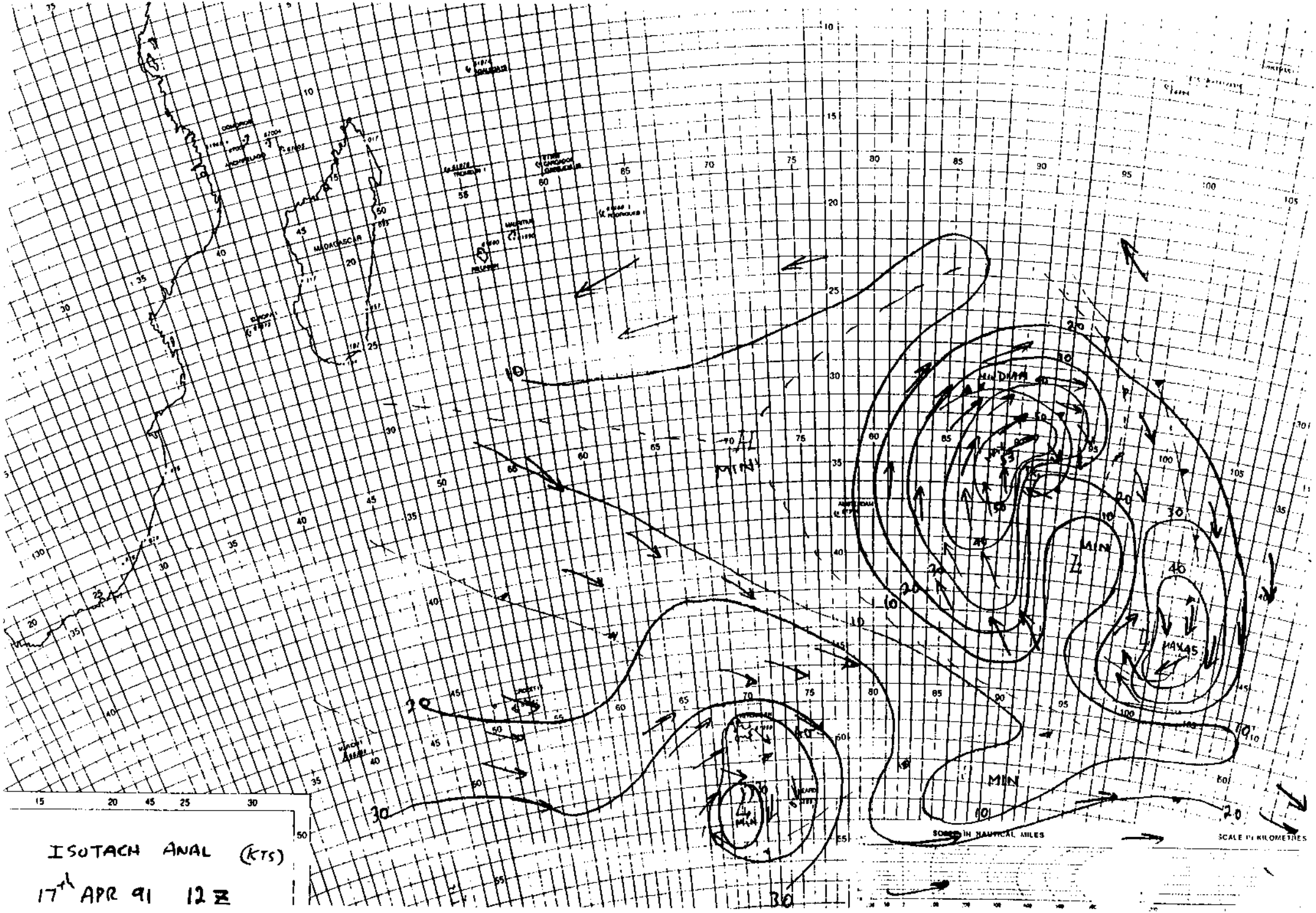
Figure 2. Time series of significant wave height at two locations - 3056S 8423E and 312S 888E corresponding to positions of the "Mineral Diamond" and "Mee May" at 0600 18 April 1991.



M.S.L. Analysis
APR 91 12 UTC

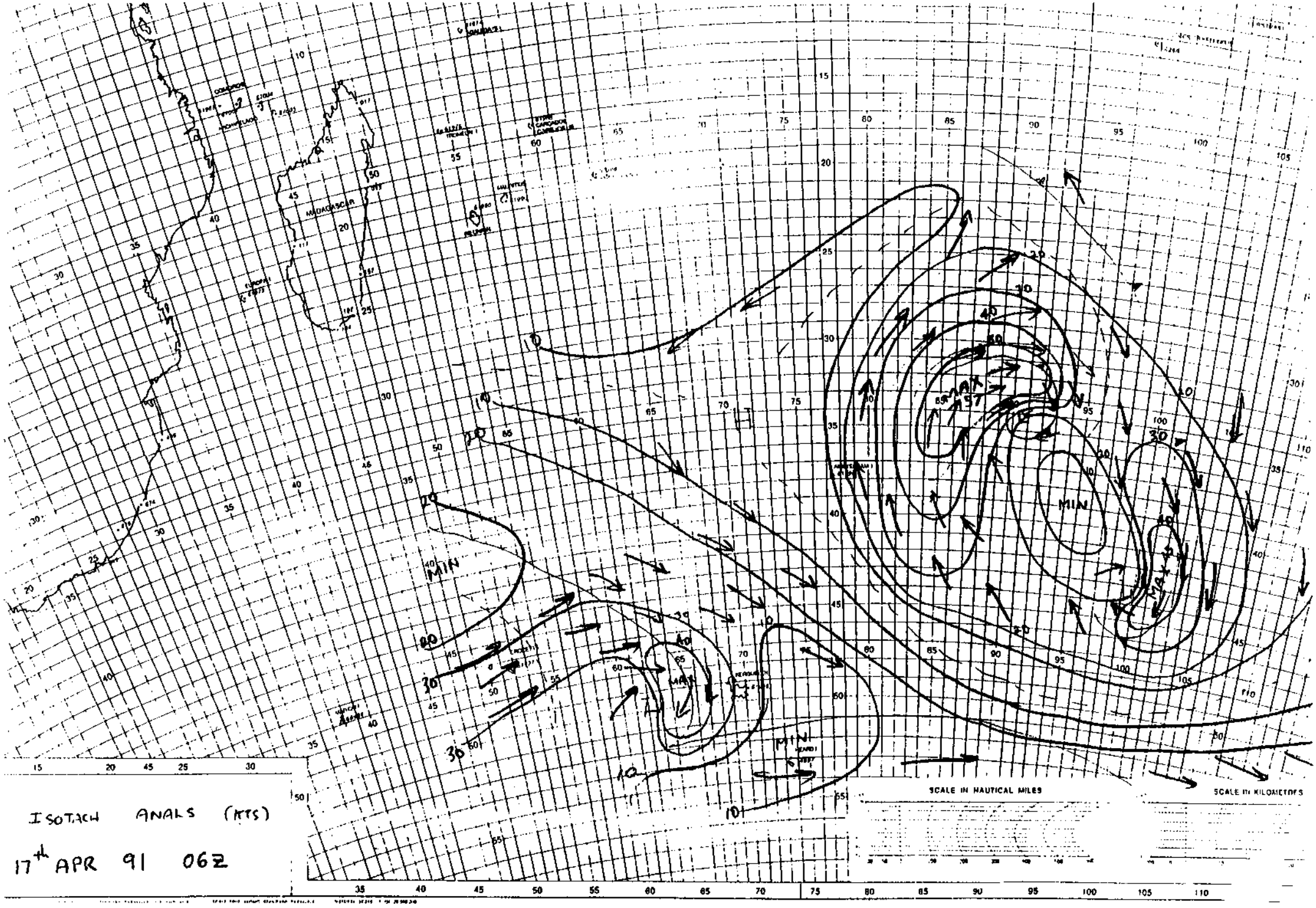


M.S.L. Analysis
APR 91 06 UTC



ISOTACH ANAL (KTS)

17th APR 91 12Z



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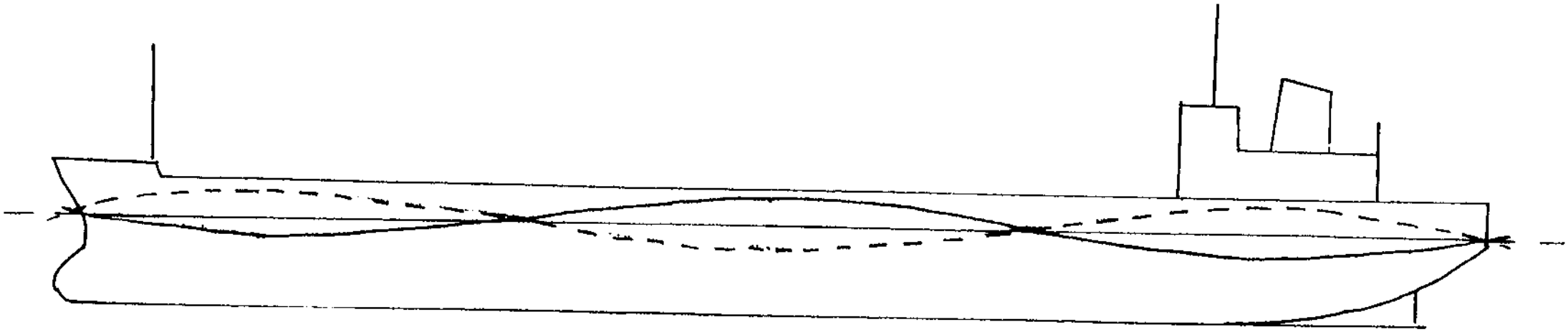
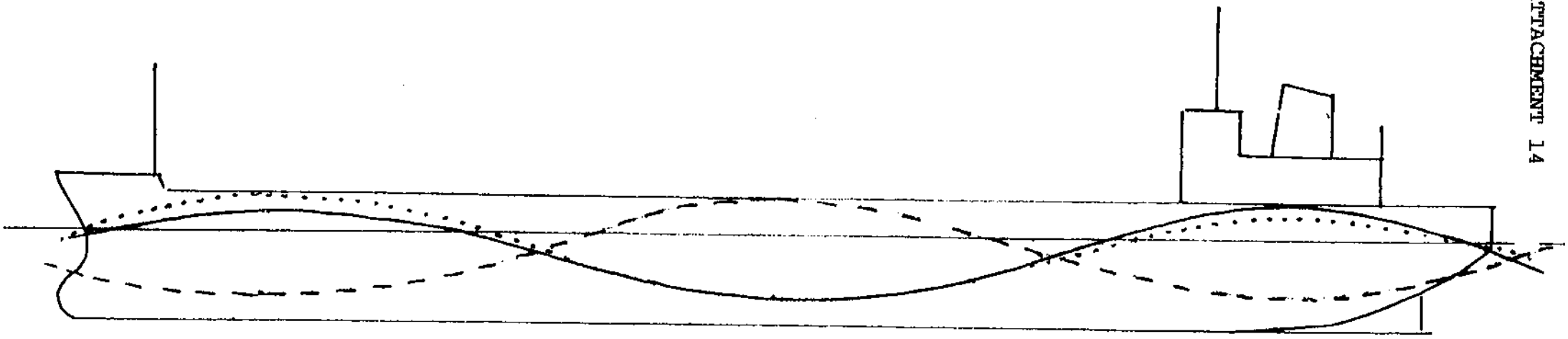


SIGNIFICANT WAVE (9.0M - PERIOD 11 SEC/189M)



MAXIMUM WAVE (18.0M - PERIOD 11 SEC/189M)

WAVE FLOWS (NO ACCOUNT TAKEN OF SHIP'S MOTION)

ATTACHMENT 14

ATTACHMENT 15

M.V. MINERAL DIAMONI
AT SEA
05th April 1991

TIMING OF CHANGE OF TOTAL BALLAST

3rd April 1991-1200 hrs- Commenced deballasting first tank No.6 hatch in position 12 27N 131 33E

Date	Timing started	timing completed	compartment deballasted	compartment ballasted
03/04/91	1200	1900	No.6 hatch	
	1900	2200	No1'P&S' UBT & DB	
	2215	2300		No1'P&S' UBT & DB
	2320	0230	No.2'P' & 4'S' UBT and DB	
04/04/91	0245	0500		No.2'P'&4'S' UBT & DB
	0510	0730	No.2'S' & 4'P' UBT and DB	
	0750	1000		No.2'S'&4'P' UBT & DB
	1020	1300	No.3'P' &'S' UBT and DB	
	1315	1530		No.3'P' & 'S' UBT & DB
	1540	1715	Fore Peak	
	1730	1845	No.5'P' & 'S' UBT	
	1910	2010		No.5'P' & 'S' UBT
	2040	2200		Fore Peak Tk.
	2230	0100	Aft Peak Tk	
05/04/91	0115	0330		Aft Peak Tk

05th April 1991-0330 hrs- Completed change of ballast by ballasting last ballast tk. Aft Peak Tk. in posn 02 53N 129 57E

MASTER

M.V. MINERAL DIAMOND
OFF No: 390000 REF: 18400
GRT: 75330 NRT: 51471
CALL SIGN: VENL

CHIEF OFFICER

No. 6 Hold Ballast Filled On 8th April 1991 In Position 13° 26' (N) 120° 45' (E) From 0830 Hrs To 1250 Hrs.

MINERAL DIAMOND

Master

ATTACHMENT 16

GROUNDING DAMAGE/STEEL RENEWAL 1986

PORT SIDE

Bottom plate renewed in forepeak frame 324 to bulkhead with No.1 double bottom tank, with damage extending back to frame 305 in duct keel. Bottom plate renewed in No.1 tank F strake between frames 288 and 277.

STARBOARD SIDE

Bottom plate and internals renewed from frame 324 aft to bulkhead at frame 312 in A, B and C strakes. Bottom plate renewed from frame 312 to 220, mainly on strakes E, F and G and forward part of No.1 double bottom. Approximately 6 metres of forward part of bilge keel and bilge strake also damaged.

ATTACHMENT 17

VOLUNTARY GUIDELINES FOR BALLAST WATER AND SEDIMENT DISCHARGE FROM OVERSEAS VESSELS ENTERING AUSTRALIAN WATERS

PURPOSE

1. The purpose of this Notice is to introduce action guidelines aimed at preventing the entry, establishment and/or spread in Australian waters of toxic and harmful marine organisms via shipping ballast water and sediment discharge.

THE ISSUE

2. It has been established that ballast water and sediment in vessels entering Australian waters has been contaminated with a range of organisms, including toxic dinoflagellate species known to cause paralytic shellfish poisoning.

3. Available evidence links the establishment of the toxic dinoflagellate Gymnodinium catenatum in waters surrounding Hobart to discharge of ballast and sediment from woodchip vessels. This organism is present in waters of Argentina, Japan, Mexico, Portugal, Spain, Venezuela, and a range of Mediterranean seaports. Toxic dinoflagellates of the Alexandrium species, also found in ballast sediment samples taken from overseas vessels, have a virtual worldwide distribution. Organisms of this species are now present in Melbourne and Adelaide. Dinoflagellates of the Gymnodium and Alexandrium species settle as cysts or spores (a resting stage) in ballast tank sediment. When released, the spores settle on the sea floor until conditions are ripe for them to hatch; they then form a free floating stage in the water and become part of the shellfish feeding cycle. They produce toxins in shellfish which, if consumed, can cause paralytic shellfish poisoning, sometimes leading to death, in human beings.

4. There is a clear potential for a range of harmful organisms and other forms of marine life to be introduced and establish via ballast water. The current control arrangements concentrate principally on preventing the further entry and spread of toxic dinoflagellates. Research is ongoing into other marine organisms likely to be introduced this way, and their significance in a quarantine and environmental sense.

THE APPROACH

5. No ballast water or sediment should be discharged unless appropriate constraints have been observed to prevent the entry of toxic dinoflagellates. The guidelines outlined below are suggested approaches in this light.

6. Scientific evidence indicates that the major risk of entry of toxic dinoflagellates is through viable cysts(ie resting stages) which settle in the sediment at the bottom of holding tanks, rather than in the water itself.

7. The purpose of the guidelines thus is to minimize, if not entirely eliminate, the discharge of sediment when ballast water is discharged into Australian waters. The measures recommended have been developed in consultation with industry interests, research organisations and authorities. They are not exclusive - the Australian Quarantine and Inspection service is prepared to consider any additional alternative action proposals which can be shown to achieve the desired effect.

8. The guidelines are being introduced on a voluntary compliance basis, in the expectation of customary co-operation from the shipping industry. They are to apply initially for six months to allow time to assess their effectiveness and the need for their application Australia-wide. Evidence of non-compliance may lead, however, to the earlier introduction of mandatory control action.

9. The guidelines are to operate under general powers provided by the Quarantine Act. However, it should be noted that power already exists under that Act to introduce compulsory controls. Under section 13(1)(d), of the Quarantine Act 1908, Proclamation 6G prohibits, inter alia, the introduction into Australia, except with the consent of the Director of Quarantine or in accordance with the Act and regulations, of 'all disease germs, microbes and disease agents and all cultures, viruses or substances or articles containing or likely to contain any disease germs, microbes or disease agents'.

10. The arrangements centre on
    A. the loading and discharge of ballast water, and
    B. the control of sediment likely to be present in that water and in ballast tanks and holds used for carrying ballast.

11. The measures apply Australia-wide.

A. Guidelines for Controls on the loading and discharge of ballast water

12. It is important that ships' masters and crew make every effort to ensure that ballast water, when loaded, is visibly clean and free from suspended sediment and turbidity. Wherever possible, ships' masters should avoid ballasting in shallow water where the likelihood of sediment uptake is highest. At berths where the depth of water is restricted or turbidity is high,the minimum amount of ballast should be taken at the berth and ballasting completed in deeper water away from the berth to minimise sediment uptake. To parallel this, a number of possible approaches, listed below, have been developed to control ballast water discharge.

13. The arrangements are

a) certification from an overseas government agency that the ballast loaded in their territories was taken from a place free, in both water and harbour sediment, from toxic dinoflagellates at the time the ballasting took place
   - such certification needs to include sediment sampling taken from the harbour bottom for the organisms in their resting stage
   - certification may also be based on a continuing program of monitoring to this effect by the relevant agency or laboratory

(NOTE: The Australian Quarantine and Inspection Service may approve, on application, specific non-government laboratories for this purpose)

b) evidence that re-ballasting at sea en route to Australia has taken place
   - preferably in open tropical water
   - it should not take place within or adjacent to Australian territorial waters, or in designated national marine park areas
   - details should be fully documented (ie, position, date, time, and tanks involved) in the official log book for the vessel and be available for inspection by quarantine staff on arrival

(NOTE: IN CARRYING OUT THIS OPERATION, THE STABILITY OF THE SHIP, AND ANY OTHER SAFETY CONSIDERATIONS, REMAINS THE RESPONSIBILITY OF THE SHIP'S MASTER. NOTHING IN THIS NOTICE SHOULD BE CONSTRUED AS AN INSTRUCTION TO DEPART THAT RESPONSIBILITY)

c) an undertaking that ballast water discharge will not take place in Australian territory

d) a compliance arrangement entered into between the vessel's owners and the Australian Quarantine and Inspection Service to ensure the cleanliness of ballast, basically through effective ship management procedures. Typically, such arrangements would include
   - properly documented operational procedures to ensure and monitor the cleanliness (ie, freedom from sediment) of loaded ballast water
   - clearly defined lines of command and directives and, as appropriate, training of operational staff in the function
   - a commitment to notify the Australian Quarantine and Inspection Service where clear water loading practices cannot be implemented or where water is loaded at the time of a toxic 'bloom'. Such notification should be well in advance of the vessel's arrival, to allow alternative strategies to be developed with minimal disruption to the ship on arrival.

(NOTE: An indicative documented compliance arrangement is available on request from the Australian Quarantine and Inspection Service.)

14. The Australian Quarantine and Inspection Service is willing to consider also proposals for water treatment, in-tank (or hold) or on shore to render the organisms non-viable. The vessel's master, or the owners would need to demonstrate the efficacy of such treatments and seek prior AQIS agreement for their use. It would also need to be demonstrated that treated water would be disposed of subsequently in a manner which would not, of itself, create quarantine or environmental concerns. AQIS currently is not aware of any suitable treatments, but these could come about in future as a result of ongoing research.

B. <u>Guidelines for Control of Ballast Sediment</u>

15. Although some minor sediment discharge may be unavoidable in de-ballasting, every effort should be made to minimize this. Where one or other of the controls detailed above has not been implemented, the procedure detailed in paragraphs 18 below and following should be observed.

16. Under no circumstances should sediment resulting from tank or hold cleaning or stripping be disposed of in Australian waters. Sediment should not be shovelled or tipped over the side of the vessel after de-ballasting. Where such disposal is necessary, as a result of tank or hold cleaning or drydocking, it should be disposed of in a manner which prevents it entering the Australian marine environment.

17. Where one or more of the recommended guidelines for ballast water discharge has been taken, and loose sediment remains which is likely to be discharged in an initial flush, for instance in the bilge well of a hold space, such sediment should be drawn off by a suitable means, (eg, via shipping pumps, priming taps on either the main or stripping pumps, or by tapping into pressure gauge lines) into holding drums, tanks, or the bilge, or by carrying out initial release into an approved discharge area (see below), or at sea outside territorial limits, before full discharge overboard takes place.

(NOTE: Bearing in mind that some minor suspended sediment discharge may be unavoidable, this procedure need not apply to relatively insignificant amounts of suspended sediment in the water)

PROCEDURES IN THE ABSENCE OF CONTROL ACTION

18. Where appropriate control action has not been taken, the Australian Quarantine and Inspection Service should be advised, preferably at the time of and in applying for Pratique (see paragraphs 21 below and following) so that an appropriate recommended course of action can be determined.

19. Recommended action in such cases may include

- allowing the vessel to discharge normally, based on risk assessment taking into account the type of vessel, its origin, and risk factors at the port of entry (including tidal flows and proximity to shellfish farms and aquaculture);

OR

- withholding discharge until samples of water/sediment are taken, analysed, and found free of harmful organisms

OR

- vessel given the option of departing Australian territorial waters to carry out appropriate re-ballasting. In exceptional circumstances, the operation may be carried out in Australian territorial waters, subject to agreement on a case by case basis by Quarantine, as necessary after consultation with State and local authorities. Factors taken into account in considering and determining such approved discharge areas may include
  - water depth (discharge would not normally be agreed to in waters less than 340 metres deep)
  - tidal flows (should be away from land)
  - the need to be distanced from estuaries and aquaculture
  - where loose sediment can be removed satisfactorily without total reballasting, run-off need only take place until discharging water is clean.

(NOTE: As indicated earlier, safety and stability considerations remain the responsibility of the ship's master)

20. The procedures in paragraphs 18 and 19 may also be appropriate in cases where testing on arrival indicates the presence of harmful organisms.

NOTIFYING THE SERVICE/APPLYING FOR PRATIQUE

PRATIQUE

21. To assist officers of the Australian Quarantine and Inspection Service in monitoring the effectiveness of the voluntary arrangements, vessels requesting radio pratique should indicate what control action has been carried out. A revised questionnaire is at Annex 1.

22. Where radio pratique has been granted, the inspecting quarantine officer on visiting the vessel shall ask for appropriate confirmatory evidence by way of certification, or entry in the ship's official or deck logs.

23. Where vessels are part of a compliance arrangement with the Service for control purposes (see Option (d) in paragraph 13 above) and problems are observed or ascertained at the place of ballasting, every effort should be made to advise the Service as soon as possible so that delays can be minimized on arrival. Preferably such advice should be given well before and separate to applying for Pratique.

24. In cases where vessels in requesting Pratique do not indicate that they have carried out appropriate control action, the inspecting quarantine officer shall endeavour to visit such vessels as soon as possible on arrival to ensure that appropriate on-arrival controls take place.

25. Quarantine officers shall record details of all cases where the voluntary arrangements have not been followed and shall pass such information on promptly to the Barrier Control Unit in Canberra

QUARANTINE SAMPLING

26. Except for special arrangements for vessels under compliance arrangements, quarantine officers may still collect vessel sediment samples from ships' masters on arrival. This is necessary as part of the Service's ongoing monitoring program and to enable the further development of vessel risk categories. Such sampling should be carried out in accordance with the sampling program detailed in Annex 2.

27. Samples may also be sought from time to time from vessels under compliance arrangements. Procedures will be arranged with the companies concerned or direct with ships' masters for this purpose.

NOTIFICATIONS

28. Regional office staff of the Service should ensure all shipping agents are alerted to the above regime, particularly those applying for radio Pratique.

29. To assist in monitoring overall compliance, Regional Offices of the Service must forward to Canberra on a monthly basis a consolidated return for their Region showing all first arrivals from overseas, ports of origin/ballasting, whether or not control action has been implemented and the type of action, and whether or not ballast was discharged in Australian waters.

CONCLUSION

29. The operation of the voluntary regime detailed above remains conditional on a number of factors. The first is the extent to which ships entering Australian waters from overseas comply with the program. The second, which will be based on ongoing inspection, observation, and research, is the effectiveness of the measures listed in maintaining control. Failure of shipping to implement control action on a voluntary basis may result in the introduction of mandatory controls if further risk assessment shows this as warranted.

Annex 1

COMMONWEALTH OF AUSTRALIA
QUARANTINE ACT 1908

RADIO PRATIQUE (HEALTH CLEARANCE)

QUESTIONNAIRE

QUESTION	ANSWER
1. NAME, TYPE AND NATIONALITY OF VESSEL?	
2. WHERE FROM AND DEPARTURE DATE?	
3. WHERE BOUND AND ETA FIRST PORT?	
4. DETAILS OF ANY COMMUNICABLE DISEASE OR ILLNESS OR DEATH ON BOARD SINCE SAILING	
5. ARE THERE ANY ANIMALS OR PLANTS ON BOARD?	
6. HAVE YOU CARRIED LIVESTOCK IN THE LAST SIX MONTHS? IF YES - - LIST TYPE, PORTS VISITED AND CLEANING PERFORMED SINCE LAST LIVESTOCK VOYAGE	
OPTIONAL SECTION (ANSWERING THIS SECTION WILL FACILITATE CLEARANCE OF YOUR VESSEL WHEN IT ARRIVES IN PORT	
7. IF THE VESSEL IS ENTERING IN BALLAST	
(1) HAVE YOU -	
(a) EXCHANGED BALLAST WATER DURING THE VOYAGE AND LOGBOOK CERTIFICATION OF TIME AND COORDINATES WHEN RE-BALLASTING OCCURRED OR;	
(b) CERTIFICATION THAT THE AREA WHERE BALLASTING TOOK PLACE IS FREE FROM TOXIC DINOFLAGELLATES?	
OR	
(2) IS YOUR VESSEL PART OF A COMPLIANCE ARRANGEMENT FOR BALLAST WATER CONTROL ACCEPTED BY AUSTRALIAN QUARANTINE AND INSPECTION SERVICE?	
(3) WILL YOU BE DISCHARGING BALLAST WHILST IN AUSTRALIAN WATERS?	YES/NO

NOTE: MASTERS OR MEDICAL OFFICERS WHO WILFULLY MAKE A FALSE STATEMENT IN ANSWER TO ANY QUESTION, ARE LIABLE TO A FINE NOT EXCEEDING $5000 OR IMPRISONMENTFOR A PERIOD NOT EXCEEDING TWO YEARS.

NOTE: THE GRANTING OF PRATIQUE TO A VESSEL DOES NOT RELEASE IT FROM BEING SUBJECT TO QUARANTINE. GOODS REQUIRE SEPARATE CLEARANCE

Annex 2

BALLAST WATER SAMPLING PROCEDURES

The Australian Quarantine and Inspection Service is looking to ships' masters and owners to comply with voluntary arrangements to prevent the entry of exotic and harmful forms of marine life through the discharge of ballast water and sediment.

To assist in monitoring the effectiveness of the voluntary arrangements, and in building up a profile which can be used in determining the scope and nature of future controls, masters of overseas vessels entering Australian territory in ballast, who intend to re-ballast, shall be requested to supply to the quarantine staff samples of ballast tank sediment (depending on the particular vessel's assessed risk profile). Wherever practicable, such samples shall be provided at the time of initial boarding by quarantine staff. Sampling procedures apply under the general powers of Proclamation 6G of the Quarantine Act 1908.

Sampling rates. To prevent undue inconvenience, quarantine officers should develop a risk profile for each vessel as a basis for sampling. This should operate as follows:

- until a performance record for each vessel can be established, each vessel discharging in Australian territory shall be subject to sampling
  - .. two representative samples shall be taken from each vessel
  - .. sampling details (including results when obtained) shall be entered on the ship's file held by Quarantine staff. Copies of results, once obtained, shall be forwarded to each region headquarters office along with details of the vessel's sampling status
- once a ship shows clear results for three consecutive arrivals in ballast, it shall be put on random sampling covering one voyage in ballast out of every five.

If a vessel on random sampling is found to be positive, the Barrier Control Unit in Canberra is to be advised immediately. Also, each subsequent arrival in ballast shall be sampled until three further consecutive negative results are obtained.

Sampling procedures:

The master of the vessel shall be advised of the need to obtain a ballast tank sediment sample of the vessel and shall be handed an information sheet as at Appendix 1. IT IS IMPORTANT THAT THE MASTER IS MADE AWARE THAT IT IS THE SEDIMENT (MUD) THAT IS OF INTEREST.

Samples can be taken in a number of ways. Adequate safety precautions must be followed. Sampling procedures shall be as follows

(a) from holding tanks, in areas where sediment is likely to accumulate (around outlet points, bulkhead and hold corners etc) are accessible

(b) by run-off from the priming taps on either the main pumps or the stripping pump where fitted, or from a tap inserted into the pressure gauge line. If necessary, the taps should be allowed to run to clear any line sediment or water before hold or tank samples are taken.
(c) by obtaining samples of harbour sediment and water (two of each) at the time and the place of ballasting.

Holding of samples for collection

- The usual operation is to leave the sample jars with the master or responsible officer, who should ensure collection of the samples at the appropriate time for subsequent collection by quarantine
  - the sample containers used are 500ml plastic containers with wide screw tops. Clear plastic containers should not be used due to the need to retain the sample in a dark environment
  - each container should have a label with the following information
    - name of vessel
    - date and port or place where the sample was collected
    - date and port or place where ballasting was carried out
    - hold or tank from which the sample was obtained.

- The samples should be kept at a temperature of 3-4°C. Normal procedure would be for them to be stored in a refrigerator on board the vessel awaiting quarantine collection, and also refrigerated at the quarantine office pending forwarding to the analytical laboratory.

- The samples can be stored under refrigeration at the quarantine office until there are sufficient to be forwarded as a lot to the laboratory, unless instructions are received to the contrary.

- Samples forwarded from distant ports are to be transported in an esky or other suitable cool container. Whenever practicable, Regional Officers should attempt to rationalise such container selection and usage in co-ordination with other analytical arrangements (eg, if possible, use the same sorts of containers as are used for meat, fish, dairy, etc samples with re-cycling as practicable).

- The laboratory for analytical purposes is CSIRO Marine Laboratories, Castray Esplanade, Hobart. Regional officers will be contacted should supplementary analysis in other laboratories need to be arranged. (NOTE The question of arrangements whereby ship's masters would onforward samples direct to approved laboratories of their choice is being investigated).

- Where samples are to be taken from a vessel which is some distance from quarantine operations, appropriate arrangements, in line with the above requirements, may be made with the vessel's agent, Customs, local port authorities, etc for the collection of samples.

Sampling by Quarantine Officers

. To ensure the proper procedures are followed, Quarantine officers may from time to time directly oversight the collection of samples or themselves take samples for the purposes of the above program, in addition to those collected by ships' masters.

BALLAST TANK SEDIMENT SAMPLING

An Australian Scientific Research Program is being conducted into the carriage of certain plankton species in ships' ballast tank sediment.

You are required by Australian law to provide a sample of ballast tank sediment (mud). This may be taken from either a hold or accessible ballast tank.

The sample is to consist of sediment (mud).

The sample is not to be taken from a ballast holding space which has been exchanged (flushed out) with tropical clean mid-ocean seawater.

The sample is to be kept refrigerated at 3-4^{o}C pending collection by an officer.

Sample jars should be labelled, showing

- the name of your ship
- date and port or place at which the sample was collected
- date and port or place where ballast was loaded
- hold or tank from which the sample was obtained.

Please be assured that the ballast water sediment sample is required for scientific research only and <u>will not</u> result in any legal action being taken against the ship, the ship's master or the ship's owner.