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SUMMARY

On 26 June 1991 the *Manila Transporter* sailed from Dampier, Western Australia with a crew of 24 and a cargo of 103,001 metric tonnes of iron ore fines for Port Talbot, Wales.

On 7 July 1991, the Master of the ship broadcast a distress message, stating that the ship was taking water in number 3 hold and that assistance was required. The Norwegian bulk carrier *Berica* responded to the message and rescued all 24 Filipino crew of the *Manila Transporter*, who abandoned ship in the lifeboats. The *Berica* then proceeded on passage as the *Manila Transporter* was believed to be sinking.

On 27 July 1991, the Singapore registered ship *Algenib* encountered the derelict *Manila Transporter* and attempted salvage operations. However, the *Manila Transporter* eventually sank on 7 August 1991.

The Australian Marine Incident 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 Philippine Authorities.

SOURCES OF INFORMATION

Maritime Rescue Coordination Centre, Canberra

Hamersley Iron, Dampier - loading documentation and communications

West Coast Shipping - documentation and communications

Master *Berica* - weather details

Master *Manila Transporter* - weather details and statement.

Under Regulation 16(3) of the Navigation (Marine Casualty) Regulations the Inspector must, where a report relates to a person's affairs to a material extent, if it is reasonable to do so, provide the person with a copy of the report or of the relevant part of the report. Such a person may then provide written comments or information relating to the report.

Submissions were received from, or on behalf of, Hamersley Iron P/L, the ship's Owners and West Coast Shipping. These submissions have been considered and the text of the report amended to incorporate such submissions where appropriate.

THE LOADING OF THE CARGO

The *Manila Transporter*, (call sign DHZV) was a nine hold bulk carrier, built in Japan to the Nippon Kaiji Kyokai Classification Society Rules in 1976, undergoing the first Special (Building) Survey at that time. The ship was 260.87 metres in length with a summer deadweight of 115,960 tonnes at 16.028 m draught. Launched as the Japanese ship *Shimo Maru*, in 1988 the ship was purchased by Trytrans Shipping Corporation of Manila and transferred to the Philippines flag and renamed the *Manila Transporter*. The vessel was managed on behalf of the owners by Unique Shipping Agencies Limited of Hong Kong.

The ship had undertaken two voyages to Australia since October 1990, having called at Dampier and Newcastle in late 1990 and at Port Kembla in February 1991.

The *Manila Transporter* sailed from Hong Kong in ballast on 13 June 1991, bound for Dampier, Western Australia. On 14 June the vessel's operators, Showa Line of Tokyo, sent a telex to Pilbara Harbour Services, stipulating the cargo quantity of 103000 tonnes and stating that the cargo, at the charterers request, should be loaded in all holds as follows:

No 1 .. 13000	No 4 .. 5000	No 7 .. 12300
No 2 .. 12000	No 5 .. 15700	No 8 .. 14700
No 3 .. 12200	No 6 .. 5000	No 9 .. 13100.

An all hold loading had been requested by the cargo receivers to facilitate and expedite discharge, a time saving of 24 hours being indicated.

On 15 June the Master sent a message to Pilbara Harbour Services revising the ship's estimated time of arrival and confirming that he intended to load all holds.

On 20 June Unique Shipping Agencies Limited sent a telex to Pilbara Harbour Services, Dampier requesting that a message be passed to the Master of the *Manila Transporter*. The telex specifically drew attention to the loss of the Mineral Diamond in the South Indian Ocean on 17/18 April 1991 and the loss of the *Alexandre-P* on a similar voyage on 14 March 1990, noting that both ships followed the same track that *Manila Transporter* would follow with an identical cargo. The telex stated that surveyors with expert knowledge had made preventative recommendations and advised:

"1. Before loading:

to prepare a cargo plan with anticipated bending moments and shearing stresses well within the vessel's safe tolerance margin. We are not suggesting that vessel to load lesser cargo than she could accommodate. Pre loading should indicate loading sequences which to be adhered to by shore loading operators.

2. During Loading

to strictly supervise ensuring cargoes are loaded to pre-loading plan and sequences and to see that loading rate not far too speedy as to create detrimental effect to vessel's structure.

3. *At sea*
to reduce engine speed and or alter course \$/where necessary during hea y weather
in order to mitigate pounding of vessel. "

The telex also included advice on the discharge of the cargo and that after discharge frames and brackets in all cargo holds should be inspected and any cracks reported immediately. The telex concluded "*please note that owners have deep concern over safety of the she as well as safety of your crew.*"

The *Manila Transporter* anchored off Dampier at 0818 Western Australian Standard Time (WAST) on 21 June 1991, after which the Master advised the terminal operators by telex that "*afier having received a message on precautionary measures from our owners regarding the loss of ore carriers 'Mineral Diamond' and 'Alexandra P' we finally realised disadvantage of loading all holds. In thir regard we revised stowage plan for intermediate hold loading as follows:*

H1/18700 H3/20800 H5/21500 H7/21400 H9/20600."

The Master also advised the terminal operators of the loading sequence required:

First Run	H5/9000	H7/10000	H3/9000	H9/7000	H1/8000
Second Run	H5/7000	H7/7000	H3/8500	H9/6000	H1/6000
Third Run	H5/3000	H7/3100	H3/2000	H9/7600	H1/4700
Final	H5/2500	Trimming	2600		

On 24 June the Master's decision to revert to alternate hold loading was endorsed by the Operators, Showa Line, in a facsimile message to Hamersley Iron, Europe, which quoted the Master's telex of 21 June 1991.

On receipt of this message Mr John Ratcliffe of Hamersley Europe P/L, in London, acknowledged the telex and stated "*Hope Master knows what he ir doing, according our expert advice, from a safety point of view, all hold loading is better. This advice also supported by recent statements made on behalf of Classification Societies (Lloyds and ABS)*".

This and the Showa Line message were copied to Hamersley Iron in Dampier, time stamped in London 1326. Assuming this to be British Summer Time (BST) the four page message was received in Dampier at about 2030 WAST. The covering sheet, signed by John Ratcliffe concluded "Would suggest that, if time permits, it may be a good idea to bring contents of our reply to Master's attention". These messages were duly passed to Pilbara Harbour Services at around 0700 25 June.

The pilot boarded the *Manila Transporter* at 2330 24 June and conducted the ship to the Parker Point berth, the ship being all fast alongside at 0230 25 June. Once alongside the Master was handed a 'Declaration by Shipper' (Attachment 2) describing the physical properties of the cargo to be loaded, as required under Marine Orders Part 34 (Solid Bulk Cargoes) and in accordance with the International Maritime Organization's Code of Safe Practice for Solid Bulk Cargoes. The Master was also handed a letter outlining the responsibilities of the ship with respect to loading (Attachment 3).

According to the Draught Survey Report (Attachment 4) the total ballast on board on berthing was 37,649 tonnes, but the distribution is not recorded and is therefore not known.

Loading of the cargo of Hamersley hematite fine iron ore minus 6mm (maximum particle size 6mm) commenced at 0352 25 June, the Master having requested a slight change of pour tonnages at hold numbers 7 and 3 in the third run (2600 and 1500 respectively) in order to allow a greater quantity for trimming purposes. Loading proceeded normally, without undue interruption, to completion at 0058 26 June.

At 1330 on 25 June the ship's agents in Karratha, West Coast Shipping, received an urgent facsimile message from Showa Line, relayed through their principals in Sydney, MacArthur Shipping, addressed to the Master, requesting that he load "as per coal cargo". After some discussion the message, in a sealed envelope, was handed to the local marine surveyor of the Australian Maritime Safety Authority, who was visiting the office prior to proceeding to the ship to conduct an inspection under Port State Control procedures.

This message was delivered to the Chief Officer on the surveyor's arrival on board at 1430, the Master apparently being ashore. Having introduced himself and delivered the envelope the surveyor went about his inspection. This inspection did not involve cargo loading issues although, whilst he was on board, the Chief Officer did indicate to him that the cargo was being loaded in accordance with the ship's stability information book and that the stresses were acceptable.

From the official "Shiploading Report" individual pour quantities and rates were as follows:

SEQUENCE	HOLD	TONNAGE	START	FINISH	RATE
1	5	8995	0352	0525	5803
2	7	9997	0528	0730	4917
3	3	8995	0800	0925	6348
4	9	7000	0932	1050	5385
5	1	7995	1058	1216	6150
6	5	7005	1220	1342	5124
7	7	6990	1345	1515	4660
8	3	8505	1520	1653	5487
9	9	6010	1658	1813	4808
10	1	6010	1820	1913	6776
11	5	3010	1917	1945	6445
12	7	2615	1949	2012	6757
13	3	1500	2017	2032	6000
14	9	7590	2037	2156	5763
15	1	4705	2200	2254	5427
16	5	2500	2301	2331	5000
17	3	2075	2356	0018	5654
18	7	435	0022	0027	5000
19	7	590	0049	0054	6782

This provided a total cargo loaded of 102,522 tonnes at a nett loading rate of 5552 tph and a hold distribution as follows:

No1/18710 No3/21075 No5/21510 No7/20627 No9/20600

Cargo loaded as per draught survey was 103,001 tonnes. Ship/shore coefficient was therefore 1.0046721, which applied to the hold figures provides an adjusted cargo distribution of:

No1/18797 No3/21174 No5/21610 No7/20723 No9/20697

The total quantity of ballast remaining on board on completion of loading was 15 tonnes.

Draught on completion of loading, as recorded on the Draught Survey Report was :

Forward	14.79 mtrs		
Aft	15.38 mtrs		
Mean	15.085 mtrs	Stern Trim	0.59 mtrs
Mid Port	15.08 mtrs		
Mid Stbd	15.08 mtrs		
Mean	15.08 mtrs	Hog	0.005 mtrs

The moisture content of the cargo, as checked at various times during the loading and as noted in the terminal Shift Report, was 5.34 to 5.35%.

During the Port State Control inspection conducted on the afternoon of 25 June a number of deficiencies in the lifeboats and fire fighting equipment were noted and the Master was instructed to rectify these deficiencies before the ship sailed. Agreement was reached that the ship should proceed to anchorage off Dampier on completion of loading in order to carry out the work necessary to rectify these deficiencies.

The *Manila Transporter* cleared the berth at 0412 26 June, and anchored in Dampier Roads anchorage at 0700.

The deficiencies identified during the Port State Control inspection were repaired during the day of 26 June. When the repairs were complete they were checked by the AMSA surveyor, who witnessed the launch of both lifeboats.

The *Manila Transporter*, with a crew of 24 Philippine nationals, cleared the anchorage at 1736 26 June, bound for Port Talbot, Wales, via the Cape of Good Hope. The Master's instructions were to arrive Port Talbot not later than 15 August.

THE LOADED PASSAGE

On sailing from Dampier the Master filed a Sailing Report with the Australian Maritime Safety Authority's Maritime Rescue Coordination Centre (MRCC), Canberra, detailing his proposed route to the western boundary (Longitude 75 East) of the Australian area of responsibility for maritime rescue. The Master also designated a time at which the *Manila Transporter* would file a daily position report with MRCC.

MRCC then received daily position reports from the *Manila Transporter* until 30 June, at which time the ship was in position 25° 28'S 098° 26'E. In this message the Master advised MRCC "Please note vessel has fixed transmitter freq and may be affected due to changes of new freq starting 1st July 91". This was the last radio message received directly from the *Manila Transporter* by the MRCC. When the *Manila Transporter* failed to report on 1 July 'ship overdue' procedures were put into effect at the MRCC and when the ship became 24 hours overdue an aircraft search was ordered, two RAAF Orion aircraft being tasked to conduct a search. However, shortly after the first aircraft had taken off on 2 July, MRCC received a message from the *Manila Transporter* routed through the Philippines registered bulk carrier *Magandung Ilog*, on passage from Port Hedland, Western Australia to Rotterdam. This message gave the position at 020322Z (2 July 1122 WAST) as 27° 12'S 089° 11'E and reiterated the statement in the previous message "Owing to changes of new freq. effective 1st July 91 our RDO xmitter unable to make contact W coastal stations except MF freq remains workable".

Following receipt of this advice the *Manila Transporter* was designated a 'non reporting ship' by MRCCAUS. However, MRCC continued to receive daily position reports from the *Manila Transporter*, routed through the *Magandmg Ilog*, until the 'Final Report' on clearing the Australian area of responsibility at 042200Z (5 July 0600 WAST), in position 29° 41'S 074° 59'E. This final message also included a request for a message to be passed to AMVER (the United States voluntary ship reporting system) advising that *Manila Tramporter* may not be able to make normal contact due to the frequency changes.

The *Manila Transporter's* track across the South Indian Ocean, once clear of the Australian coast, had been a composite great circle, a great circle track to 29° 50'S 073° 10'E, (reached at noon on 5 July), thence a course of 270T towards the South African coast. Weather conditions from noon on 5 July were recorded as being gale force, south westerly winds with very rough seas and heavy swell.

According to information received from the Master, on the morning of 6 July the daily bilge soundings indicate 50cm of water in number 3 hold. The bilge pump was set up and number 3 bilges pumped out, after which the Chief Officer conducted an inspection from the void space and described the ingress of water from number 3 hold as a trickle. By that afternoon soundings of number 3 bilges indicated 10 to 15 cm of water.

The following morning (7 July) the Chief Officer reported to the Master at 0615 that there were traces of cargo showing in the wake of the ship. Immediately an inspection was carried out and traces of cargo were seen to be appearing from the port side of number 3 hold. Also a loud creaking sound was heard at this time emanating from the hull abreast of number 3 hold.

At 0625 the bilge pump was started on number 3 hold, pumping from both port and starboard bilges and at 0630 the ship's speed was reduced to manoeuvring speed. Number 3 hold access hatch was opened and water was sighted, reaching the lower platform of the hold ladder. The bilges of numbers 2 and 4 holds were checked at this time, but found to be dry.

At 0645 number 3 hatch cover securing cleats gave way and the hatch covers became dislodged, creating more noise and banging sounds.

At 0650 contact was made with the Norwegian bulk carrier *Berica*, running on a parallel course some miles to the south, which was requested to stand-by to provide assistance.

Speed was reduced to 'half ahead' at 0730, then at 0740 a large 'inverted L' shaped fracture was discovered in the port side hull plating abreast of number 3 hold. The horizontal arm of the fracture was said to be 10 metres long and approximately 10 metres from the upper deck. As the ship rolled water gushed in and out of the hold and the fracture was seen to be increasing. Also the ship was observed to be progressively listing to port.

At 0800 a distress message was broadcast to the *Berica* on VHF channel 16 and at 0805 the Master ordered the engines to be stopped and the crew to be mustered on the bridge. At 0820 the Master decided to abandon ship.

By 0900 the *Berica* had approached to a position about 500 metres off and abandon ship procedures commenced. The manned lifeboats cast off from the *Manila Transporter* at 0930 in position 29° 42'S 064° 16'E and by 1005 all 24 of the crew were mustered safely aboard the *Berica*. *Berica* then made a complete circuit round the *Manila Transporter* before resuming passage.

MRCC received advice of the incident through Capetown Radio, all messages from the ***Berica*** to Capetown being relayed to Canberra, the final one being that 24 persons had been rescued and that the abandoned vessel *Manila Transporter*, 2 lifeboats and one life-raft were adrift at position 29° 42'S 64° 17'E.

The *Manila Transporter* was presumed to have eventually foundered.

On 27 July 1991 the Singapore registered multi purpose vessel *Algenib*, on passage from Singapore to Durban, South Africa, encountered the derelict *Manila Transporter* in position 23° 55'S 65° 55'E. On inspection the *Manila Transporter* appeared to be in a stable condition with damage confined to number 3 hold and the Master of the *Algenib* decided to attempt salvage. Initially assistance from a salvage company was declined, but eventually the owners of the *Algenib* decided that professional assistance would be necessary and made the appropriate arrangements.

The tugs *Smit Sulawesi* and *Smit Langkawi* rendezvoused with the *Algenib* and a salvage crew was placed aboard the derelict. However the condition of the *Manila Transporter*, with a hole measuring 17m by 7m in the shell plating on either side of number 3 hold (Lloyd's List of 9 AUGUST 1991), was found to have seriously deteriorated. The salvage crew was withdrawn and on 7 August the *Manila Transporter* was reported to have sunk in a position some 700 miles east of Mauritius.

COMMENT

The foundering of the ship raises a number of relevant issues:

- (i) the stresses on ballast passage to Australia;
- (ii) the loading plan;
- (iii) the presentation of the cargo for loading;
- (iv) the voyage from Australia.

(i) *The stresses on ballast passage*

There is no record that the vessel was subjected to any unusually adverse weather during the voyage from Hong Kong to Dampier.

According to the records of the Australian Quarantine Inspection Service (AQIS) the *Manila Transporter* did not change ballast whilst on passage from Hong Kong, as recommended under the guidelines contained in AQIS circular "Voluntary Guidelines for ballast water and sediment discharge from overseas vessels entering Australian waters". Apparently the Master did not consider a change of ballast was necessary as Hong Kong is not a place where exotic toxic dinoflagellates originate.

On the ballast passage, neither weather conditions nor, apparently, any shipboard operations were undertaken that need to be considered by the investigation as possible factors in the structural failure of the *Manila Transporter*.

(ii) *The loading plan*

The Master drew up the original, all hold, loading plan in compliance with Charterer's requirements, which were based upon ease and speed of discharge. It is not known what facilities were on board, other than the ship's loading manual, to assist the Master in his calculations of the hull stresses in the loading of the cargo. However, it is assumed that some form of calculations had been carried out and that the Master was satisfied that the hull stresses would have been acceptable.

The Owners have advised that the ship's loading manual contained information only for alternate hold loading of iron ore cargoes, that stability and stress data for all hold loading of iron ore required extrapolation of data provided for coal loadings. Whereas such extrapolation reportedly indicated that the induced stresses were within acceptable limits, the results of such calculations cannot be guaranteed as being accurate.

The *Manila Transporter* normally loaded ore cargoes in alternate holds, but the Owners have advised that an all hold loading of iron ore was carried out on one previous occasion, for a voyage from India to Japan, in order to facilitate cargo segregation. On that occasion the ship was reportedly subject to rapid and continual rolling in only relatively moderate seas.

According to the Owners the Chief Officer calculated a GM of about 14 metres for an all hold loading at Dampier, as against a GM of 7.6 metres for the alternate hold loading. Such a large GM would have resulted in quite a short, rapid rolling motion, with attending acceleration forces, in the seas encountered in the South Indian Ocean.

The Owners' concern that *Manila Transporter* should be loaded correctly and safely, following the recent loss of the *Mineral Diamond* and the earlier loss of the *Alexandre-P*, both of which were widely publicised, was justifiable and shows concerned management. Their message to the ship would appear to have created some doubt in the Master's mind with regard to the suitability of the original, all hold, loading plan and resulted in him changing to a loading according to the information contained in the ship's approved loading manual.

It is not known whether this matter was discussed further between the Master and the Owner, either by telephone or by telex.

There was a series of delays with important facsimile messages relating to the recommended distribution of the cargo.

The facsimile message of 24 June from Mr John Ratcliffe to Showa Line timed at 1215 BST, was copied to Hamersly Iron, Dampier at 1326 BST .

The time 1215 BST equates to 2015 in Tokyo. As the telex message from Mr Ratcliffe to Showa Line was not prefixed 'urgent' it is possible that the message went unattended until the following morning; this would account for an apparent delayed response from Showa Line.

The copy of the message to Hamersley Iron was sent from London at 1326 British Summer Time (GMT + 1). The time in Karratha was 2026 24 June, some 6.5 hours before the *Manila Transporter* berthed and some 8.5 hours before loading commenced.

Hamersley Iron Management attitude was that the advice from Hamersley Europe had been telexed directly to Showa Line and that the responsibility for the ship's safety rested with the owner and the Master. However, the message was reportedly passed to Pilbara Harbour Services, at around 0700 25 June. Thereafter no further action appears to have been taken to deliver the message to the Master.

Had the full text of Mr Ratcliffe's message been delivered to the Master immediately it would have given him the opportunity to contact the owner.

The telex from Showa Line, prefixed 'urgent', requesting that the Master load "as for a coal cargo" was received by West Coast Shipping at 1330 and was not received aboard until 1430. The West Coast Shipping office is located some 30 kms from the Parker Point berth and some attempt was reportedly made to contact the ship by VHF, as there is no direct telephone link to ships berthed at Parker Point. However, no attempt appears to have been made to pass the message by telephone through the terminal operators.

By the time that the message was delivered aboard, at 1430, approximately 13500 tonnes had been loaded into number 7 hold, 1200 tonnes more than under the original "all hold" plan. This message was therefore received on board too late to effect a change in loading.

It would have been able to have the chance to revert to the original, all hold, loading plan loading would have had to be stopped by 1415, at which time approximately 12330 tonnes would have been loaded into number 7.

The final paragraph of the Showa Line message to the Master was “understand your vessel is under loading operation. Pls confirm your final decision”. These statements would appear to anticipate probable difficulties in making further changes and leave the final decision with the Master. The Master did not pass a reply through the Agent and may therefore have waited until after departure before responding.

The loading sequence followed was that requested by the Master and the nett loading rate of a little over 5500 tph was typical for the port, although an hourly rate in excess of 6000 tph was recorded for six of the pours.

The responsibility for the safe loading of a ship rests with the Master and it is up to the Master to determine that the stresses placed upon the hull during loading operations are acceptable and do not overstress the ship.

Certain commercial pressures exist for the cargo loading to be expedited as quickly as possible and one way to achieve this is to keep the number of pours/hatch changes to a minimum. The first run of the loading consisted of pours of 7000,8000,9000 and 10000 tonnes, or 6.04%, 6.9%, 7.76% and 8.62% of deadweight respectively. Without a knowledge of the concurrent deballasting sequence and the relevant stress information, it is not possible to determine whether or not such volumes of cargo, when taken with its distribution and loading rate, are significant.

It is concluded, therefore, that :

The cargo was loaded in accordance with the Master’s instructions;

It is not possible to determine whether the proposed all hold loading would have prevented the subsequent hull failure.

In view of the known loss of bulk carriers, two of which had sailed from Dampier in 1991, Pilbara Harbour Services and West Coast Shipping should have ensured immediate delivery of the messages to the ship.

(iii) The presentation of the Cargo

The International Maritime Organization’s Code of Safe Practice for Solid Bulk Cargoes lists iron ore fines under Appendix C - materials which are neither liable to liquefy nor to possess chemical hazards. The moisture content is given as being 0% to 16%

The Declaration by Shipper delivered to the Master on arrival at Dampier detailed the average moisture content of the cargo to be loaded as 2% to 6% and an angle of repose of 37 degrees at the stated moisture content. The Declaration also stated that the commodity was not considered to be a cargo which may liquefy during the voyage. The actual moisture content, as recorded in the terminal loading records, was 5.34 - 5.35%.

Tests conducted on behalf of the Department by Griffith WA. Services, Geraldton in May 1991 found the transportable moisture limit (IML) of Hamersley hematite fine iron ore to be indeterminate (Attachment 11).

The maximum loading rate achieved was 6776 tonnes per hour on the second pour to number 1 hold. The overall average loading rate was 5578. Neither of these figures are outside rates normally experienced at bulk shipping berths.

It is concluded that :

The cargo presented by Hamersley Iron for loading aboard the *Manila Transporter* is considered to have been in accordance with the IMO Code of Safe Practice for Solid Bulk Cargoes.

There was no inherent characteristic in the cargo that made it unsafe.

The loading rate of cargo was within rates normally experienced for bulk loading ports.

(iv) *The voyage from Australia*

Having rectified the deficiencies to the lifeboats and replaced certain fire extinguishers to meet the Port State Control requirements the vessel apparently met international safety requirements. There were no other obvious signs that the vessel was in any way unfit to proceed to sea.

On Sailing from Dampier the *Manila Transporter* duly filed a sailing plan with the MRCC, as required under section 269F of the Navigation Act 1912, then participated in the AUSREP system by providing a daily position report.

On 1 July 1991 the International Maritime Radio Communications frequencies were changed. However, the radio equipment provided aboard the *Manila Transporter* had not been modified to enable operation on the new frequencies. Although the vessel was equipped with 500 kHz, the radio telegraphy distress frequency, on 1 July the *Manila Transporter* was unable to communicate directly with the Australian coastal radio stations. In the daily position report of 30 June the MRCC had been advised of this probability.

On 1 July when the *Manila Transporter* failed to provide the daily position report, notwithstanding the contents of the previous day's message, standard ship overdue procedures were put into effect. After a further 24 hours, still no contact had been made with the *Manila Transporter* through other ships in the area and checks with other international radio stations had failed to reveal recent contact with the ship. Due to concerns for the vessel's possible safety, the decision was taken to order an air reconnaissance to establish whether the *Manila Transporter* was in fact safe. Shortly thereafter a daily position report was received from the *Manila Transporter* through the *Magandang Ilog* and the aircraft was recalled.

From the log abstract of weather experienced on the voyage, (Attachment 8) provided by the Master, the *Manila Transporter* experienced very rough seas and a high (heavy) swell almost continuously from the afternoon of 27 June, relieved only by a 28 hour period of rough seas on 3/4 July. The winds, and therefore seas, were mainly quarterly until the afternoon of 30 June, following which the winds were forward of the beam apart from two periods on 3 July. On 3 and 4 July the sea state is described as rough and very rough for winds of only force 4 and 5, which would indicate an over-statement in these instances. However, the wind force may have been under estimated late on 4 July, as from that time the *Berica* was on a parallel course just a few miles to the south of *Manila Transporter* and was recording winds of force 6 and 7 at that time. On 5,6 and 7 July both the *Manila Transporter* and the *Berica* recorded near gale and gale force winds, very rough seas and high to very high swells.

It is probable that the working (bending, flexing and racking) of the ship in the heavy swell resulted in a small fracture developing at a weak point in the shell plating; such a weak point could be the result of corrosion or physical damage, or a combination of both. Once started the fracture would have increased with the continual working in the heavy seas until such time as, sometime during the night 6/7, it was large enough to open and permit entry of seawater in considerable quantities, when the damage would be exacerbated by the sloshing effect of the water. The loss in continuity of longitudinal strength caused by the large fracture, coupled with the added weight of the water in number 3 hold, would cause the ship to bend excessively, resulting in number 3 hatch securing cleats failing and the hatch covers becoming dislodged.

The fact that the *Manila Transporter* remained afloat for a further 31 days before sinking indicates that the ship may have been able to make a port of refuge. However, in the gale force conditions at the time, with number 3 hold open to the sea and the hatch covers dislodged, plus the accompanying noises, the *Manila Transporter* must have appeared to be in imminent danger of breaking up. The Master's action in contacting the *Berica* and requesting that ship to stand by to provide assistance was very sensible. Bearing in mind the apparent suddenness and rapidity of the recent loss of the *Mineral Diamond* and the earlier loss of the *Alexandre-P*, both with the loss of all hands, and the fact that these losses had been brought to his attention by the owners, the Master was correct to safeguard the lives of the crew.

Both the abandonment of the *Manila Transporter* and the rescue of all the crew by the *Berica*, without loss or serious injury, appear to have been conducted in a professional and seamanlike manner. However, had the *Manila Transporter* not been inspected under the provisions of Port State Control, the seized lifeboat release hooks and other deficiencies not rectified and the lifeboats not test launched, then the outcome may have been considerably different.

It is therefore concluded that:

With the condition of the ship on the morning of 7 July the Master was prudent in his decision to abandon the vessel once the *Berica* was in position to stand by the *Manila Transporter*.

The discovery of the deficiencies in the lifeboat equipment during the Port State Control inspection and the rectification of the deficiencies before the vessel sailed from Dampier were instrumental in the successful outcome of the abandonment.

CONCLUSIONS

From the findings of the investigation it is concluded that:

- 1 The cargo was loaded in accordance with the Master's instructions.
- 2 The cargo presented by Hamersley Iron for loading aboard the *Manila Transporter* was in accordance with the IMO Code of Safe Practice for Solid Bulk Cargoes.
- 3 There was no inherent characteristic in the cargo that made it unsafe.
- 4 The loading rate of cargo was within rates normally experienced at bulk carrier berths.
- 5 It is not possible to determine whether the proposed all hold loading would have prevented the subsequent hull failure.
- 6 In view of the known loss of bulk carriers, two of which had sailed from Dampier in 1991, Pilbara Harbour Services and West Coast Shipping should have ensured immediate delivery of the messages to the ship.
- 7 With the condition of the ship on the morning of 7 July the Master was prudent in his decision to abandon the vessel once the *Berica* was in position to stand by the *Manila Transporter*.
- 8 The discovery of the deficiencies in the lifeboat equipment during the Port State Control inspection and the rectification of the deficiencies before the vessel sailed from Dampier were instrumental in the successful outcome of the abandonment.

ATTACHMENT 1

DETAILS OF SHIP

Name of ship:	Manila Transporter
Previous names:	Shinso Maru (1976 - 1988)
Owner:	Trytrans Shipping Corp, Manila
Managing Agent:	Unique Shipping Agencies, Hong Kong
Operators:	Showa Line, Tokyo
Voyage Charterer:	Hamersley Iron P/L
Crew:	24 Filipinos
Year of Build:	1976
Building Yard:	Mitsubishi H I, Yokohama
Gross Tonnage:	67,624
Nett Tonnage:	34,517
Deadweight Tonnage:	115,960
Length Overall:	260.87 metres
Maximum Beam:	40.67 metres
Moulded Depth:	24.01 metres
Maximum Draught:	16.028 metres
Number of Holds:	9, strengthened for heavy cargoes
Classification:	Society Nippon Kaiji Kyokai

International Safety Certificates - Expiry Dates

Safety Construction:	12.11.91
Load Line:	13.07.94
Safety Equipment:	03.12.92
Safety Radio:	02.12.91
Classification Special Survey:	July 1989
Last Annual Survey:	September 1990
Last Dry Docking:	September 1990

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 2.56 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

H A M E R S L E Y I R O N P T Y L T D



(INCORPORATED IN VICTORIA)
**P.O. BOX 21, DAMPIER,
WESTERN AUSTRALIA 6713**
AUSTRALIAN COMPANY NUMBER
004 558 276

TELEPHONE DAMPIER
(091)43 6000 - DAMPIER OPERATIONS
(091)43 6077 - RAILWAY COMPLEX

TELEX - DAMPIER
99529 . DAMPIER OPERATIONS
99043 - RAILWAY COMPLEX

99151 - PORT ADMINISTRATION

CABLES - "6DHAMIRON DAMPIER"

The Master
M.V. "MANILA TRANSPORTER"
Berthed at
DAMPIER WA

21/6/91

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.
 - 1 a. 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 Fort 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. Tonnages indicated by shore belt weightometers 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 cooperation 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

[Handwritten Signature]
.....
Signature of Master

Date: *[Handwritten Date]*
.....

Yours faithfully,
HAMERSLEY IRON PTY LIMITED

[Handwritten Signature]
.....
MANAGER, PORT OPERATIONS



MARINE SERVICES OF WA PTY LTD

(INCORPORATED IN WESTERN AUSTRALIA)

Australian Company Number 009 207 803

DRAFT SURVEY REPORT AND CERTIFICATE OF WEIGHT

Vessel: MANILA TRANSPORTER No: 8304 FPUK	Date: 28/06/1 991 G.R.T.:	67,624
Owners: TRMRANS SHIPPING CORPORATION	Captain: P.L. ALAMILLO	
Port from: DAMPIER, WESTERN AUSTRALIA	Port to: PORT TALBOT	
Description of Cargo: HAMERSLEY HEMATITE FINE IRON ORE MINUS 6mm		
Berth Loaded: PARKER POINT		
Date of Initial Survey: 25/06/1991	Date of Final Survey: 13/10/90	
Consignee (s): BRITISH STEEL PLC LONDON SE1 7SN U.K.		

	<u>INITIAL SURVEY</u>	<u>FINAL SURVEY</u>
Density of seawater at the berth	1.023	1.023
Ship's draft, Fore	7.45 metres	14.79 metres
Ship's draft, Aft	7.64 "	15.38 "
Ship's draft, Port midship	7.60 "	15.08 "
Ship's draft, Starboard midship	7.55 "	15.08 "
Ship's draft, Mean of Means	7.5675 "	15.08125 "
Corresponding displacement (Corrected for density, etc.)		
	(A) 61,293 tonnes	(B) 127,030 tonnes

ESTIMATED WEIGHTS OF FUEL AND WATER

Bunkers	3,134 tonnes	3,121 tonnes
Slop tanks	nil	nil
Fresh water	117 "	500 "
Ballast	37,649 "	15 "
Stores	450	450 "

TOTAL WEIGHT	(a) 41,350 tonnes	(b) 4,086 tonnes
	(A-a)= 19,943 tonnes	(B-b)= 122,944 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) =

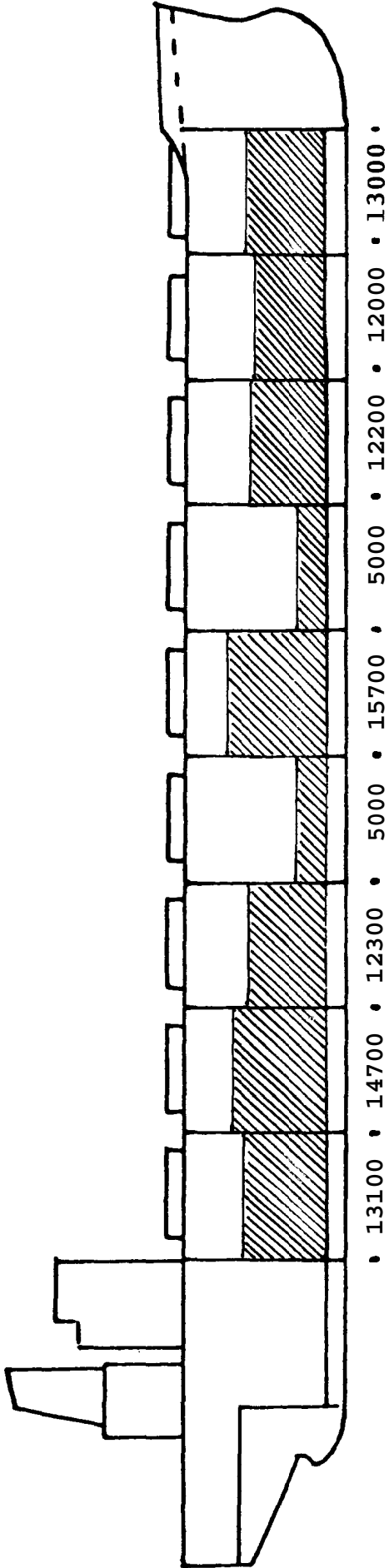
When loading: (B-b) - (A-a) = 103,001 metric tonnes = 101,374 long tons

That is:-

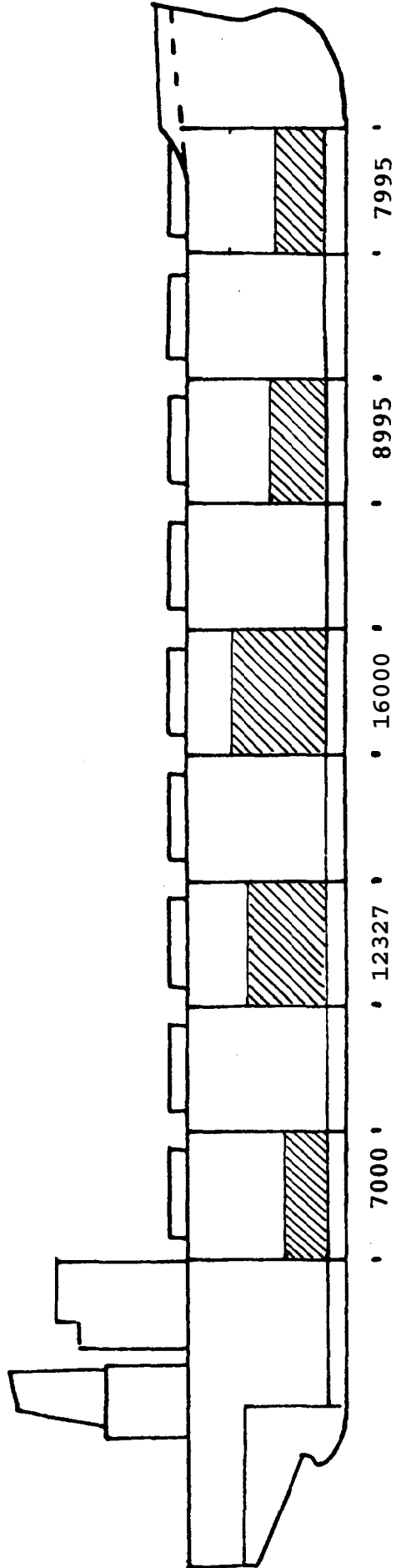
ONE HUNDRED AND THREE THOUSAND AND ONE METRIC TONNES OF FINE IRON ORE FOR BRITISH STEEL TO PORT TALBOT

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

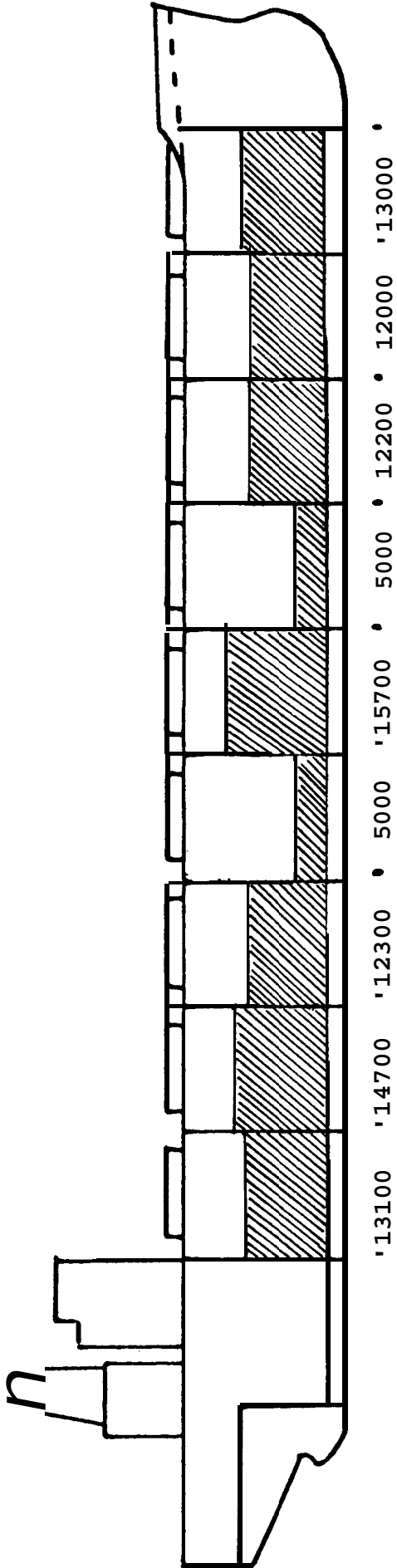
Signed: Wm. O'Brien
Surveyor



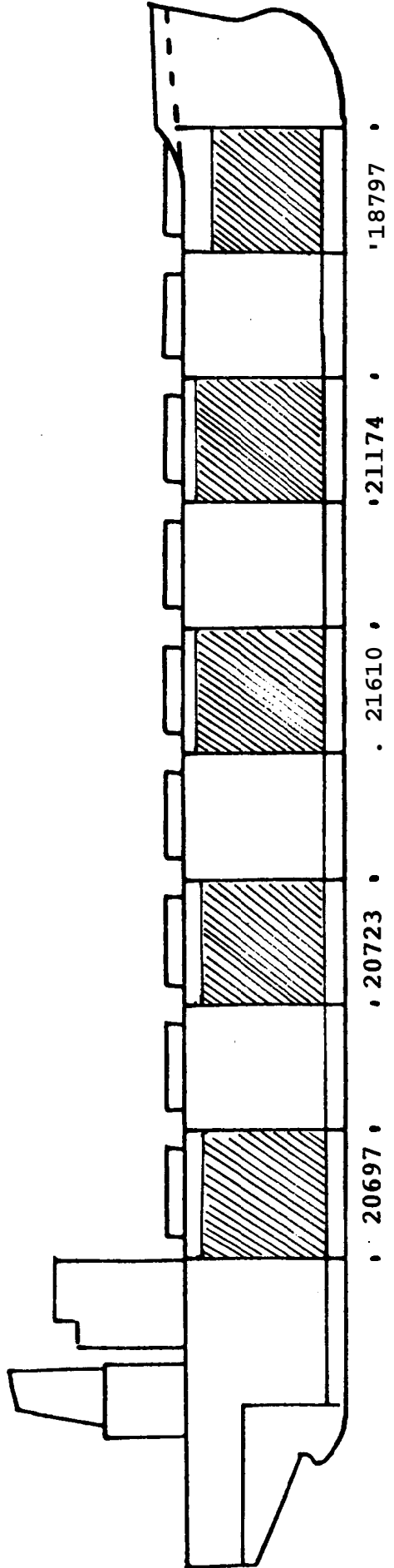
ORIGINAL LOADING PLAN



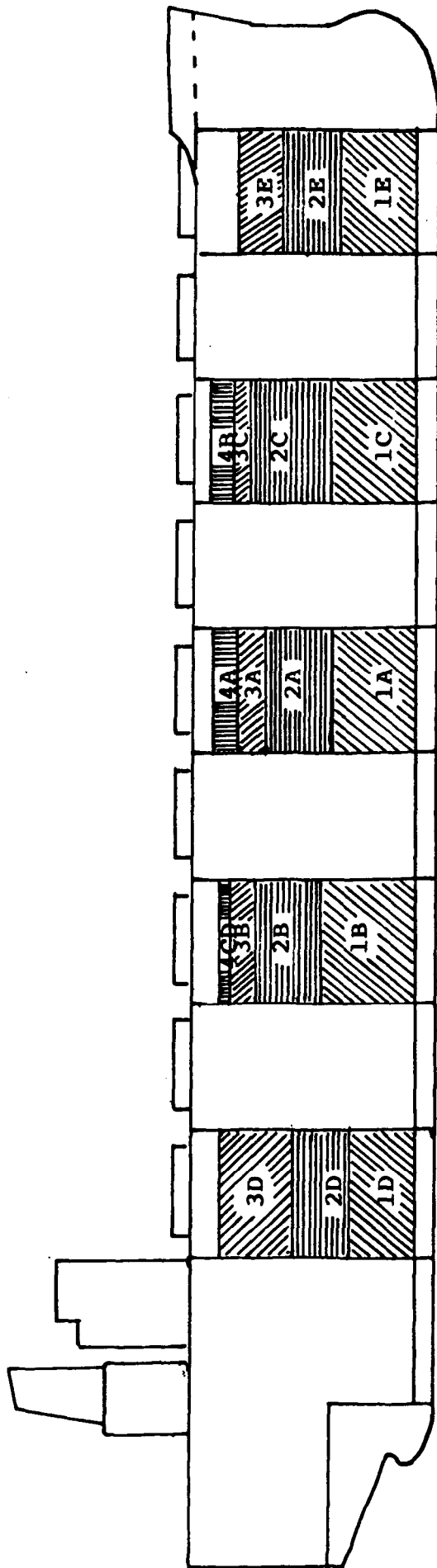
LOADING SITUATION AS AT 1415 25TH



ORIGINAL LOADING PLAN



CARGO AS LOADED



LOADING SEQUENCE

M.V. "MANILA TRANSPORTER"
VOYAGE NO. 26-D

DETAILS OF WEATHER EXPERIENCED AFTER DEPARTURE DAMPIER, AUS.

DATE	TIME	NOON POSITION	G/COURSE	BAROMETER	TEMP.	WIND		SEA		SWELL	CLOUDS	SKY	AMOUNT	STATE OF WEATHER	VISIBILITY
						DIRECTION	FORCE	DIRECTION	DESCRIPTION						
						S X W	W X S	S X W	W X S						
26/JUNE '91	2000		292°	1016	23	S X W	2	S X W	SLIGHT	LOW	Cu	8	2	8	
	2400		270°	1017	24	W X S	3	W X S	SLIGHT	LOW	Cu	8	2	7	
27/JUNE '91	0400		248°	1016	23	SW	4	SW	MOD.	MOD.	NS	8	2	8	
	0800		248°	1017	23	SW	4	SW	MOD.	MOD.	NS	8	2	8	
	1200	LAT. 20° 41' S LONG. 113° 05' E	248°	1018	21	S	6	S	ROUGH	HIGH	NS	10	60	6	
	1600		248°	1017	23	S X W	6	S X W	V. ROUGH	HIGH	NS	8	2	8	
	2000		248°	1018	21	SW	6	SW	V. ROUGH	HIGH	NS	8	2	8	
	2400		248°	1019	21	S X E	4	S X E	ROUGH	HIGH	NS	8	2	8	
28/JUNE '91	0400		248°	1019	21	SSE	6	SSE	V. ROUGH	HIGH	AS	8	2	8	
	0800		248°	1019	21	SSE	6	SSE	V. ROUGH	HIGH	AS	8	2	8	
	1200	LAT. 22° 25' S LONG. 103° 21' E	248°	1022	22	SEX E	6	SEX E	V. ROUGH	HIGH	AS	8	2	8	
	1600		248°	1021	24	S X E	6	S X E	V. ROUGH	HIGH	AS	8	2	8	
	2000		248°	1021	19	S X E	6	S X E	V. ROUGH	HIGH	AS	8	2	8	
	2400		248°	1022	18	SEX E	6	SEX E	V. ROUGH	HIGH	AS	8	2	8	
29/JUNE '91	0400		248°	1021	19	SE	6	SE	V. ROUGH	HIGH	Cu	8	2	8	
	0800		252°	1022	19	SE	6	SE	V. ROUGH	HIGH	Cu	8	2	8	
	1200	LAT. 23° 00' S LONG. 105° 15' E	252°	1022	21	E	6	E	ROUGH	HIGH	Cu	9	3	7	
	1600		252°	1020	21	SW	5	SW	ROUGH	HIGH	Cu	8	2	8	
	2000		252°	1020	21	SW	5	SW	V. ROUGH	HIGH	Cu	8	2	8	
	2400		252°	1021	19	NE	5	NE	V. ROUGH	HIGH	Cu	8	2	8	

DATE	TIME	NOON POSITION	G/COURSE			TEMP.	WIND			SWELL	CLOUDS	AMOUNT	STATE OF WEATHER	VISIBILITY
			G	COURSE	BAROMETER		DIRECTION	FORCE	DIRECTION					
30/JUNE '91	0400		252°		1020	ESE	ESE	5	ESE	V. ROUGH	CB	8	2	5
	0800		252°		1020	ESE	ESE	5	ESE	V. ROUGH	CB	8	2	5
	1200	AT. - 25°-28'S LONG. - 088°-26'E	252°		1019	N x E	N x E	5	N x E	V. ROUGH	CB	8	2	5
	1600		252°		1014	NW	NW	6	NW	V. ROUGH	CB	8	2	5
	2000		252°		1014	NW	NW	6	NW	V. ROUGH	CB	8	2	5
2400			252°		1014	W	W	6	W	V. ROUGH	NS	4	3	7
31/JULY '91	0400		257°		1014	SW x W	SW x W	7	SW x W	V. ROUGH	NS	8	2	8
	0800		260°		1017	SSW	SSW	7	SSW	V. ROUGH	NS	8	2	8
	1200		260°		1020	SW x S	SW x S	7	SW x S	V. ROUGH	NS	8	2	8
	1600	AT. - 26°-40'S LONG. - 088°-16'E	260°		1019	SW x S	SW x S	7	SW x S	V. ROUGH	NS	8	2	8
	2000		260°		1020	SW x S	SW x S	7	SW x S	V. ROUGH	NS	8	2	8
2400			260°		1020	SW	SW	7	SW	V. ROUGH	NS	8	2	8
2ND/JULY '91	0400		260°		1020	SW	SW	6	SW	V. ROUGH	CB	8	2	8
	0800		260°		1022	SW x W	SW x W	6	SW x W	V. ROUGH	CB	8	2	8
	1200	AT. - 26°-16'S LONG. - 088°-46'E	260°		1023	SW x S	SW x S	6	SW x S	V. ROUGH	CB	8	2	8
	1600		260°		1023	SSW	SSW	6	SSW	V. ROUGH	CB	8	2	8
	2000		260°		1025	S x W	S x W	6	S x W	V. ROUGH	CB	8	2	8
2400			260°		1025	S x W	S x W	6	S x W	V. ROUGH	CB	8	2	8

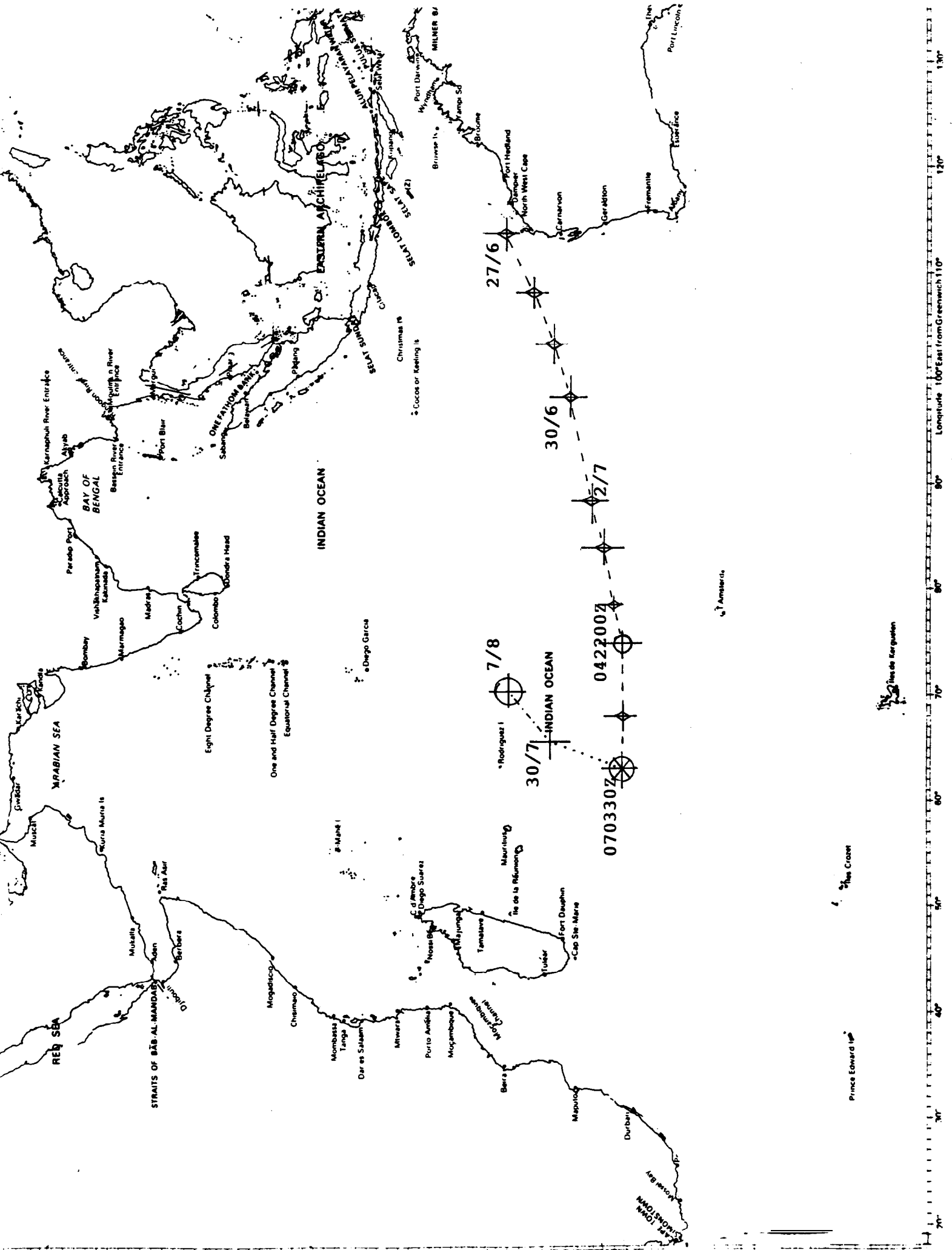
DATE	TIME	NOON POSITION	G/COURSE	BAROMETER	TEMP.	WIND			SEA			SWELL	CLOUDS	AMOUNT	STATE OF WEATHER
						DIRECTION	FORCE	DIRECTION	DESCRIPTION	DIRECTION	DESCRIPTION				
3RD / JULY 41	0400		260°	1025	15	SXE	6	SXE	V. ROUGH	HIGH	NS	7	2	8	
	0800		260°	1025	15	SXE	4	SXE	V. ROUGH	HIGH	NS	7	2	8	
	1200	LAT. -28.00'S LONG. -053.53'E	257°	1025	18	SSW	5	SSW	V. ROUGH	HIGH	NS	7	2	8	
	1600		257°	1024	18	SSE	5	SSE	V. ROUGH	HIGH	NS	8	2	8	
	2000		257°	1024	16	SSE	5	SSE	V. ROUGH	HIGH	NS	8	2	8	
	2400		257°	1024	15	WXS	4	WXS	ROUGH	HIGH	NS	8	2	8	
4TH / JULY 41	0400		257°	1024	15	WXS	4	WXS	ROUGH	HIGH	NS	7	2	7	
	0800		257°	1024	16	WXS	4	WXS	ROUGH	HIGH	NS	7	2	7	
	1200	LAT. -24.02'S LONG. -053.46'E	252°	1024	14	WXS	4	WXS	ROUGH	MOV.	NS	7	2	8	
	1600		253°	1022	18	WXS	4	WXS	ROUGH	HIGH	Ca	8	2	8	
	2000		253°	1022	16	NNW	5	NNW	ROUGH	HIGH	Ca	8	2	8	
	2400		253°	1020	8	NNW	6	NNW	ROUGH	HIGH	Ca	8	2	8	
5TH / JULY 41	0400		262°	1019	17	NWYN	6	NWYN	V. ROUGH	HIGHT	NS	7	2	7	
	0800		266°	1016	18	WNW	7	WNW	V. ROUGH	HIGHT	NS	7	2	7	
	1200	LAT. -24.58'S LONG. -073.16'E	266°	1015	14	WNW	7	WNW	V. ROUGH	HIGHT	NS	7	2	8	
	1600		270°	1013	16	SWXW	8	SWXW	V. ROUGH	HIGHT	NS	6	60	6	
	2000		270°	1016	16	SWXS	8	SWXS	V. ROUGH	HIGHT	NS	6	60	6	
	2400		270°	1014	14	SW	8	SW	V. ROUGH	HIGHT	NS	8	2	7	

DATE	TIME	NOON POSITION	G/COURSE	BAROMETER	TEMP.	WIND		SEA			SWELL	CLOUDS	SKY	AMOUNT	STATE OF WEATHER	VISIBILITY
						DIRECTION	FORCE	DIRECTION	DESCRIPTION	DESCRIPTION						
6TH / JULY '41	0400		270°	1020	14	SWXW	7	SWXW	V. ROUGH	HIGH	NS		7	2	7	
	0800		270°	1025	14	SWXS	8	SWXS	V. ROUGH	HIGH	NLS		7	2	7	
	1200	LT. - 29°-44'S LONG. - 068°-17'E	270°	1027	18	SSW	7	SSW	V. ROUGH	HIGH	NS		8	2	8	
	1600		270°	1026	16	SSW	7	SSW	V. ROUGH	HIGH	NC		8	2	8	
	2000		270°	1024	16	SWXS	8	SWXS	V. ROUGH	HIGH	WS		8	2	8	
2400		270°	1030	15	SWXS	7	SWXS	V. ROUGH	HIGH	NS		8	2	8		
7TH / JULY '41	0400		270°	1024	14	SWXS	7	SWXS	V. ROUGH	HIGH	NS		7	2	7	
	0800					SWXS	6	SWXS	ROUGH	HEAVY						

M.V. BERICA

BUMBURY - CAPE TOWN

DATE	NOON POSITION	0000--0400				0400--0800				0800--1200				1200--1600				1600--2000				2000--2400			
		BARO TEMP	WIND DIR	SEA COND.	WIND FORCE	BARO TEMP	WIND DIR	SEA COND.	WIND FORCE	BARO TEMP	WIND DIR	SEA COND.	WIND FORCE	BARO TEMP	WIND DIR	SEA COND.	WIND FORCE	BARO TEMP	WIND DIR	SEA COND.	WIND FORCE	BARO TEMP	WIND DIR	SEA COND.	WIND FORCE
26-06-91																									
27-06-91	Lat 32° 30' S Long 112° 56' E	1006.5 14°C	28 10	9		1008 13°C	26 10	9		1010 19°C	29 6/7	6		1006.5 17°C	29 8	6		1004.5 17°C	28 9	7		1003.5 16°C	28 9/10	8	
28-06-91	Lat 31° 47' S Long 109° 06' E	1017.5 14°C	24 8	7		1018.5 15°C	24 8	7		1022 16°C	21 7	6		1021.5 17°C	27 7	6		1023 16°C	22 6	6		1023 15°C	30 4	6	
29-06-91	Lat 30° 40' S Long 103° 24' E	1022 15°C	29 4	3		1023 15°C	26 5	4		1022.5 18°C	28 5	5		1021 18°C	28 5	5		1022.5 17°C	30 4	3		1020 17°C	03 4	3	
30-06-91	Lat 29° 58' S Long 097° 44' E	1018 16°C	03 4	3		1018 16°C	32 4	3		1014.5 18°C	33 6	5		1010.5 19°C	33 7	5		1008.5 16°C	26 9	6		1009 16°C	27 8	8	
01-07-91	Lat 29° 59' S Long 093° 07' E	1011 14°C	25 9	8		1013.5 15°C	23 9	8		1016.5 16°C	22 8	7		1015.5 16°C	26 8	7		1017 16°C	27 8	7		1017 15°C	26 7	7	
02-07-91	Lat 30° 00' S Long 088° 57' E	1016.5 15°C	26 8	7		1019 17°C	25 8	7		1020.5 16°C	23 8	8		1021 16°C	23 8	8		1023 16°C	23 8	8		1023.5 14°C	23 7	7	
03-07-91	Lat 29° 58' S Long 084° 12' E	1023 14°C	26 5	5		1024.5 16°C	27 5	4		1023 15°C	25 6	6		1022.5 16°C	25 6	6		1024 16°C	32 4	4		1022.5 15°C	28 4	4	
04-07-91	Lat 30° 01' S Long 078° 48' E	1021.5 15°C	28 4	3		1021.5 17°C	27 4	3		1022 17°C	29 6	5		1020 17°C	29 6	5		1019.5 18°C	30 6	5		1018 19°C	34 7	6	
05-07-91	Lat 29° 59' S Long 073° 02' E	1015.5 17°C	34 7	6		1014.5 18°C	33 7	6		1012.5 19°C	31 7	6		1011.5 15°C	27 8	6		1015 15°C	25 9	7		1018 15°C	24 8	8	
06-07-91	Lat 29° 59' S Long 068° 25' E	1019 14°C	24 8	8		1023.5 15°C	25 8	8		1025.5 15°C	18 8	8		1025 15°C	18 8	8		1027.5 15°C	23 7	6		1024.5 15°C	21 8	7	
07-07-91	Lat 29° 41' S Long 064° 16' E	1028 15°C	21 8	7		1029 15°C	23 6	5		1029.5 17°C	22 5	4		1027.5 17°C	24 5	4		1027.5 16°C	24 5	4		1027 16°C	32 4	4	





INSPECTORATE GRIFFITH INTERNATIONAL

CERTIFICATE

OF

A N A L Y S I S

COMMODITY : HAMERSLY IRON ORE FINES
SAMPLE DATE : RECEIVED 17TH MAY, 1991

THIS IS TO CERTIFY:-

At the request of the Department of Transport and Communications, Griffith W.A. Services did carry out Analysis and arrange confirmation testing on an Iron Ore Fines sample received on the 17th may, 1991.

NATURE OF SAMPLE AND MOISTURE CONTENT

The particle size and nature of this sample indicated a constant moisture of 4.3%, however it was not possible to obtain a constant flow moisture point.

TRANSPORTABLE MOISTURE LIMIT:-

The method for TML in accordance with code of Safe Practice for Solid Bulk Cargoes produced the flow moisture point on the flow table to be indeterminate. This may be due to the material not having a flow moisture point as defined in the code. If the material does possess a flow moisture point our tests revealed that the TML would be between 6.8% and 8.6%.

Ref: 91/A-24/5
29th May, 1991.



For and on behalf of
GRIFFITH W.A. SERVICES
P.O. BOX 2220
GERALDTON, 6530
WESTERN AUSTRALIA
Telephone (099) 21 2472
Telex: 198805 GRYFYD
FAX: (099) 214452