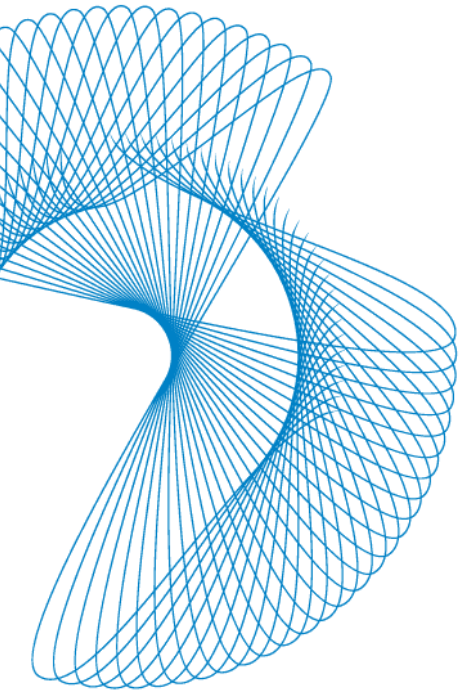
MARITIME NEW ZEALAND



Accident Report

Flooding

San Rakino

3 October 2005

Class A

Photograph 1
San Rakino

REPORT NO.: 05 3855

VESSEL NAME: *SAN RAKINO*

Ship Type:	Fishing vessel
Certified Operating Limit:	Offshore
Port of Registry:	Auckland
Flag:	New Zealand
MSA No.:	101314
Built:	1977
Construction Material:	Steel
Length Overall (m):	29.26
Maximum Breadth:	8.07
Gross Tonnage:	227
Net Tonnage:	68
Registered Owner:	Sanford Limited
SSM Company:	SGS-M&I
Accident Investigator:	Ian Howden

SUMMARY

San Rakino was a fishing vessel that suffered hull shell plate failure while engaged in fishing operations off the Kaipara Harbour on the west coast of Northland. The vessel was able to make Ahipara where divers were able to carry out temporary repairs. The vessel then rounded North Cape to Auckland where she was dry docked for repairs.

Maritime New Zealand commenced an investigation after the vessel returned to Auckland.

Vessel and survey company documentation and records were examined.

The Skipper and management of the vessel were interviewed.

Sections of the failed shell plate were obtained for metallurgical testing. Photographs were taken. A sample of water and sediment from a flooded void was also taken for testing.

Maritime New Zealand commissioned metallurgic testing to be carried out on sections of plate that had failed and conducted an analysis of the water and sediment sample that was taken from a flooded void space. The findings of that report should be read in conjunction with this document. In this report the metallurgical report is referred as the Metal Test Report (*See Appendix 1 – Metal Test Report*).

The cause of plate failure was found to be internal corrosion.

This report examines the cause of corrosion and makes recommendations to industry to prevent similar accidents occurring in the future.

NARRATIVE

At 0710 hours New Zealand Standard Time (NZST) on 1 October 2005, the fishing vessels ***San Rakino*** and ***San Hauraki*** departed Onehunga in the Manukau Harbour. Both vessels pair trawled north from the Manukau Heads towards the Kaipara Harbour on the west coast of the North Island of New Zealand. A MetService forecast of 35 knots from the south west was forecast for the following day. Both vessels anchored south of the entrance to the Kaipara Harbour for the night.

At 0600 hours New Zealand Daylight Time (NZDT) on 2 October, the two vessels commenced pair trawling. At 0930 hours, with increasing winds from the south west, the two vessels hauled their nets and dodged towards the Manukau Heads.

On 3 October, both vessels were south of the entrance to the Kaipara Harbour. At 1200 hours, with bad weather forecast, the two vessels decided to round North Cape for the east coast.

Shortly after, at 1300 hours, the water level alarm in one of the fish room bilge sumps on ***San Rakino*** sounded. The crew inspected the fish room but were unable to find the source of water ingress. As the two vessels headed north, the sump alarm in the fish room sounded a number of times and bilge pumps were switched on in an attempt to control the ingress of water.

This contained the water within the two sumps in the fish room that had a common bilge system.

At approximately 1500 hours, a crewman observed water 'squirting' through the fibreglass coating on the fish room floor near an inspection plate for the shaft tunnel. The Skipper called the ship's owner and in consultation with the Fleet Operations Manager, a decision was made to head for Ahipara, with ***San Hauraki*** in attendance, to enable divers to inspect the hull.

At 2025 hours, the owners called the Rescue Co-ordination Centre New Zealand (RCCNZ) advising them of the situation.

Whilst north bound to Ahipara, the fish room was inspected every 30 minutes. ***San Rakino*** and ***San Hauraki*** encountered winds from the south west of 35 knots and 3.5 metre seas. The free surface effect of sea water in the void spaces of ***San Rakino*** caused sections of the fish room floor to flex as the vessel rolled.

Where sections of the fibreglass outer layer on the fish room floor were compromised, the pressure continued to squirt sea water into the fish room. This water then drained into the fish room bilge sumps. The continued operation of the pumps were able to prevent sea water from accumulating in the fish room.

On 4 October, at approximately 0300 hours, both vessels dropped anchor off Ahipara.

At 0700 hours, divers and the Fleet Manager arrived on board. Divers subsequently reported a hole in the hull plating on the port side close to the keel plate. A plywood patch and rubber seal, measuring approximately one metre square, was placed over the hole and attached with self tapping screws *(See Figure 1 – Vessel Profile & Photograph 8)*.

With a forecast of strong winds backing to the northwest, a decision was made to depart Ahipara for Auckland via North Cape. Three spare pumps were airlifted on board. At 1420 hours, both vessels weighed anchor. Some water ingress was detected through the breached hull but, as before, this was held in check by the vessel's pumps. Throughout the voyage from Ahipara, 30 minute inspections were made of the fish room and a two hour radio schedule was maintained with RCCNZ.

After an uneventful trip, ***San Rakino*** arrived in Auckland at 0730 hours on 5 October and was slipped for repairs.

Vessel

San Rakino is owned and operated by Sanford Ltd. The vessel is a 29.26 metre steel hard chine trawler, built in Japan in 1977. She has a beam of 8.07 metres and a draft of 3.2 metres. Her gross tonnage is 223.73 and her registered tonnage is 81.09 tonnes. The main engine is a six cylinder Daihatsu diesel developing 559 kW. There are two auxiliary Yanmar 3 KDL 38 kW diesel engines both driving 60 kVA alternators. Fuel capacity is 84 000 litres.

The carrying capacity of fish and ice is stated in some documentation at 100 tonnes although the vessel's stability handbook gives loading restrictions of 120 tonnes of fish/ice in the hold and allows 4.5 tonnes on the deck. The stability book states the fish room capacity is approximately 202 square metres.

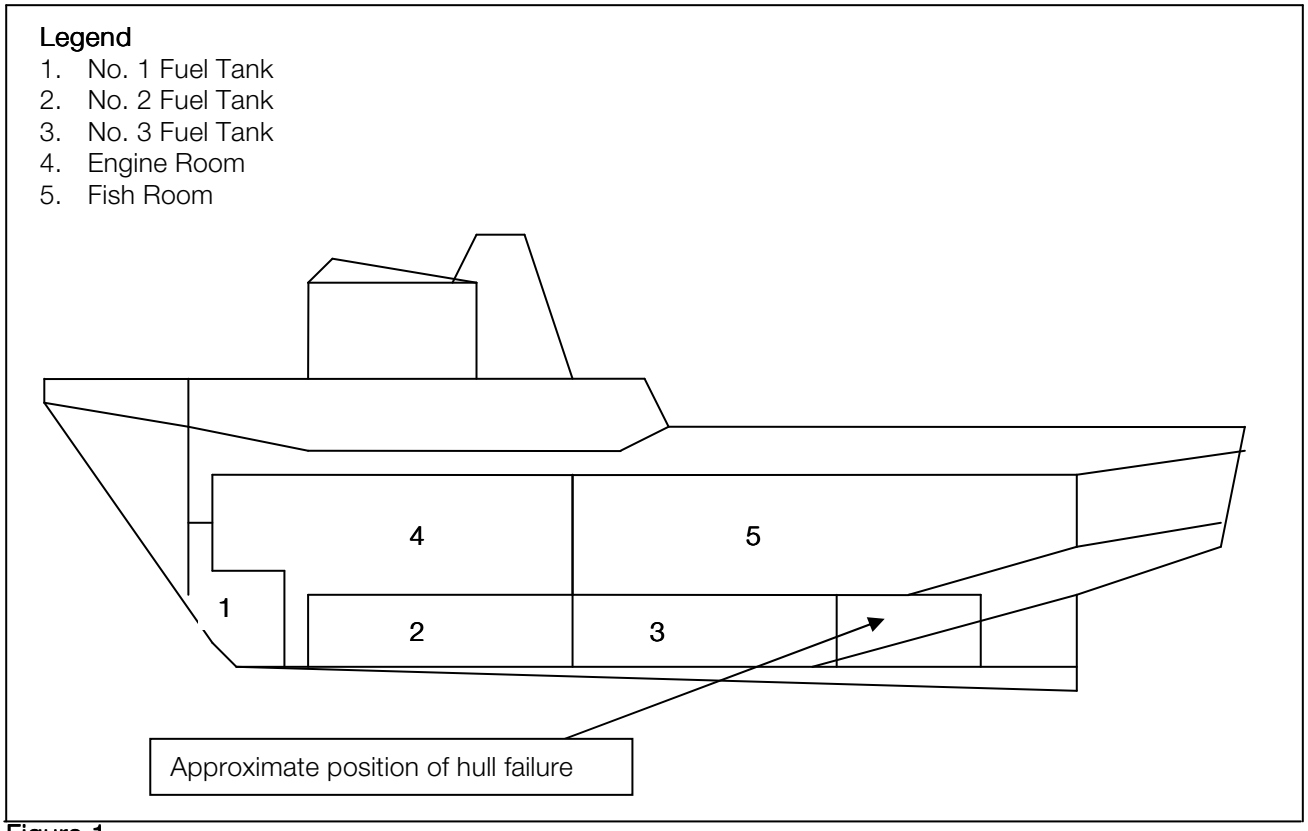


Figure 1
San Rakino Vessel Profile

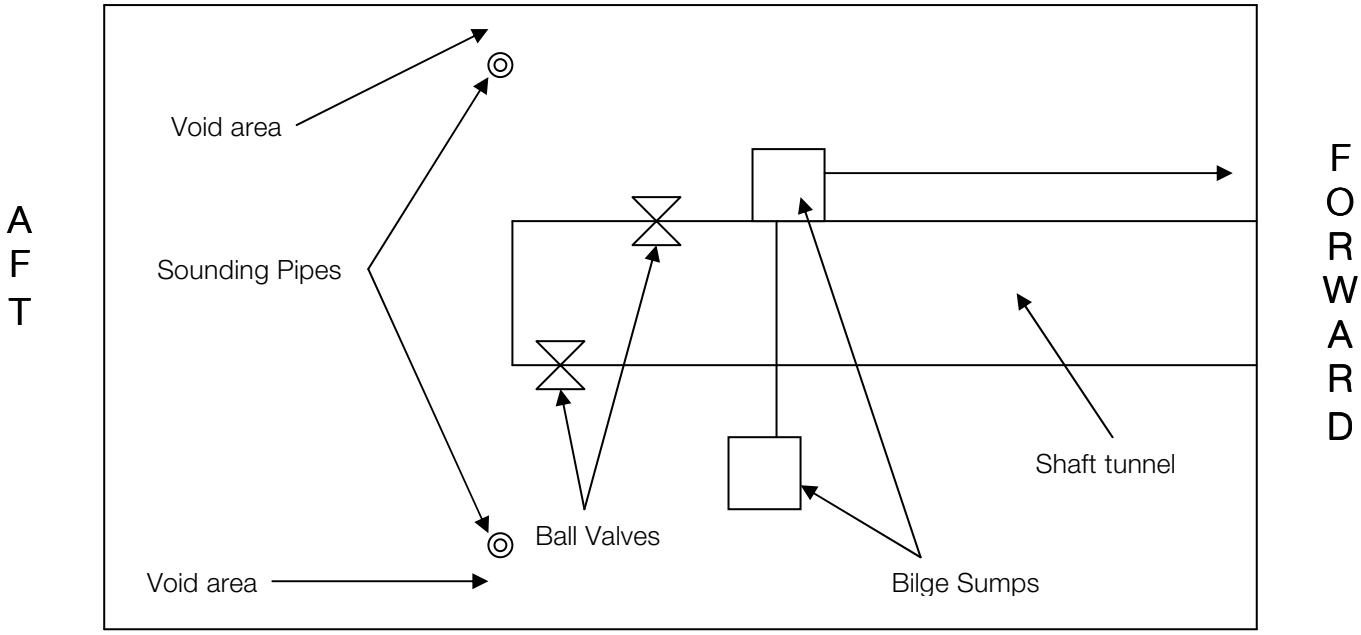


Figure 2
Vessel Fish Room Piping Arrangements

Safety Equipment

- Distress Signals
- Parachute Flares x 6
- Buoyant Smoke Floats x 2

Life Saving

- Life rafts x 2
- Life Buoys x 4
- Life Jackets x 8
- Rescue Boat x 1

Pumps

San Rakino had a 3.5kW and a 7.5kW engine room pump draining the port fish room bilge sump. Both bilge sumps in the fish room were common with a 10 cm balance pipe running between the two. In addition, an electric pump on an automatic level switch operated from the port bilge sump. A submersible electric pump, that drained on to the deck, was also fitted on the vessel.

Photograph 2
Port Bilge Sump

Photograph 3
Starboard Bilge Sump

Crewing

Four crewmen including the Skipper were on board the vessel at the time of the accident. The Skipper is a highly experienced fisherman. He holds a Deep Sea Mate's and Marine Engineer 6 Certificates of Competency obtained in January 1992. He has been Skipper of ***San Rakino*** for 12 years and has worked for Sanford Ltd for a total of 28 years. Crew certification was compliant for the size of vessel and area of operation.

History

San Rakino is one of four Japanese-built sister ships built to Lloyd's specification in Japan between 1977 and 1978 and purchased by Sanford Ltd. In addition to ***San Rakino*** two of these vessels, namely ***San Hauraki*** and ***Albert Sanford*** continue to be owned and operated by Sanford Ltd.

San Rakino and ***Albert Sanford*** were the first of the four vessels to be delivered to New Zealand. Both were constructed in Shimonoseki in winter and suffered a degree of corrosion to the hull plating and other sections during construction. Because of this, and prior to ordering ***San Manukau*** and ***San Hauraki***, Sanford Ltd specified that these vessels were to be covered during construction to minimise corrosion. The internal sections of hull including the void areas under the fish room were painted with shop primer on all four vessels.

San Manukau capsized in January 1996 caused by loss of stability due to flooding of the fish hold via the vessel's bilge pumping system. One crewman was lost. The vessel was sold by Sanfords and is now operating out of New Zealand.

The Transport Accident Investigation Commission (TAIC) and the then Maritime Safety Authority investigated the accident and promulgated a number of recommendations. One of these was to:

> *"Install a sounding pipe for the void space on the sister vessels to* ***San Manukau*** *and some means for pumping this space when it becomes flooded"*

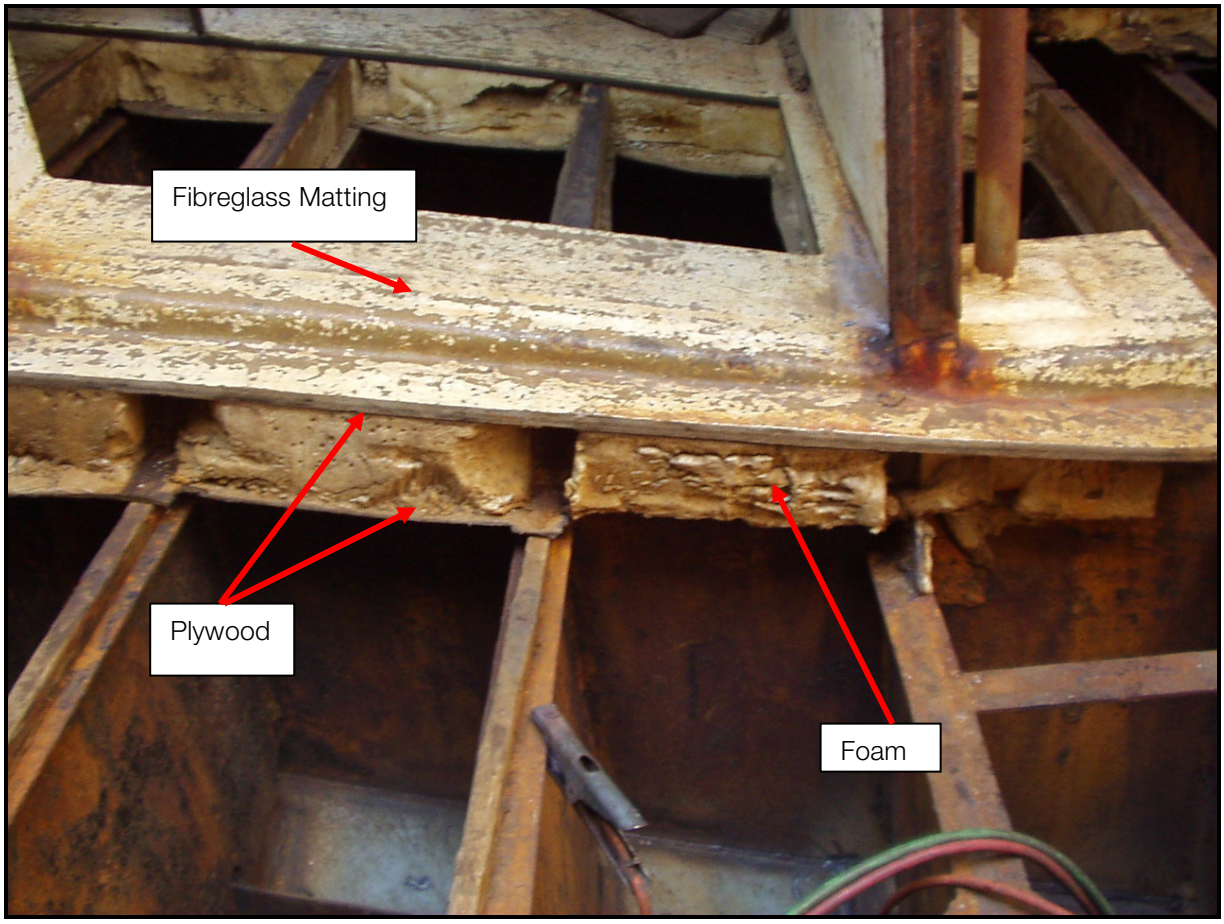
Sanfords reply was:

> *"A method for pumping out the void space when it becomes flooded on the sister vessels to the* ***San Manukau*** *has already been installed. Sounding pipes will be installed by the end of August 1996"*

Fish Hold

San Rakino's fish hold is lined with foam insulation material. The floor section is made up of a 'sandwich' consisting of 2.54 cm and 0.63 cm plywood at the top and bottom respectively, which are separated by 17 cm of foam. The sandwich rests on bottom longitudinals and transverse void frames. A fibreglass matting lies on top of the top layer of plywood *(See Photograph 4 - Showing cut away section of fish room floor)*.

The aft section of the fish room floor has void ***spaces*** that are filled with concrete.



Photograph 4
Showing cut away section of fish room floor

Condition of Void Spaces

After arriving in Auckland, sections of the fish room floor were cut away to allow for repairs and maintenance. In the void spaces that were accessible, extensive corrosion was observed on both longitudinal and transverse frames. In many cases, limber holes leading from one void space to another, that should have enabled water to reach areas where water could be pumped, were found to be blocked with rust sediment.

The galvanised sounding pipe in the void space in which the hull plating failed, had completely corroded away due to galvanic corrosion *(See Photograph 5)*. This pipe and another leading to another void space on the starboard side of the fish room was installed after ***San Manukau*** capsized. There was no evidence of a striker plate being fitted against the hull under the sounding pipes although the section of hull that failed was not directly beneath the pipe aperture. In all other void spaces that were inspected, heavy rusting was found on the transverse and longitudinal frames *(See Photograph 5)*.

The void space on the starboard side of the fish room, adjacent to the section of hull plating that failed, was full of rust coloured water. When sounded, it was found to have thick rust sediment measuring approximately 200 mm in depth in the lowest point of the void. Analysis of water from the flooded void established it was at least 90% seawater and had an acidic level of 5.71 pH. This made it highly corrosive *(See Photograph 6)*.

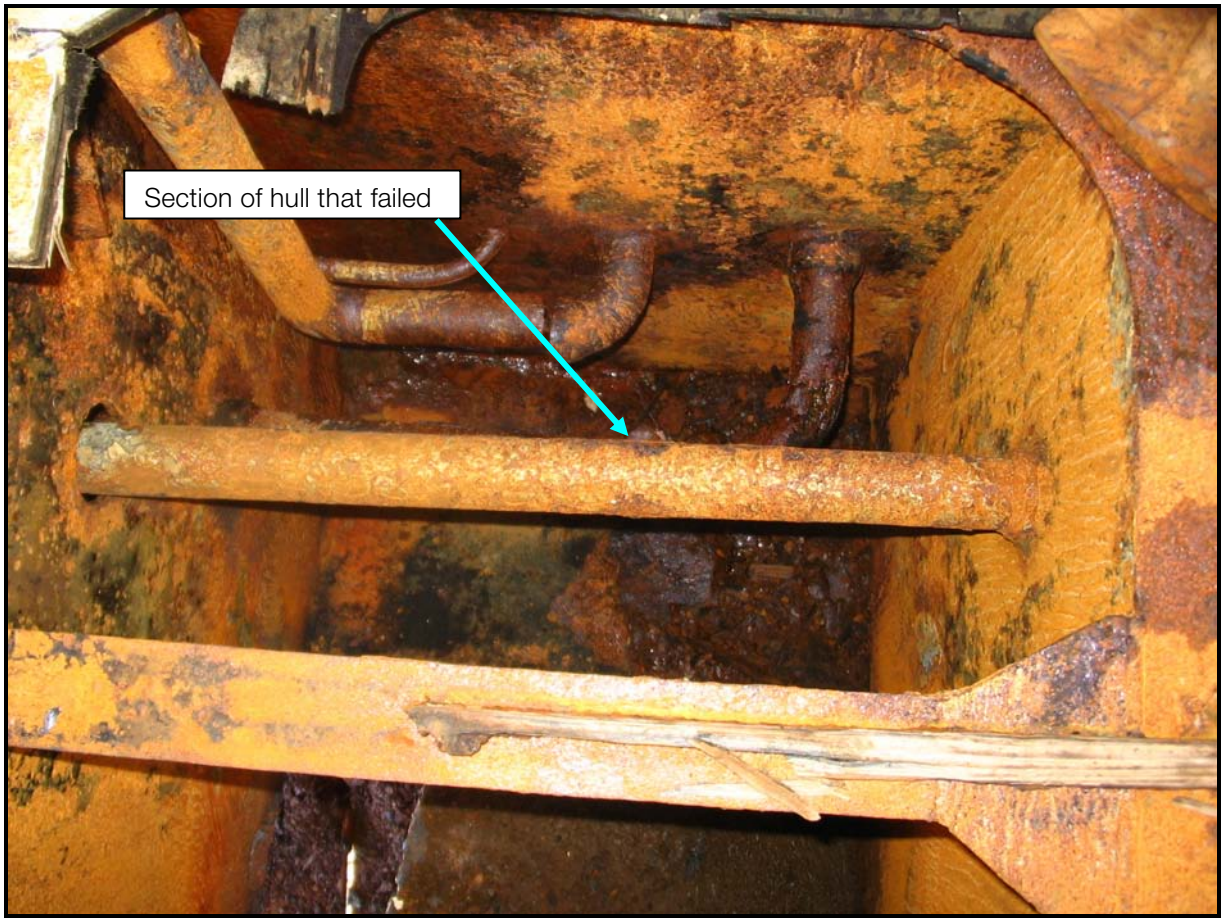
In the void space in which the hull plating failed, loose coat rusting was evident. A steel fore and aft stringer located higher up on the hull did not have a limber hole to allow water to drain clear *(See Photograph 7)*.

The two void spaces with sounding pipes could be drained with valves accessed from the shaft tunnel in the fish room floor.

Photograph 5

Photograph 6

Photograph 7



Photograph 8

Hull Plating

The section of plating that failed was situated close to the keel and located between frames 13 and 14. It was constructed of 8mm plate. The hole measured approximately 8 cm in width and was roughly circular in shape. *(See Appendix 1 - Photographs on page 2 of 9 – Metal Test Report)*. The immediate area around the hole was a substantial corrosion cell with thickness measurements as low as 2 to 3 mm, a diminution of plate thickness of up to 75%.

Metal Test Report

The Metal Test report stated the steel in the failed section of hull plate was of poor quality with linear and slag inclusions present. The comment was made that there was no evidence that this had played any significant part in causing corrosion in the badly corroded areas. The report contains detailed analysis of the samples provided by Maritime New Zealand. Photographs of holed sections of hull are included together with informative data including excerpts of publications on aqueous corrosion and micro biological corrosion. Of interest in terms of ultrasonic readings is the opinion that metallic defects (inclusions) and laminar problems due to bad quality steel would nullify attempts to accurately measure plate thickness.

The main findings of the report were as follows:

Hull plate failure was due to internal corrosion probably over several years.

Metallic defect and laminar problems compromised accurate measurement of plate thickness.

Defects in the steel did not play a significant role in the corrosion process.

The amount of corrosion damage is not clear.

Micro biologically induced corrosion may have been a factor.

The report recommends surveys be carried out on sister ships

Appendix A	*Ultrasonic Inspection reading taken after the vessel was slipped and photographs of damaged sections of hull.*
Appendix B	*Results from Scanning Electron Microscopy.*
Appendix C	*Water sample analysis.*
Appendix D	*Photographs.*
Appendix E	*Case study on corrosion mechanisms.*
Appendix F	*Excerpt Metals Handbook – Aqueous corrosion.*
Appendix G	*Excerpt Metals Handbook – Corrosion Fundamentals, Testing & Protection*

Ultra sonic hull inspections

Evidence

The Skipper

The Master considered ***San Rakino*** to be an excellent vessel with good sea handling capabilities. He believed that even had the fish room floor given way, the pumps on board would have been able to contain any water ingress. He was unaware as to the existence of the sounding pipes in the two voids and had not considered the possibility of flooding or internal corrosion within the void spaces. He stated that the void spaces were completely sealed and he believed there was no provision for drainage or pumping.

His involvement in survey matters was limited and he placed reliance on management to ensure surveys were carried out in accordance with Safe Ship Management (SSM) requirements.

He voiced concern the vessel had reached the state it was in and commented on a scenario where the vessel could have touched bottom whilst crossing the Manukau Bar leading to serious consequences if a substantial section of the hull was to fail.

The Operations Manager

The Manager stated that after he boarded ***San Rakino*** at Ahipara, he observed the fish room floor was flexing over a distance of approximately 30cm from free surface effect in the flooded void spaces. After the plywood patch with a rubber seal was bolted in position, the amount of flexing reduced markedly. An experienced engineer had been transferred to ***San Rakino*** from ***San Hauraki*** prior to his arrival.

Throughout the trip to Auckland, contact was maintained with RCCNZ. Additional pumps were placed on board by a helicopter. A naval architect was consulted a number of times on stability issues before the decision was made to depart Ahipara. Nets were dropped in the fish room to reduce GM (Metacentric Height) and the fish room was divided up using all the wood on board to limit free surface

effect in the event of the fish room flooding. The Operations Manager estimated that if the floor gave way he would have had 2.54 cm of freeboard.

He believed that had the fish room floor broken loose en route to Ahipara the ship's pumps may not have been able to prevent to fish room flooding and the vessel could have capsized.

He stated considerable reliance was placed on the ultra sound testing carried out in 2002 to establish hull thickness (*See Appendix 2 - Diagrams*). He further stated that shore staff religiously drained voids during periodic inspections.

Maritime Rules

San Rakino falls within the class of vessel as defined in **section 2 of Maritime Rule Part 21**. Section 2 and Appendix 6, 10 thereto outline the obligations of Safe Ship Management companies and owners of such vessels in terms of entry and conditions to be met to enable vessels to remain in the Safe Ship Management System. Among other matters this includes requirement and guidelines for the maintenance of ships and equipment:

21.13 Entry to and Conditions to be met in Order for Ship to Remain in Safe Ship Management System

(1) The owner of a ship to which this section applies must ensure that—

(a) the ship belongs to an organisation's approved safe ship management system; and

(10) The organisation must carry out inspections of each ship from time to time to ensure that the ship and its equipment are being maintained in accordance with the approved maintenance plan and remain fit for their intended purpose. These inspections are to include the inspections required by **Rule 46.17**, and such inspections are to be independent of any audit required by **Rule 21.13(8).**

Part 21 Safe Ship Management Systems

(5) The owner of a ship to which this section applies must ensure that the ship has a maintenance plan—

(a) which includes any inspection and test requirements of **Rule Part 46**; and

(b) approved by the organisation if the ship enters and remains in an approved safe ship management system operated by an organisation which is not the owner of the ship.

Appendix 6
New Zealand Safe Ship Management Code

10 Maintenance of the Ship and its Equipment

10.1 The owner should establish procedures to ensure that the ship is maintained in conformity with the provisions of relevant mandatory rules and regulations and with any additional requirements established by the owner.

10.2 In meeting these requirements the owner should ensure that:

.1 inspections are held at appropriate intervals;

.2 any non-conformity is reported with its possible cause, if known;

.3 appropriate corrective action is taken;

Rule 46 Surveys, Certification and Maintenance

Rule 46.17 Inspections

(1) The owner of a ship to which this section applies must ensure the organization within whose approved safe ship management system the ship operates —

(a) inspects the hull and external fittings below the waterline with the ship out of the water at intervals not exceeding 2 years. The period between such inspections may be extended for ships of 24 metres or more in length having steel or aluminium alloy hulls, at the discretion of the organisation managing the approved safe ship management system to which the ship belongs, provided at least 2 such inspections are carried out in any 5 year period and there is not more than 3 years between any 2 such inspections; and

(b) inspects the propeller shafts and rudder stocks with water lubricated bearings at intervals not exceeding 4 years. Other propeller shafts and rudder stocks may be inspected at intervals not exceeding 5 years; and

(c) inspects and tests the ship's equipment that is required by the maritime rules in accordance with applicable maritime rules.

(2) An organisation may extend the period between inspections specified in rules 46.17(1)(a) and 46.17(1)(b) by not more than one month for a ship that belongs to its approved safe ship management system where there is good reason for doing so.

46.18 Maintenance

(1) The owner of a ship to which this rule applies must ensure that the maintenance plan required by **Rule 21.13(5)** —

(a) is for a period of —

(i) 4 years in the case of a ship having propeller shafts which have water lubricated bearings; or

(ii) 5 years in any other case; and

(b) details —

(i) the inspections required by **Rule 46.17**; and

(ii) any preventative maintenance to be performed within the period to which the plan applies; and

(c) is consistent with the requirements of the maritime rules.

SSM Documentation

San Rakino's SSM manual required the vessel to have a documented four year maintenance programme in place. The programme was required to address all aspects of the ship as required by legislation, regulation or good seagoing practise *(See Appendix 3 – Extract from SSM manual – Ships Operation).*

4.0 Preventive Maintenance Schedule

4.3 Annual Programme

- *Internal hull inspections by SGS M&I inspectors.*

4.4 Four Year Programme

4.4.3 Year Three

Thoroughly inspect steel structure and any timber work in and around the engine room and midship space. Treat any corrosion and dry out wet spots and restore (See Appendix 4 – Extract from SSM Manual – Four Year Programme).

5.5 Structural Breach or Collision

5.5.2 Damage below the Waterline.

This required the Skipper to ascertain the extent of damage, advise shore base and proceed to the nearest port for repair (See Appendix 5 – Extract from SSM Manual – Structural Breach or Collision).

Among other requirements to:

- *Ascertain extent of damage and if possible effect temporary repair and stabilise vessel*
- *Radio shore base and advise situation, position, action being taken and any assistance required.*
- *If vessel can be stabilised proceed to nearest port for repair.*
- *Monitor situation constantly and keep shore base advised of situation and vessel position at regular intervals*

Survey Documentation/History

After the capsize of ***San Manukau*** the recommendations of the TAIC report were accepted in relation to ***San Rakino*** by the installation of galvanised sounding pipes in the void spaces on both sides of the fish room.

In 1996, the void spaces under the fish room floor were inspected. The surveyor commented that the hull below the fish room was damp and had some corrosion but no severe wastage and that the areas needed to be cleaned out and coated. This work was cited as being carried out on the Hull, Decks and Deckhouses check list dated 1 April 1996 *(See Appendix 6 - Surveyor's Report April 1996).*

Subsequent SSM survey data prior to 2002 referred to internal hull inspections being carried out "*where accessible". Phrases of "not tested" or "where visible"* were used in other inspections *(See Appendix 7 – Example of Survey Documentation)*.

In March 2002, an ultra sonic inspection was carried out on the hull plating. Readings on the port hull plating below the waterline were satisfactory insofar as no plate thickness reductions were found of less than 7.8mm. Sections of the starboard hull plating were found to be compromised with two small isolated holes. These two sections of hull were replaced. Sections of fish room floor in the aft section of the fish room directly above the repair areas were cut out for access and replaced. With the exception of this work the last visual inspection of the void spaces was in 1996.

In May 2002 the surveyor recommended the *"Fish room insulation to be stripped out of fish room for next survey for hull internal examination".*

When spoken to, the surveyor who did the May 2002 survey stated he intended this to take place in two years time. When interviewed, the Vessel Manager stated he understood this was due in March 2006 *(See Appendix 8 - Surveyor's Report 2002).*

A subsequent SSM document in March 2005 again referred to hull inspection *"where accessible" (See Appendix 9 –Surveyor's Report March 2005).*

Chronology of Survey History over 1996 – 2006

01/04/1996	*"Panels cut out of fishroom insulation to view hull below, port aft and starboard forward. Two existing plugs removed to view void spaces, cofferdams. Hull below fishroom is damp and has some corrosion but no severe wastage. Areas cleaned out and coated"* Hull Thickness –"✔" - surveyor.
16/05/1997	Hull exterior *"Survey afloat- In order where visible.* Hull interior "✔" surveyor. *"Fishroom bilges pumped"* surveyor
26/03/1998	Hull interior Hull thickness "✔*not tested"* Hull external & internal Corrosion "✔" surveyor
13/01/1999	Hull external corrosion (not ticked) Hull internal corrosion "✔"
23/03/1999	Survey of chain lockers and cables.
14/01/2000	Hull external corrosion "✔" Hull internal corrosion (not ticked)
11/04/2000	Hull exterior – hull thickness *"good"* Hull interior – not checked.
13/04/2000	Docking inspection
21/12/2000	Hull external corrosion (not ticked) Hull internal corrosion "✔"
11/12/2001	Hull external corrosion "✔" Hull internal corrosion "✔" *"Fishroom insulation to be stripped out of fishroom for next survey for hull internal examination"* surveyor.
03/04/2002	*"inspection of hull external and internal (where accessible)"* SSM Company
19/12/2002	*"inspected internal where accessible"* SSM company
18/12/2003	Audit and inspection of safety equipment and SSM system only.
27/02/2004	Hull inspection above waterline, random test – *"no hammer test …. Structurally ok".* Hull inspection below waterline – *"underwater in great shape"*
17/03/2005	*"Inspection of hull where accessible"*

The surveyor who conducted the 17 March 2005 in water audit commented that the statement on the inspection report of hull inspection "where accessible' was erroneous and that this was a standard statement item from a generic document maintained by the survey company. Hull inspections were not conducted during an audit. He had made arrangements for the GRP cladding (on the fish room floor) to be removed at the next four yearly survey due in March 2006.

Stability

San Rakino had a stability handbook on board in accordance with SSM requirements. Company skippers, including the Skipper of *San Rakino*, had attended a meeting in October 1996 in which the company's naval architect gave an address on basic principles of stability. This was after the loss of the *San Manukau.*

When advised of the accident the Operations Manager consulted a naval architect as recommended on page 1 of the stability handbook *(See Appendix 10 - Stability Handbook)*.

Action Taken

The company has taken the following measures:

- A larger capacity electrical pump with a cutter head has been installed in the fish room bilge sump.
- A more sensitive probe system has been installed on a PLC (programmed logic device) to measure how much water is in the sump on a percentage basis and how often it is pumped out.
- A water level sensor has been installed in a void space.
- A pumping system has been installed into the port void space by teeing into the existing port sump suction pipe and installing a ball valve in the line to prevent any back flow from the bilge sump.
- A balance pipe has been installed to enable the starboard void space to drain into the port void space.
- Interior sections of the hull and frames have been painted with Altex Ballast Tank system in sections where the fish room floor has been removed.
- An inspection procedure has been initiated to remove sections of the fish room every survey to inspect the void space and take ultra sound measurements of the hull.
- Sections of hull as shown in the Metallurgy report have been cut out and replaced.

COMMENT & ANALYSIS

Had the insulation floor failed and broken loose prior to ***San Rakino*** reaching Ahipara, it is possible that the vessel's pumps would not have been able to hold the water in check. The Investigator considers that free surface effect in the fish hold may have caused the vessel to capsize.

Remaining at Ahipara or attempting to cross the Manukau Bar was not an option given the forecast strong northwest conditions.

The company took all reasonable steps to make ***San Rakino*** as seaworthy as possible and sought professional advice before her departure from Ahipara.

Operators and surveyors who fail to inspect void areas over extended periods place the safety of vessels and crew at risk. The inspection regime was inadequate insofar as substantial sections of the hull were last internally conducted in April 1996.

It is clear that the sounding pipes were seldom if ever used by crew to determine if the voids were flooded and the Skipper on the voyage in question was not even aware of their existence or the two drain valves, notwithstanding that the pipes were clearly visible from within the fish room.

Both void spaces were capable of being sounded despite the destruction below the fishroom floor of the lower section of the pipes through corrosion. Only two void spaces could be sounded. The other void spaces were completely sealed with the exception of limber holes, many of which were blocked. It is possible some flow of water may have been possible over the top of the frames below the fish room floor.

Sealed areas in steel vessels are highly susceptible to rust. This is due to the lack of ventilation allowing such areas to remain moist. Changing temperatures with resultant build up and reduction in moisture levels are commonly associated with vessels with refrigeration systems. Heavy corrosion can be expected in void spaces adjacent to refrigerated sections.

The high acidic pH level found in the flooded starboard void space was highly corrosive. This suggests that despite the Operations Manager's statements that the void spaces were religiously checked by shore staff the void space had been flooded for a considerable period. Heavy corrosion was found in this and other void spaces including the void space in which the hull plating failed.

The Metal Test Ltd Report advises the pH value of water needs to be between 8.5 pH + to 9.5 pH +, as opposed to the 5.71 that was detected on ***San Rakino***, to reduce or stop corrosion of carbon steels. It states further that associated corrosion is not limited to the wetting and drying process that is commonly associated with salt water vessels. Analysis of the water sample gives rise to the real possibility of micro biologically induced corrosion with the presence of sulphates and a high level a bacterial infection. Based on these findings it is reasonable to determine that if the void space in which the hull plating failed was equally compromised, a high level of corrosion could be expected in associated sections of hull.

Despite the preventative maintenance schedule requiring regular internal hull inspections, it is clear from flag state inspection documentation that after1996, when the fish room floor was cut out for void space inspections hull inspections were limited to areas that were readily accessible.

It is essential that all internal sections of hull be inspected on a regular basis. The area of hull under the void spaces represents a significant section of hull that was required to have regular inspections in accordance with the SSM inspection schedule.

This required, in the year three of the maintenance programme, to:

> *"Thoroughly inspect steel structure and any timber work in and around engine room and midship space" (See Appendix 10 – Stability Handbook).*

All internal hull sections should have been inspected even if such inspection required cutting out a small hole on the fish deck to allow visual inspection.

Sanford Ltd failed over an extended period of time to ensure adequate measures were taken to inspect sections of hull, as required under the New Zealand Safe Ship Management Code.

The Safe Ship Management company failed over an extended period of time to ensure that adequate hull inspections were carried out in accordance with it's obligations under Rule Part 21 of the Maritime Rules.

San Rakino and her sister ships are now nearing 30 years virtual continuous operation. As with all steel vessels of this age corrosion must be constantly addressed and associated cost carried if the vessels are to operate safely.

Apart from shop primer being applied when *San Rakino* was built there was no evidence of further coatings on the internal hull. Normally, shop coatings are applied immediately after or preferably before exposure to the elements and a final paint system such as Altex Ballast Tank System, a brand of paint commonly used in industry to cover steel applied to prevent rusting in enclosed spaces.

The Skipper rightly pointed out that had the hull failure occurred on a bar, the consequence could have been more serious.

Ultra sonic inspections are a useful tool to detecting reduction in hull plate thickness. Many class societies insist on it and is good practice for any fleet owner. However, sole reliance is not recommended. This is especially the case if there are significant distances between areas tested. Isolated corrosion cells can lie between test points and not be detected. Testing should be carried out in conjunction with internal inspections. The Metal Test Ltd report refers to the danger of inaccurate readings in cases where slag and linear inclusions are present in steel plate.

The failure of the owners and the surveyors to fully inspect the void spaces under the fish room over a 9 year period holds points to a significant latent failure on management's part.

SAFETY RECOMMENDATIONS

It is noted that Sanford Ltd has taken action that has addressed some of the following recommendations.

1. It is strongly recommended that ***San Rakino*** and her sister ships be inspected as a matter of urgency to determine when void spaces were last inspected and in consultation with the vessel's SSM company put in place a scheduled inspection regime to ensure:

    - All void spaces are checked and are free of water every time the fish room is cleaned and that this is recorded in the vessels log.

    - All void spaces have limber holes capable of draining to a point in the hull where water can be effectively pumped.

    - All void spaces and associated sections of hull and frames are inspected for corrosion and plate deterioration and replaced or recoated as required.

    - Procedures be put in place to ensure void spaces are sounded on a regular basis.

It is further recommended that:

2. Sanford Ltd consider placing plugs in the hull of ***San Rakino*** and her sister vessels to enable void areas be drained through the hull.

3. Sanford Ltd ensures ships crews are fully conversant with void space drainage systems on all fleet vessels. Sanford Ltd advises it will audit crew to ensure compliance.

4. Sanford Ltd put in place SSM documented procedures to ensure all void spaces are sounded and drained on a regular basis in all fleet vessels.

5. SSM companies be reminded of the importance of ensuring surveyors carry out internal hull inspections in all sections of hull including those that may require removal of deck or other sections for access.

6. Sanford Ltd is censured for failing to ensure that hull inspections were properly carried out on ***San Rakino***.

7. Maritime New Zealand advise the maritime industry of the circumstances surrounding this accident to warn mariners of the danger of internal hull corrosion and the importance of ensuring regular inspections of all internal sections of hull.

8. Copies of this report be forwarded to Seafood NZ, all SSM Companies and to other companies that operate offshore fishing vessels in New Zealand waters.