Comparative Sea Trials of Plastic Stack-Nest & Stack-Only Fish Boxes

Technical Report No.308

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SEA FISH INDUSTRY AUTHORITY
Industrial Development Unit

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SUMMARY

Although the wooden fish box is still commonly used in Scotland for handling fish both at sea and ashore there is a growing acceptance of an eventual change from wood to plastic boxes. Of the two types of plastic box available (stack-only and stack-nest) the stack-nest is considered a most suitable replacement and is already in use ashore but there have been reservations concerning its use at sea.

From June to December of 1986, Seafish carried out a series of comparative trials on Scottish vessels to assess plastic boxes when used at sea. The boxes used were a new stack-nest design, produced to a Seafish specification as a replacement for the wooden box, and an existing plastic stack-only box of the same nominal capacity of 70 litres. The trials are described and discussed in this report.

The trials first concentrated on a direct comparison between the two types of plastic box, and the fishrooms of three vessels were modified and partitioned to carry both box types. More care needs to be taken with fishroom layout when using plastic boxes and as a result of these trials it was possible to produce a set of recommendations on layout. Throughout the summer months it was shown that ice retention and fish quality were comparable between box types, even on trips of nine days. Further trials using stack-nest only then demonstrated that

fishroom capacity was not seriously affected and that when stowed properly boxes were both stable and secure, even in bad weather.

From here the trials moved on to the use of stack-nest boxes on deck where problems of box orientation and stability were thought to exist. Nevertheless it was shown over a series of trials that with simple modifications to the handling system the boxes could be used on deck successfully.

Fishroom temperatures were also monitored throughout the trials voyages manned by Seafish staff and the effect of poor insulation was noted.

A fish quality improvement was noted throughout the trials as a result of good boxing practice when fish were weighed at sea and correctly iced and boxes not overfilled.

Overall the trials successfully showed that a plastic stack-nest box of suitable design can be used at sea provided proper box handling and stowage practices are used. In the fishroom the box proved to be strong and stable, stowage capacity was not adversely effected and ice loss differences between plastic stack-only and stack-nest boxes were insignificant. The stack-nest box was successfully used on deck also. The handling advantages of the stack-nest compared to the stack-only and the traditional wooden boxes were soon appreciated by the crews and preference was shown for the stack-nest box.

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COMPARATIVE SEA TRIALS OF PLASTIC STACK-NEST AND STACK-ONLY FISH BOXES

1. INTRODUCTION

In Scotland the wooden fish box is in extensive use and hired to box users by a number of independent box pools. A dispute in the North East during 1984 over an increase in charges led to box users establishing a Box Pool Formation Committee to consider the creation of a common box pool. A feasibility study made by Seafish (Reference 1) showed that there were financial advantages in a common box pool using plastic boxes, particularly boxes of the stack-nest type.

Following discussions with this committee Seafish produced a specification for a plastic stack-nest box to replace the existing wooden units (Appendix 1). In early 1986 the Box Pool Formation Committee disbanded and created a company, "Scotbox", to establish a common box pool using a plastic box designed to comply with the Seafish specification.

Although general acceptance of a change from wood to plastic existed in the fishing industry, there were reservations on the catching side concerning the use of a stack-nest box at sea. These were based on theories that they would effect quality by allowing excessive loss of ice and also reduce fishroom stowage capacity. There were also worries concerning the strength and stability of the stack-nest box and its use on deck.

It was decided therefore that in conjunction with the Scottish White Fish Producers Association Ltd., representing the catchers, and Scotbox that Seafish would conduct a series of trials throughout the Summer of 1986 to compare and assess the use of plastic stack-nest and stack-only boxes at sea.

2. OBJECTIVES

2.1 To consider any change in available fish stowage space when using stack-nest as opposed to stack-only boxes in the fishroom.

2.2 To compare ice loss between plastic stack-nest and stack-only boxes under commercial conditions at sea.

2.3 To compare the handling advantages and disadvantages between the different plastic box types.

2.4 To consider the change in handling practices necessary with the change from wood to plastic boxes.

3. CHOICE OF FISH BOX

3.1 STACK-NEST FISH BOX

When Seafish produced their specification for a plastic box (Appendix 1) suitable to replace the existing wooden units, due consideration had to be made for both catching and processing sectors of the Fishing Industry. The stack-nest was considered most suitable, but had to meet several stringent criteria in terms of capacity, overall size and strength. At the outset of the trial the only stack-nest box then available that would meet these criteria was the G.P.G. C1519 (Figure 1) made to the Seafish specification. The box was new and untried and so the opportunity was taken to assess the box whilst conducting the comparative trial. 1000 of these boxes were provided by Scotbox for trials.

Type: GPG C1519 stack-nest box
Material: High density polyetheylene
Capacity: 70 litres
External dimensions: 815mmx483mmx275mm (32inx19inx10.8in)
Stacking pitch: 250mm (i.e. rim to rim dimension when stacked)

It will be noted that width and length dimensions met the "prefered dimension" as given in Appendix I. This preference had been declared so that the resulting box design would always fit within storage spaces allocated for wooden boxes on existing vessels, without wasting space thus avoiding a potential source of capacity loss.

3.2 STACK-ONLY FISH BOX

As the trial was to be comparative it was important that the stack-only box used had the same 70 litre capacity as the stack-nest box chosen. Several boxes of this capacity existed but none were of the existing wooden box length and width dimensions. This would create problems in terms of fishroom conversion to use both types but had to be accepted. The PERS box (Figure 2) was chosen and supplied by Scotbox as required.

Type: PERS
Material: High density polyethylene
Capacity: 70 litres
External dimensions: 845mmx515mmx190mm (33.25inx20.25inx7.5in)

4. TRIALS FISHING VESSELS

4.1 ROSEBAY - PD53

Skipper - W. Lawson
Port - Peterhead
18 metre wooden trawler. No shelter deck. Built 1979.
Fishroom insulation - partial on deckhead only.
No refrigeration.
Typical fishing trip - 5 days.

4.2 RIVAL - BCK53

Skipper - A. Reid

Port - Buckie

22 metre wooden shrimp/prawn trawler. Shelterdeck. Built 1953.

Fishroom uninsulated.

No refrigeration.

Typical fishing trip - 4 days.

4.3 FRAGRANT CLOUD II - PD233

Skipper - J. McLean

Port - Peterhead

22 metre wooden seiner. Shelterdeck. Built 1980.

Fishroom insulation - rear bulkhead to engineroom and partial on deckhead only.

No refrigeration.

Typical fishing trip - 7-9 days.

4.4 SEAGULL - BF83

Skipper - K. West

Port - Kinlochbervie

18.0 metre wooden trawler with full shelterdeck.

Built 1983.

Fishroom insulation - forward and rear bulkheads only.

Seacool deckhead refrigeration fitted.

Typical fishing trip - 2 days.

4.5 SUNBEAM - INS189

Skipper - W. Smith

Port - Peterhead

26.0 metre wooden seiner with 3/4 shelterdeck.

Built 1978.

Fishroom insulation - forward and rear bulkheads only.

Seacool deckhead refrigeration fitted.

Typical fishing trip 8-10 days.

5. TRIALS PROCEDURE

5.1 CHOICE OF FISHING VESSELS

All five trials vessels were initially nominated by the Scottish White Fish Producers Association (S.W.F.P.A.). The individual skippers were then approached by Seafish and agreement reached as to the nature of the trial, modification to the fishing vessel and timetable.

In order to compare ice loss it was important to consider the combined effect of poor fishroom insulation, trip length and high ambient temperature. It was on this basis that ROSEBAY, RIVAL and FRAGRANT CLOUD were chosen for trials during the summer.

Following this it was thought necessary to consider the use of stack-nest boxes on the West Coast and a non comparative trial was conducted on board SEAGULL.

Trials with handling plastic boxes on deck were conducted on board SUNBEAM.

5.2 VESSEL MODIFICATION

5.2.1 Fishroom conversion - All five vessels underwent some modification to their fishrooms, depending upon the nature and extent of the individual trial. ROSEBAY, RIVAL and FRAGRANT CLOUD had the aft part of their fishrooms partitioned and modified to carry PERS stack-only boxes on one side and G.P.G. stack-nest boxes on the other. SEAGULL and SUNBEAM were modified to take G.P.G. boxes only. All modification was undertaken under the direct supervision of Seafish staff. Conversion details are given in Appendices 2-6.

5.2.2 Working deck conversion - Although some initial work was carried out on FRAGRANT CLOUD the trials on board SUNBEAM concentrated on the working deck and several options involving new

equipment and subsequent modifications were tried. Details are given in Appendix 6.

5.3 FISHROOM TEMPERATURES

Thermocouples were installed in the aft part of the fishroom at deckhead, floor, engineroom bulkhead and both sides. This was to enable fishroom temperature to be monitored throughout the fishing trip. When installed alongside stack-nest boxes the thermocouples were positioned between the tapered sides of the boxes in the centre of the air gap present. Details of installation on individual vessels are given in Appendix 8.

5.4 SEA TRIALS

All vessels had a member of Seafish technical staff on board during the trials which usually consisted of two consecutive fishing trips. This was to enable box filling procedure, sample location and temperature measurement to be carried out as detailed below.

5.4.1 Ice loss - box filling procedure - A major element of the trial was to compare ice loss between the two types of plastic box. It was important therefore that all boxes were not only filled in a similar and correct manner but that there was ice remaining at the end of the trip to be compared. The 70 litre capacity of the box had originally been specified in order to contain 45kg (7 stones) of fish and 15kg of ice. This was considered adequate for the trial when filling boxes with finfish. A unit of 25kg (4 stones) was used when handling shrimp and prawns due to their much lower stowage density.

By using a Seafish checkweigh scale, boxes were filled with the required weight of fish at sea. As both boxes had the same capacity it was assumed that by topping up with ice the amounts of ice in the boxes would be similar when comparing boxes containing the same species and size of fish. The fish were bottom and top iced.

5.4.2 **Sample location** - To obtain a direct comparison between both types of box in terms of ice loss, some boxes were labelled and coded at sea in equivalent positions within each box type stack. Their position was such that data could be obtained from the bottom, centre, side and top within a box tier and also from tiers at engineroom bulkhead, centre and hatch positions. With each pair of boxes it was important to ensure that both contained fish from the same haul, preferably of the same species and size.

5.4.3 **Temperature measurement** - Thermocouple readings were taken from the fishroom on each haul. Further individual readings of fish and ambient temperatures were made throughout the sea trip.

5.4.4 **Box handling** - General observations regarding the box handling at sea both on deck (if applicable) and in the fishroom were made.

5.4.5 **Weighing at Sea** - Although weighing at sea was used to enable a comparison of ice loss between box types to be made its importance as a means of filling boxes correctly was also demonstrated.

5.5 FISH MARKET TRIALS

The landing of all sea trial trips were attended and monitored by Seafish staff and the information obtained as detailed below.

5.5.1 **Box weights** - Labelled and coded boxes were broken down and fish and ice weights obtained. Ice at the top and bottom of each box was measured separately. A Mettler TE120 electronic weigh scale was used.

5.5.2 **Fish prices** - Fish prices were obtained in order to make comparisons with other vessels and between trips.

5.5.3 **Buyer and Processor reaction** - Whilst the trial proceeded some of the fish buyers and processors who had handled fish in the plastic boxes were approached and their comments regarding fish quality and box handling were obtained.

6. TRIALS NARRATIVE

6.1 ROSEBAY TRIAL - PETERHEAD

JUNE 17-21 1986 **Fishroom Conversion.** This was done whilst the vessel was on the slipway at Peterhead. The Skipper wished to continue using the stack-nest box after the comparative trial was complete and so the fishroom was first modified to carry GPG stack-nest boxes only (Figure 3) and then partitioned aft and modified on the starboard side to carry the PERS stack-only box (Figure 4). Details of the conversion are given in Appendix 2.

JUNE 23-37 **Trip 1.** Comparative trial using GPG and PERS boxes with Seafish staff on board. 62 GPG and 75 PERS landed, weighed at sea.

JUNE 30- JULY 4 **Trip 2.** Comparative trial with Seafish staff on board. 93 GPG and 90 PERS landed, weighed at sea.

JULY 7-11 **Trip 3.** Partitioning to accommodate PERS box removed and weighing machine put ashore. Vessel continued using GPG box only. 100 boxes landed, not weighed at sea.

JULY 14- AUG. 1 **Trips 4, 5 and 6** with 91, 215 and 136 G.P.G. boxes landed, not weighed at sea. After trip 6 the boxes had to be removed for trials on board FRAGRANT CLOUD. Wooden boxes were put back without any fishroom modification necessary.

6.2 RIVAL TRIAL - BUCKIE

JUNE 30- JULY 5 **Fishroom conversion.** This was done whilst the skipper was on holiday and the vessel underwent some maintenance. The aft part of the fishroom was

partitioned and modified to carry the two box types. Details of the conversion are given in Appendix 3.

JULY 6-11 **Trip 1.** Comparative trial with Seafish staff on board. 93 GPG and 113 PERS boxes of shrimp landed, weighed at sea.

JULY 13-17 **Trip 2.** Repeat of Trip 1. 93 GPG and 81 PERS boxes of shrimp landed, weiged at sea.

JULY 20-24 **Trip 3.** Vessel switches to prawn fishing. 21 GPG and 19 PERS boxes of prawns weighed at sea and landed. No Seafish staff on board but Skipper and crew marked boxes for assessment ashore. The Skipper was keen to continue with the trial using GPG stack-only boxes currently used by the Danes for shrimp, instead of PERS. Unfortunately the GPG stack-nest boxes were required for the FRAGRANT CLOUD.

6.3 FRAGRANT CLOUD TRIAL - PETERHEAD

JULY 30 - AUG 1 **Fishroom conversion.** The work was done in two stages to fit in with the vessels normal periods in harbour between fishing trips. The aft part of the fishroom was modified during the first period. As with ROSEBAY the Skipper wished to continue using the stack-nest boxes after completion of the comparative trial. The fishroom was modified first to carry GPG stack-nest boxes only and then partitioned and further modified to take PERS boxes on the starboard side. Two portable benches for use with the GPG box were made and put on board for some preliminary trials using plastic boxes on deck instead of the traditional wooden box.

Details are given in Appendix 4.

AUG. 1-8 **Trip 1.** Comparative trial using GPG and PERS boxes with Seafish staff on board. Voyage abandoned due to series of probems with fishing gear and only 20 GPG and 26 PERS boxes filled.

AUG. 8-11 **Fishroom conversion.** Fore part of fishroom modified to take GPG boxes.

AUG. 11-19 **Trip 2.** Comparative trial using GPG and PERS boxes. Seafish staff on board. 246 GPG and 196 PERS landed, weighed at sea.

AUG. 21-28 **Trip 3.** Comparative trial as Trip 2. 246 GPG and 196 PERS landed, weighed at sea.

SEPT. 6. **Trip 4.** PERS boxes removed. Vessel continued weighing at sea using GPG boxes only. 409 landed.

Existing fishwasher replaced with Seafish design model.

SEPT. 18 **Trip 5.** Due to shortage of plastic boxes ashore, some wooden boxes used, 264 GPG and 165 wooden landed, all weighed at sea.

SEPT. 25 **Trip 6.** 327 GPG boxes landed, all weighed at sea. Plastic boxes removed from vessel for SEAGULL trial. Wooden boxes put back on board and weighing machine retained for use with them.

6.4 SEAGULL TRIAL - KINLOCHBERVIE

OCT. 10-11 **Fishroom conversion.** Aft part of fishroom modified to take GPG stack-nest box only. Details of the conversion given in Appendix 5.

OCT. 12-14 **Trip 1.** Seafish staff not on board. Vessel lands 115 GPG boxes, weighed at sea.

OCT. 14-16 **Trip 2.** Seafish staff on board. 203 GPG boxes landed, weighed at sea.

OCT. 20 Some of GPG boxes overlanded to Grimsby examined.

OCT. 19-21 **Trip 3.** 190 GPG boxes landed, not weighed at sea. Wooden boxes put back on board.

6.5 SUNBEAM TRIAL - PETERHEAD

NOV. 17-19 **Fishroom conversion and working deck modifications.** Aft part of fishroom modified to take GPG stack-nest box. Forward box stowage areas on working deck replaced with redesigned aluminium stanchions. Aluminium track system fitted on starboard side bulwark rail to enable boxes to be slid instead of carried. Portable box support/gutting benches made for attachment to track. Defined as System Mk. I. Details are given in Appendix 6.

NOV. 19-28 **Trip 1.** Two Seafish staff on board. Vessel landed 370 GPG boxes, weighed at sea.

NOV. 28-30 **Working deck modification.** Aluminium track and benches removed and replaced with wooden track system on deck (System Mk II). Details given in Appendix 6. Seafish checkweighing unit replaced with commercial equivalent (NESCO FISHWAY).

DEC. 2-10 **Trip 2.** Seafish staff on board. Due to shortage of plastic boxes only 160 GPG weighed at sea and landed. 280 wooden boxes not weighed at sea also landed.

DEC. 10-11 **Working deck modification.** Wooden track system modified by addition of plastic runners (System Mk III). Details given in Appendix 6. Supply of plastic

boxes for fishroom unsure so vessel reverted to wooden boxes for fishroom stowage.

DEC. 13-15 **Trip 3.** Seafish staff on board. Trip curtailed due to bad weather. 120 wooden boxes landed.

DEC./JAN. The crew continued to use the plastic boxes on deck until problems were experienced with a large haul that involved stowing full boxes on the port side of the deck.

7. RESULTS AND DISCUSSION

7.1 FISHROOM CONVERSION

Although wooden boxes are nominally similar in dimensions the nature of the material is such that it is difficult to ensure exact dimensions and consequently several inches of 'slack' are allowed for in the fishroom construction. If necessary this is easily taken up at sea by using boards and wedges. This wedging of boxes coupled with the stable nature of wet wood also reduces the chance of full boxes breaking free when full. It is not essential therefore that fishrooms used for carrying wooden boxes are exactly square or indeed vertical as any gaps or uneveness caused by warping and wear, or even in construction are easily taken up.

With plastic boxes dimensions are exact and the fishroom must be made to more precise dimensions. This is a necessary criteria when using plastic, as any attempt at wedging causes distortion and can result in instability of the stacks and premature box breakage. However to enable boxes to be removed and to account for lack of precision in fishroom construction (particularly existing ones) some slack has to be allowed even when plastic boxes are used. This, coupled with the very low coefficient of friction between wet plastic surfaces, means that plastic boxes must have an inbuilt locking mechanism moulded in, to ensure that boxes cannot slide away from one another as a result of vessel motion. To ensure that

the interlock design will be effective it is important the storage space is designed to ensure that boxes are stacked correctly and squarely. Some details of the conversion arrangements necessary are shown in Figs. 5 to 8.

With a change from wood to plastic therefore it is inevitable that some conversion work will be necessary to ensure safe stacking of boxes, regardless of box type. The cost and (equally important), time involved in this can be kept to a minimum if the plastic box has the same plan dimensions as the existing wooden units.

The first three conversions on ROSEBAY, RIVAL and FRAGRANT CLOUD were complicated by the need to use both stack-only and stack-nest boxes in the same fishroom and made more so as a result of the PERS and GPG boxes having different external dimensions. This resulted in additional plywood partitioning and lining being installed (Figures 2 and 4) and consequently the time and cost elements involved could not be taken as typical of future installation.

In contrast SEAGULL and SUNBEAM had the aft parts of their fishrooms converted to carry GPG boxes only and, coupled with the experience gained on the three previous vessels, conversions were simple and completed within two days for each vessel.

As a result of the experience gained during these and earlier trials it has been possible to compile a set of recommendations for the procedure necessary when converting a fishroom to carry plastic boxes, particularly of the stack-nest type. The recommendations are given in Appendix 7.

7.2 FISHROOM STOWAGE CAPACITY

With the stack-nest design the 60% or so reduction in stowage volume when nested gives considerable advantages ashore in reduced storage and transport needs and potential improvements in handling. To some extent these advantages also apply when the stack-nest box is used at sea but it also suffers a disadvantage in that it takes

up more space for an equivalent stowage capacity when full than the straight stacking design. Prospects of reduction in carrying capacity have caused much concern amongst the catching side of the industry and measurement of the capacity of vessels converted to carry plastic boxes was thus used as part of every conversion schedule.

Table 1 (page 15) gives comparative dimensional data for box stacks of approximately the same height using both types of plastic box used in the trials and two options with wood. It can be seen that six GPG stack-nest boxes equates exactly in height with eight PERS stack-only and as both boxes have the same capacity, gives the impression that a 25% reduction in stowage volume occurs (Figure 10). This was pointed out on several occasions during the trials but is in fact something of misconception as the PERS box is both longer and wider than the GPG. If this is taken into account then the actual difference when comparing volumetric efficiency of the two box types listed is 14.7% with the stack-only having the greater efficiency.

Although the number of full stack-nest boxes that can be put into a fishroom may appear to be less than a straight stacking wood or plastic equivalent we must consider existing practice and the implications of this. With wooden boxes overfilling is quite common and any comparative judgement of box capacity must take this into account. At Peterhead, wooden boxes typically contain some 54kg (8½ stones) of fish and when stowed at sea this equates to a gap of about a third the box depth existing between boxes stacked on top of one another (Figure 9).

This effectively means that the depth of the box has been increased and as seen in Table 1 means that 6 overfilled wooden boxes equate to 8 non overfilled ones. It does, however, result in significant losses in fish quality, weight and value through crushing.

Table 1 shows the number of each box type required to carry 20 tonnes of fish. For ease of reference between box types the

equivalent number of empty wooden boxes to fill the space occupied is also given. These show two very important points in the argument surrounding loss of fishroom stowage capacity.

The first relates to the fact that plastic boxes cannot safely be overfilled and as such the current practice of massive overfilling would have to stop. When a fishing vessel leaves port with stack-only boxes it is not possible to stow all the empty boxes in the fishroom as space has to be left for access, working space and

TABLE 1

PLASTIC AND WOODEN BOX STOWAGE COMPARISON FOR STOWAGE OF 20 TONNES OF FISH

	GPG 6 HIGH (STACK NEST)	PERS 8 HIGH (STACK ONLY)	WOOD 8 HIGH	WOOD 6 HIGH WITH 60mm OVERFILL
Box depth (mm)	250	190	180	240
Stack depth (mm)	1520	1520	1440	1440
Box length (mm)	815	845	813	813
Box width (mm)	483	515	483	483
Stack ext. vol (l)	600	660	565	565
Stack int. vol (l)	420	560	467	470
Volumetric Efficiency int. vol / ext. vol	70%	84.7%	82.5%	83.2%
Fish capacity per box (kg)	45	45	38	54.0 *
Boxes required for 20 tonne of fish	444	444	526	370
Equivalent number of empty wooden boxes to fill space occupied	628	518	526	493

Note * If the same fish stowage density were used as with plastic boxes this weight would be 50.5kg. The figure used relates to current typical stowage practices with fish being crushed into the given stowage space.

sometimes additional ice (other than in the ice lockers). This means that boxes have to be stowed on the working deck. With current overfilling practice the number of boxes required to fill the fishroom is much reduced and space for empty boxes is not too much of a problem. If stack-only plastic (or even correct filling of wood) were adopted many more empty boxes are required and one questions whether or not box storage space would be available. The problem is not easily resolved particularly if one considers the current trend toward mechanisation of fish handling on the working deck and the take up of space by gutting machines and conveyors. In fact with plastic stack-only boxes the capacity of the fishroom may well be defined not by the number of full boxes that can be stowed but by the ability to carry sufficient empty ones.

The second point relates to the space saving features of the stack-nest box when empty. It is clear in Table 1 that in terms of correctly filled wooden box equivalents that the filled capacity of the nominal fishroom would be reduced by 102 boxes if stack-nest were used. But this assumes of course that stowage of the stack-nest is restricted to the same space as the filled stack-only boxes. In practice the space both in and usually between the ice lockers is not used for fish stowage due both to the ability of the vessel to carry empty boxes and the need to use the space at all but this space can be utilised if needed. Stowage of additional empty stack-nest boxes is not a problem.

For example the 444 boxes listed in Table 1 will nest when empty into the equivalent space of 250 wooden boxes. Thus any available storage space in a vessel fishroom can be allocated for fish stowage in the knowledge that storage of the necessary empty boxes will be be a limiting factor. On FRAGRANT CLOUD it was found that by utilising this space the stowage capacity could be increased. The results are shown in Table 2 (page 17). It is clear that with some thought the loss, if any, in fishroom capacity associated with the use of stack- nest boxes need not be very great.

One point that must be made of course is how often do fishing vessels "fill up" and require maximum stowage capacity, bearing in mind the increasing effect of quotas. Figures taken from DAFS for the period October 1983 to June 1984 (Reference 2) showed that for a group of 33 vessels (normally completing trips of more than 6 days at sea) and 500 landings only seven vessels made one full trip and 3 landed twice at full capacity.

TABLE 2

FISHROOM BOX CAPACITIES OF TRIALS VESSELS

VESSEL	BOX CAPACITY (TONNES)		COMMENTS
	WOOD OVERFILLED (54kg/BOX)	GPG STACK-NEST (45kg/BOX)	
ROSEBAY	11.9	11.2	Full fishroom. 20 boxes in ice pounds.
FRAGRANT CLOUD	22.2	22.9	Full fishroom. 80 boxes in and between ice pounds.
SEAGULL	20.7	15.1*	Aft fishroom only.
SUNBEAM	23.7	21.8*	Aft fishroom only.

*Conversion on these vessels was limited to the after fishroom storage space. Use of additional space, as defined in the text, would increase the total available storage space, but this proved unnecessary in the circumstances in which the tests were taken.

The shrimp catching sector of the industry must also be considered in terms of box capacity as these vessels, although using the same wooden box, do not overfill them. Nevertheless the previous discussion regarding stowage of empty boxes still applies and if sufficient empty boxes are to be carried to fill the fishroom then a reduction in fishroom capacity need not be as great as it may initially appear. Danish vessels already using plastic stack-only

boxes are seen in N.E. Scottish ports and have cages built onto the working deck and wheelhouse casing to contain them. Stack-nest boxes may well cause some reduction in fishroom capacity but how significant this is requires further investigation.

7.3 FISHROOM TEMPERATURES

As the main indicator for comparison between the two box types was to be a measure of ice loss it was important to be sure that any differences were attributable to box and not fishroom design. Fishroom temperatures were therefore monitored throughout the trials trips and are given in Appendix 8 together with more detailed discussion than given in this section.

For the comparative trials on ROSEBAY, RIVAL and FRAGRANT CLOUD there were no measured differences in fishroom temperatures before boxing, between port and starboard sides, that would give advantage to either box type. With boxes stowed though the readings taken from the fishroom sides were consistently some $1^{o}C$ higher on the stack-nest side. This is no doubt a result of the closer proximity of the thermocouples to the stack-nest only box sides than that of the stack-nest. Even if caused by air flow through the tapered sides of the stack-nest boxes the effect is clearly negligible.

Points worthy of note included the beneficial effect of fitting a sealed lining around the box stacks as part of the re-squaring of the fishroom, regardless of box type. This applied particularly to the engine room bulkhead with ROSEBAY and FRAGRANT CLOUD and the fishroom floor with RIVAL. The advantage of fishroom chilling on SEAGULL and SUNBEAM were also shown together with its limitations. The chillers effectively control heat input to the fishroom by controlling air temperature above and forward of the box stack but heat gain through the engine room bulkhead still causes temperature rise once boxes are stacked against it and ice melts away.

7.4 COMPARISON OF ICE LOSS

The results of trials comparing ice loss on board ROSEBAY, RIVAL and FRAGRANT CLOUD are given in the following paragraphs.

When analysing the results care must be taken when comparing sample residual ice weights. Although fish size, species and weight are generally comparable some tolerance must be allowed particularly for initial ice weights as this was measured on a volumetric basis using an ice scoop. As the trial was being conducted under commercial conditions some minor degree of overfilling at the initial filling stage sometimes occured due to variation in ice scoop measure. Measurements taken ashore showed that this could give a variation of plus or minus 0.5kg. As each box contained two scoops of ice, only differences in excess of 2.0kg between samples are considered significant. In addition the actual ice weight varied slightly between ports depending upon the type of ice used i.e. tube, plate or flake.

7.4.1 Rosebay

The results of the two manned sea trips are shown in Tables 3 and 4. Both trips were of five days duration and when landed all boxes contained top ice (Figure 12). If one takes an overall view of the samples there was no significant difference in ice loss between PERS stack-only and GPG stack-nest boxes. Apart from some boxes stowed on the fishroom floor all boxes had adequte ice remaining. Some boxes stowed against the engine room bulkhead showed the effect of heat ingress by ice having melted at one end of the box (Figure 11).

Further trips of the ROSEBAY were made with the GPG boxes only (Figure 13) and no on board weighing (Table 5). As a result boxes were overfilled and box weights varied considerably. This is clearly shown in Table 6 where the fish weights for ROSEBAY's five trips are compared. When weighing at sea to 7 stones all samples contained 7-7¼ stones of fish. When not, weights are spread evenly over 6¾ to 9 stones. The effect on quality and icing are discussed in Section 7.5.1.

7.4.2 Rival

The results of three comparative trips are given in Tables 7-9. On the first trip all boxes put onto the quayside appeared to have

a reasonable amount of top ice present although in several cases the ice had melted away at the sides and was no doubt a result of the high fishroom temperatures (Appendix 8) as it applied to both box types. As the boxes contained shrimp it was not practical to break down boxes on the quayside and so only a total ice and shrimp weight was obtained for each sample on the quay. Nevertheless separate shrimp and ice weights were obtained for some samples at the factory and by using a mean shrimp weight, an ice weight estimate was obtained for all boxes. On this basis there was no significant difference in ice loss between the box types. On RIVAL there also appeared to be no significant ice loss in boxes stowed on the fishroom floor. A tendency to put extra ice into these boxes is shown in the results to have not melted away any more than elsewhere in the fishroom. The reason for this is no doubt the fitting of a false floor over the existing one, to square the fishroom for the trial (Appendix 3), having some insulative effect.

The second landing occured during the late afternoon when it was very warm and a strong wind was blowing across the quay. Boxes remained uncovered both on the quayside or on a lorry whilst unloading continued. The result in terms of ice loss was quite dramatic with much more meltwater running from the stack-nest boxes than from the stack-only. It was not possible to measure ice weights until some 1½ hours after unloading in the local factory and a marked difference was obtained. As no difference in ice loss was perceived on the first trip it is clear that this occured on the quayside. Clearly if stack-nest boxes are put into a warm airflow the tapered sides and air gaps between boxes will lead to excessive ice loss. Since fishrooms are enclosed and not directly subject to ambient and wind conditions the effect on fish stored on board will not be great but it must be allowed for in quayside and factory operations.

The third trial was due entirely to the interest and effort of both Skipper and crew who continued the comparative trial with nephrops. Although only 40 boxes were filled, four sets of samples were made.

Three of these showed no difference in ice loss, the fourth did although ice remained in both boxes and may well be a result of having to check weights 1½ hours after the landing in the factory.

7.4.3 Fragrant Cloud

The results of the second and third manned sea trips are given in Tables 10 and 11. It will be remembered that the first trip had been badly affected by a series of gear problems. These results in terms of ice loss should be signficiant with trips of 7 and 8 days duration but overall there appears to be little difference between box types. All boxes had ice remaining with the exception of those boxes stowed on the fishroom floor. Predictably the results also show that boxes stowed in the centre or outer edge of the tiers tended to hold their ice much better than top or bottom boxes.

Although the fourth and fifth trips were not manned by Seafish the crew continued to weigh at sea and use GPG stack-nest boxes only. The opportunity was taken to examine boxes stowed in the bottom of the fishroom of each landing. Both trips were significant, Trip 4 being 7 days with a further 30 hour lay in harbour before unloading and Trip 5 being of 9 days. Boxes taken from the bottom corners of each box tier were examined (see Tables 12 and 13). With the exception of the fourth tier all boxes had little if any ice remaining in the box bottom with some ice on top. Nevertheless fish temperatures were only just starting to rise apart from the first tier of the 9 day trip where fish temperatures of 3.8-4.6^{o}C were found. This particular result could have been avoided, as for some reason the crew had not continued their normal practice of placing a row of empty boxes on the bottom of the first tier. Clearly the limit of stowing 7 stones of fish into a 70 litre box in this type of fishroom had been reached at 9 days.

7.4.4 Seagull

This trial concentrated on the GPG stack nest-box only, the objective being to study problems in overland transport from Kinlochbervie to Grimsby across a weekend. As on previous trials

fish were weighed at sea but this time ice quantities were reduced reflecting the shortness of trip made by the vessel. With sea trips of less than two days and fishroom chilling installed ice loss was not a problem. As can be seen in Table 14 some boxes taken from 'worst' locations were examined ashore and found to contain little ice. These boxes were not typical as most boxes appeared to have much more ice on their tops (Figure 14). Boxes from this Thursday landing were then examined at two premises the following Monday at Grimsby. In both cases boxes were overlanded in a refrigerated vehicle and then put into respective chill stores on Saturday. Results are shown in Table 15 and are summarised below.

At Fish Merchant 1 the chill was not functioning correctly, and boxes had been re-iced on top before storage in the "chiller". Nevertheless little ice remained.

At Fish Merchant 2 no re-icing was done and boxes contained both top and bottom ice, thus indicating that the stack-nest box could be used in overlanding direct from the fishing vessel. The need to maintain chill stores in good order was also shown.

7.4.5 Sunbeam

Although this trial concentrated on deck handling, GPG stack-nest boxes were carried in the aft part of the fishroom. On the first landing some boxes were checked (see Table 16) and found to be well iced but with excess ice in the box bottom.

7.4.6 The Effect of Stacking

In any stack of boxes of iced fish in a fishroom a proportion of the ice is used to cool the fish. Thereafter ice loss is caused by heat gain from external sources and is dependant upon ambient temperature, insulation, deckhead chilling and fishroom practice by the crew. The effect on boxes with an external face should be greater than that on boxes which are entirely surrounded by other filled boxes. However the numbers of the latter are surprisingly

small, being as low as 16% of the total on the ROSEBAY and 26% on the FRAGRANT CLOUD with full fishrooms. The figures are even lower with the fishroom only partly filled.

The trials demonstrated that the use of stack-nest boxes did not lead to greater ice loss within the stack. The results of the trial in fact show that it is not box type but box location that gives large differences in ice loss, regardless of box type.

7.5 FISH QUALITY

Although a full quality assessment programme was not included as part of the trials the Seafish staff involved have experience in quality assessment and were able to make some comment.

7.5.1 Whitefish quality

By weighing at sea and not overfilling boxes it was possible to put fish onto the fishmarket in an adequately chilled condition. In general, the quality of fish landed by all trials vessels was (age considered) excellent. Fish from both types of plastic box were brighter, firmer and better looking than their often squashed counterparts from overfilled wooden boxes, a comment echoed by both crews and processors alike. There were some exceptions though. On FRAGRANT CLOUD's earlier trips some mixing of quality was evident in individual boxes. This was caused by poor washing and was overcome by replacing the vessels fishwasher with one to Seafish design (Figure 15). Some of the boxes taken from the bottom of the first tier of FRAGRANT CLOUD's and SUNBEAM's nine day trips had lost nearly all their ice and the fish was beginning to look poor. This was due entirely to ice loss as boxes of the same age immediately above were for nine days in good condition. Some boxes, although weighed, had been over iced on SUNBEAM's first trip and in some boxes fish were suffering from ice marking.

On her third trip the ROSEBAY's crew did not weigh at sea but simply filled boxes to their own standard. The result was box weights that varied from 7½-9 stones, achieved by half filling

boxes on one haul, allowing fish to settle and then topping up on the next. Fish quality was not very good with much evidence of ice marking and crushing. By her fifth trip the crew were doing a much better job with box weights ranging from 7-8 stones and much improved fish quality.

7.5.2 Shrimp/Nephrops quality

The quality problem associated with whitefish and box overfilling is not applicable with shrimp and nephrops as overfilling is not practiced. Some shrimp is already landed in plastic stack-only boxes instead of wood and use of these plastic boxes results in better quality. Fears were expressed that the stack-nest box would not be able to match the stack-only box for quality. One problem foreseen was that the stack-nest design was open and air could get onto the shrimp whereas the stack-only boxes effectively sealed air out when stacked.

On all three landings of RIVAL at Buckie, Seafish staff received full co-operation from processor MORAY SEAFOODS whose own quality control manager assisted in assessing samples. With both shrimp and nephrops the quality between the two box types was comparable with the samples taken from the stack-nest boxes certainly being as good as those in the straight stack. All shrimp samples from the plastic boxes were acceptable.

7.6 BOX HANDLING - FISHROOM

7.6.1 Loading

As far as the fishing vessel is concerned box handling begins with a stack of empty boxes on the quayside and the need to stow them safely onboard, usually in the fishroom. The stack-nest box displays a major advantage here since stacks of nested boxes can be lifted from the quay in units of 15 to 20 boxes at a time directly into the fishroom from where they can usually be slid into position. There is a need though to provide purpose built lifting hooks to lift via the box lips since the box handles are sealed

when nested by the boxes inside. This is not a disadvantage as a 20 high stack is not very secure when lifted with a two point lift. A four point lift from the corners should be used (Figure 16). The stack-only plastic box could also be lifted in stacks of 7 or 8 boxes but unlike their wooden counterpart are light and easily separate from each other. This caused problems not only in lifting in stacks but also dragging boxes those few metres from the quay stockpile to the vessel, as they tended to separate. In the fishroom the boxes were less easy to stack and crew often resorted to handling boxes individually. Although not too apparent from the trials the stack-only used on its own would need to be stowed on deck as well. All stack-nest boxes should go into the fishroom. Figure 17 shows a similar number of both types of box temporarily stowed on the shelterdeck of RIVAL. The difference in stowage space can be seen.

Once in the fishroom the empty boxes need to be secured. Plastic boxes cannot safely be wedged and so the traditional practice of wedging stacks between fishroom floor and deckhead could not be used. Plastic boxes need to be contained and this is best done by using removable stanchions so that space can be cleared ready for full box stowage as boxes are used up (Figure 18). This practice is already in common use on many vessels. During the trials the stack-nest boxes were sometimes successfully lashed to the fishroom sides (Figure 19) but this was not practical with stack-only boxes.

7.6.2 Use at sea

The plastic boxes weighed 5kg compared to 7-12kg for wood and this made moving empty boxes around easier. Once stacked on the fishroom floor, though, it was necessary to put a portable keep bar along the front of the stacks (Figures 8 and 20) to prevent forward movement of boxes in bad weather. Providing the boxes were not overfilled and were able to interlock properly then this was all that was required. During the trials period some very bad weather was encountered by RIVAL, SEAGULL and SUNBEAM. On no occasion did any box movement occur. It is important to remember, that the

fishrooms had been modified correctly for stowage of the plastic boxes.

The stack-nest boxes had an advantage in that the stacking location is effectively 25mm deep. Any slight overfilling can therefore be accommodated without the box becoming insecure. This was not the case with the stack-only design.

The stack-nest box has an internal depth of 250mm compared to 180mm for the stack-only and 160mm for wood. This was a considerable advantage when stowing medium to large fish as they could sit in the box without being crushed (Figure 11). This particular stack-nest design has the same internal length as the wooden box so the problem of very large fish still applies. Once the trials moved away from the comparative stage and stack-nest boxes only were used in the fishroom it was very noticeable how much more open the fishroom was with more space to work.

7.6.3 Unloading

Although existing unloading hooks could and on occasion were used this was not advisable when using plastic boxes as the chain or rope digs into the ends of the top box causing distortion (Figures 21 and 22). As commented on in 7.6.1 a purpose built four point lift should be used (Figure 23).

When unloading wooden boxes a four man crew is used in the fishroom since boxes are generally handled individually to get them beneath the hatch. Both types of plastic box showed a considerable labour saving advantage in that they could be dragged to the hatch in stacks. The depth of stack that could be dragged depended somewhat on the nature of the fishroom floor (some individual box handling was sometimes still necessary) but a reduction in fishroom labour was possible.

With overfilled wooden boxes a lot of residual ice and loose fish have to be removed from the fishroom before it can be cleaned down.

With the plastic boxes there was very little of this saving the crew a lot of time.

The actual unloading rate of individual boxes was not much different when comparing wood to plastic. The overall unloading time when using plastic boxes is less since there was less delay caused by getting individual boxes to the hatch, handling broken boxes and not having to remove the ice that falls from overfilled boxes onto the fishroom floor. Less effort was also required on the quay as plastic boxes were much easier to drag, although the use of purpose designed box handling barrows or fork lifts is preferable to dragging.

7.7 BOX HANDLING - WORKING DECK

As the comparative box trials progressed and much of the resistance against use of stack-nest boxes in the fishroom was shown to be unfounded the problems associated with the use of boxes on the working deck had to be addressed. On most Scottish vessels fish from the cod end are put into boxes for temporary stowage. Five high stacks are then used as a gutting bench with fish being gutted directly from the box. The wooden box with its extra weight and stability lends itself to easy use for this purpose. It was argued that the stack-nest box would slide around the deck and also be impossible to use for gutting because of the problem of box orientation. If the wooden box were simply to be replaced directly with stack-nest then this would be quite true and it must be remembered of course that all plastic boxes, whether stack-only or stack-nest, will slide around if not constrained. A further point is that direct substitution of the 57 litre capacity wooden box by a 70 litre plastic box leads to problems in manhandling the heavier, full, plastic box. Thus the change should be accompanied by improvements in handling practices to reduce the effect of heavier manual lifts if possible. Ultimately, with the onset of more mechanised deck handling, the need to use boxes on deck at all will diminish. Nevertheless, existing practice will no doubt continue for many years to come and so an attempt was made to overcome the problems and show that the stack-nest plastic box could be used successfully.

Following an initial assessment into the use of portable gutting benches to hold boxes of fish on board FRAGRANT CLOUD (Figure 24) a series of short trials were made on board SUNBEAM. The existing handling system was much as described above with empty wooden boxes being stowed in stanchioned pounds fitted port and starboard under the forward part of the shelterdeck. These would be removed by the crew and carried aft to the fish pound on the starboard side. They would then be filled (not overfilled) carried forward and stacked. The position of the stacks depended upon the quantity of fish but usually involved stacking in the forward starboard pound with individual stacks left half way as gutting positions. Some boxes could be left aft to feed the rearmost gutting station. With very large hauls the port side pounds would be used as well.

7.7.1 Deck Handling System Mk1

The problem with plastic boxes used in the traditional method of fish handling on deck is that they would slide and stacks fall over. It was thought that if the boxes could be restricted to move only in the direction required the easy sliding action could be turned into an advantage by reducing the effort required to move boxes. An aluminium track was fitted to the shelterdeck on the starboard side (see Appendix 6 and Figure 25). Plastic boxes filled in the normal manner were lifted onto the track and slid forward to the stanchioned pounds, were they were lifted off and stacked.

As gutting proceeded boxes were fed back along the stack to the gutting positions. These were a simple tray which could be fitted to the track when required. The problem of box orientation did not apply as boxes sat on the table and not another box. Empty boxes were washed and nested out of the way.

In use the trackway was found to work very well but the handling system itself was found to have several shortcomings. The track was not long enough and needed to be extended further forward. The boxes themselves, larger and heavier when full than wood, were sometimes difficult to manhandle both onto and off the track and

stacking in the pound proved confusing at times because of the need to orientate boxes correctly. It was also not possible for the crew to start gutting until nearly all fish had been scooped into boxes. In use the crew found it difficult to clear fish off the deck and down to the fishroom as quickly as normal. The system also took up a lot of space and there was concern about sufficient room to stow fish on deck if a big haul was made. Nevertheless the crew did use the stack nest boxes on deck quite successfully without them sliding everywhere and gutting from the boxes was no problem.

7.7.2 Deck Handling System Mk II

Following the first trip it was decided that instead of a single track in the shelterdeck, a series of parallel tracks running along the deck would be a more workable option (see Appendix 6). This gave a number of advantages.

1. As boxes could be dragged full in stacks three high and there was no need to lift individual boxes until stacking boxes higher than this in the forward pound.

2. By having three tracks running alongside one another instead of a single track the crew could start gutting at one stack whilst others continued to be slid past them.

3. This gave a box stowage and handling system comparable to the existing one with wooden boxes and would enable as much fish to be stowed as before.

One potential disadvantage of course was that gutting would have to be from box stacks and box orientation might be a problem.

The original trackway and gutting tables were removed and a triple trackway made by simply fitting wooden battens to the deck (Figure 29). Portable wooden stanchions were also fitted in way of gutting positions to prevent boxes tipping over in bad weather.

In practice there were problems with the trackway, caused by minor obstructions on the deck surface causing jamming, but with some minor modifications it was considered that the system would work well. Once the box stacks were in position the method of working appeared no different than when using wooden boxes. The crew found that by working from two or three athwartships stacks that they could gut without having to turn full boxes (Figures 30 and 31) and thus avoiding the problem of correctly orientating each box.

7.7.3 Deck Handling System Mk III

To prevent boxes jamming and make movement of boxes easier P.T.F.E. strips were fitted (Appendix 6 and Figure 32). At sea the problem of jamming had now disappeared and boxes could be moved fore and aft with ease. This seemed to have resolved most of the problems so the MkIII was left on board for further evaluation.

Only one reservation had been expressed by the crew and that was the need to carry the heavier boxes across to the port side for temporary stowage after a heavy haul, then back again for gutting. This in fact happened on a voyage early in 1987, soon after a change of ownership of the vessel, and the new Skipper decided to revert to the use of wooden boxes.

At the time of preparation of this report further work on this aspect of fish handling remains to be done. However it is clear that the problem is not insoluble and that there are advantages in time and effort in replacing manual lifting practices by sliding operation, which is possible with the use of plastic boxes.

7.8 BOX HANDLING - ASHORE

Plastic boxes, particularly stack-nest, are already in common use ashore and their advantages generally appreciated. It was not in the scope of these trials therefore to conduct any shore trials as such. However there were instances during the trials when critisam was made and is commented on here.

When nested the stack-nest box used on these trials seals the handles (commented in 7.6.1). This caused some comment at both box washing plants with experience of the boxes in that the hooks sometimes used for moving stacks of nested boxes could not be used effectively. It was appreciated that if the box was in common use then a special hook would be devised.

On more than one occasion it was pointed out that the boxes tended to slide off wooden pallets or were unstable on them and dangerous. This is true, but of course the stack-nest box has been designed to be fork-lifted by its top rim in order to avoid the use of pallets at all. This was demonstrated at Kinlochbervie when a fork lift truck driver, unloading pallets of empty wooden boxes onto the quay was confronted by 560 plastic boxes nested in 20 high stacks. He adjusted the tines of his fork lift truck to suit the box and quickly unloaded them.

On occasions it was stated that the plastic boxes caused minor problems in the factory, these views but were generally a result of lack of familiarity with the box or the need to have to adjust to change.

One acknowledged disadvantage was that if an attempt was made to drag a box off a stack from one end then the box dropped at one corner into the nesting location and jammed. This is unfortunate but unavoidable if one wishes to maintain maximum internal box length. Throughout the trial period this criticism was only made on one occasion and can be overcome by use of a simple handling aid (section 7.12.1).

7.9 CREW REACTION TO BOXES

On all five trials vessels the crews were impressed by the stack-nest box when used in the fishroom and reservations regarding handling, fish quality and box stability at sea were soon overcome. The advantages in terms of quicker and easier loading of empty boxes and removal of full ones were well appreciated as was the less cluttered fishroom. Given the choice between the two types of

plastic box used on the comparative trials the crews preferred the stack-nest design. This was demonstrated by both ROSEBAY and FRAGRANT CLOUD continuing to use the GPG stack-nest boxes for as long as possible after the two comparative trial trips. Crews on both vessels were disappointed when boxes were taken away for trials on other vessels. On RIVAL, SEAGULL and SUNBEAM the crews readily accepted the stack-nest box. There was some understandable concern expressed by the Skipper of RIVAL about possible loss in fishroom capacity (see 7.1.2). Nevertheless he wished to continue the comparative trial using a different type of stack-only box instead. Again boxes had to be taken off the vessel for other trials.

Although the trials on board SUNBEAM with use of stack-nest boxes on deck proved that it can successfully be done, more trials work will need to be carried out to overcome some of the remaining reservations.

7.10 BUYERS REACTION TO BOXES

Buyers of fish in both stack-only and stack-nest boxes were often approached for comment during the trials period. Almost without exception it was acknowledged that the quality of fish in both types of plastic box was very good and that it looked and kept better than that taken from wooden boxes. This simply shows what can be achieved if fish are not crushed and are adequately iced rather than any special characteristic of plastic.

If fish are not crushed then one might expect to obtain a higher fillet yield. This was demonstrated by one processor who compared the yield from 10 boxes each of plastic and wood bought from Kinlochbervie (SEAGULL) who claimed a 3% greater yield from fish kept in the stack nest boxes.

From the buyer's viewpoint though there was one matter that caused a lot of concern and unfortunately at times became more of an issue than that of the box comparison. This centred around the use of 7

stones as a unit of sale in the plastic boxes. This was chosen to avoid overfilling and crushing and to ensure ice remained throughout the longer summer trips. Unfortunately this was not appreciated by many buyers who, accustomed to 8 or 9 stones of fish per box took the view that a 7 stone unit was being imposed upon them, which incurred extra costs of transport since this is currently on a per box and not per stone basis.

The use of the weighing at sea system gave an accurate 7 stone weight in each plastic box (Figure 33). Normally a certain amount of extra weight has to occur in the wooden boxes in order to ensure minimum box weights and gain buyers' confidence. The on board weighing achieved this without giving much fish away and this was unpopular with some buyers.

Nevertheless, in spite of a certain amount of buyer resistance, the better quality product was recognised as fish prices were generally comparable with wooden boxes (Section 7.11).

7.11 FISH PRICES

Some monitoring of fish prices was made throughout the trials period and a summary of average prices is given in tables 17, 18 and 19.

It is important to note that in these tables prices have been presented on a per stone basis and NOT per box to avoid giving the wrong impression.

Overall the prices obtained by ROSEBAY were comparable and often better than other market prices on the day and the Skipper was satisfied with the results. Comparing the two types of plastic box the GPG stack-nest seemed to do better. This was not a result of any quality difference but a belief by some of the buyers that the GPG boxes contained more fish in spite of the weighing at sea. This was not the case but simply an optical illusion. The PERS box

being longer, wider and not having tapered sides is shallower than the GPG. Nevertheless the greater depth of the GPG seemed to indicate more fish.

The first full trip of FRAGRANT CLOUD was marred by a dispute on the market over box weights. This centred on the cod, and although later discovered to have probably been the result of a fish being misplaced in adjacent boxes, caused an unfavourable reaction by many of the buyers who subsequently marked the vessels fish down in price. The vessel undoubtedly lost money on this trip but the Skipper persevered and the next landing there was a reversal of attitude with prices from plastic boxes generally much better than from the wood. This trend continued for the remaining trials trips with the Skipper satisfied with prices obtained. Again the GPG boxes appeared to obtain better prices than the PERS.

At Kinlochbervie a deeper wooden box is used and inevitably higher box weights of 9-9½ stones landed. It was not surprising therefore that a 7 stone unit in the stack-nest box was not in favour, although the salesman and buyers accepted it was a trial. The prices for SEAGULL's fish are compared to her partner vessel OSPREY showed an overall slight disadvantage. Buyers commented though that they did not consider the GPG boxes contained 7 stones of fish (Table 14 shows this to be incorrect).

7.12 GPG C1519 STACK NEST BOX: APPRAISAL

At the outset of the comparative trials the only stack-nest box available to Seafish specification (Appendix 1) was the GPG C1519. The box was new and untried at sea and consequently the trials were an opportunity to thoroughly evaluate the box. Whilst the trials continued another manufacturer, Allibert, produced their own version of a box to the same specification.

7.12.1 Box handling

First impressions of the box by both fishermen and processors were generally favourable with much comment as to its robust appearance

and feel. To achieve maximum internal length the designer moved away from conventional stack-nest practice and moved the stacking pillars to the box sides. This gave the advantage of retaining the same internal length as the existing wooden box which would have been reduced if the pillars were kept to the ends. Unfortunately this created two problems when handling the boxes. Firstly the box lifting handles became inaccessible when boxes were nested (section 7.8). This was more of a nuisance factor and could easily be overcome if the box were in more general use. Secondly, it was not easy to drag a loaded box away from the top of a stack without the box jamming (section 7.8). On one corner the box pillar has to cross the nesting recess of the box below. It is here that the box loses its support on that corner and twists, the pillar then jamming on the side of the recess column. This can be avoided if space is available to one side of the box being removed, simply by pulling the box across the top rims of two adjacent boxes. It can also be overcome by inserting a 25mm diameter piece of tube beneath the box being moved and across the top rim of the box below to give support and prevent the box twisting. This problem is not considered serious. Some improvement could be achieved if the nesting recess at either end were chamferred to a depth of 50mm but this would have to be considered alongside box strength and tool design.

Apart from the above mentioned criticisms the box handled at sea very well indeed and was liked by crew using it.

7.12.2 Box damage

7.12.2.1 At the start of the trial in June 1986, 1000 GPG boxes were available and were used until the end of December. The first sign of any damage was seen during the trials on ROSEBAY when it was observed that some boxes had shallow cuts on the top rim and nest stops at the box ends. This was considered a result of crew catching the box with their gutting knives whilst gutting.

7.12.2.2 In order to prevent boxes jamming together when nested and thereby ease separation, most stack nest box designs incorporate nest stops which are usually integral with the box top rim. On the new GPG design they are located at the box ends on either side of the handholes and also act as lifting points for fork lift truck handling. The stops are a simple open ended box structure and are designed to support up to five stacked and loaded boxes when used with fork lift truck. Towards the end of July it was noticed on a few boxes that the outer vertical part of these nest stops were slightly buckled, the damage occuring at one end of the box only (Figure 34). It was thought that this was probably the result of a stack of nested boxes being dragged off the end of a flat bed lorry when the boxes would inevitably land on one end and thus account for the damage seen. Thereafter the number of boxes so damaged increased throughout the trial. By November there would usually be one or two such boxes in every 20 stack of nested boxes. The distortion seen did not prevent the box nesting but would have tended to make handling by fork lift more unstable with loaded stacks and was clearly not satisfactory.

At Kinlochbervie, prior to the trials there, one instance was found of the nest stops having collapsed completely at both box ends (Figures 35 and 36). This resulted in the box nesting completely into the bottom of the box below it, causing considerable distortion and cracking. It must be stressed that this was an isolated case. Two other possible causes of nest stop collapse are wedging of nested stacks between deckhead and fishroom floor and also stacking loaded boxes in the fishroom on top of a nested box (this to give separation from fishroom floor without losing a full box height). Although both of these practices would tend to cause collapse at both ends as seen at Kinclochbervie the collapse most likely occured between

box washing and arrival as boxes are separated at the box washing plants. The problem was reported to G.P.G. during the trials who immediately took steps to strengthen the nest stops.

7.12.2.3 To give a visual indication of box orientation the box has two shallow recesses moulded into the top rim at one end and into which are put coloured plastic inserts. The recesses form a discontinuity in box beam structure of the top rim and, although modified by GPG shortly after production of the box began, this was not included on the 1000 trials boxes. By November, when the boxes had been in use for six months, there were a few instances of boxes split vertically from the bottom corner to the top, through the coloured indicator (Figure 37). It has been assumed that the modification introduced by GPG will prevent this from occuring.

7.12.2.4 As a direct replacement for the wooden box it is inevitable that existing handling practices will tend to be used. To a limited extent this was sometimes allowed to happen in order to ascertain how the box would perform. Two areas of concern were observed during unloading from the fishroom. The first involved moving stacks of loaded boxes to the fishroom hatch. It was obviously preferable for crew to drag a full stack than manhandle individual boxes (7.12.1) and so stacks up to six high were manually dragged by the handle of the bottom box from one end. This put considerable strain on the handle especially when the crew started to use the unloading winch to lift box stacks up to eight high at one end to facilitate stack movement.

However the handles appeared to stand up to the punishment with no breakage.

When unloading, the vessels standard box unloading hooks were sometimes used in place of the special designs of hook

prepared for the trials. The standard hook arrangement was made up of a double legged sling with chain legs. The two point lift meant that the chain legs cut into the top box rims in way of the handle rather than against the strenghtened rim as would occur when using a four point lift. Boxes distorted whilst under this load and handles showed slight kinking on the top rim (Figure 21). Clearly use of the specially designed landing hooks is a must if box damage is to be avoided.

7.12.2.5 Following the theme of 7.12.2.4, boxes are also dragged around on the concrete fish market floor. In this situation some abrasion of the box base is inevitable and allowed for in the box design. Nevertheless the abrasion seen on several boxes seemed to concentrate on box ends and be somewhat excessive. This is only an observation but these boxes were only used for six months and with nothing like the number of handling cycles that would occur if used in full commercial sense. The use of a box barrow or fork lift would overcome this problem.

7.12.3 General Comments

7.12.3.1 Box Capacity - The box specification asks for a "working storage capacity of at least 70 litres" (Appendix 1 section 1.3). Measurement carried out by Seafish staff indicates that the GPG box has in fact a capacity of 69 litres, which includes the space above the box created by the convex nature of the box bottom when stacked. This is not considered detrimental as the box proved quite capable of containing the nominal design load of 45kg (7 stone) of fish and 15kg of ice.

7.12.3.2 Box Top Rim - The box specification states "The box top rim structure running along the long side of the box should have a minimum external depth of 50mm" (Appendix

1, Section 1.7). The GPG box has such a rim of only 45mm depth as the company based their design of the moulding tool on original draft specification, which did not include this requirement.

The purpose of the rim depth requirement is to prevent the side lips of boxes riding up on one another when stowed at sea. This can occur due to a combination of uneveness in the floor and movement due to tolerance in the fishroom squaring. During the trials the 45mm box rims proved to be perfectly adequate but one must bear in mind that all trials vessels fishrooms were squared to suit the boxes under direct supervision of Seafish staff. The limitation of rim depth might prove more troublesome in fishroom's with greater dimensional tolerances.

7.12.4 Design Changes

In view of the problem with nest stops (7.12.2.2) and concern with the box top rim (7.12.3.2) a considered solution would be to extend the box top rim to nest stop depth around all four sides. This would create a box rim depth of 85mm and also give a nest stop around the box on all sides. It is appreciated that this would require a new moulding tool but boxes so made would be compatable with the existing design.

The probem of sliding one box away from another (7.12.1) should also be considered as this was effectively the only real handling problem that was encountered during the trials.

8. CONCLUSIONS & RECOMMENDATIONS

8.1 The trials demonstrated that plastic boxes of both type can be used at sea.

8.2 The successful use of plastic boxes at sea depends upon proper box handling and stowage procedures being used, including some modifications of fishrooms to suit box dimensions.

8.3 The stability and strength of the stack-nest box used proved suitable for use at sea.

8.4 The fishroom capacity was not adversely effected by use of stack-nest boxes but some losses may occur if stack-only boxes are used without overfilling because of the stowage space required for the boxes when empty.

8.5 No significant difference in ice loss or quality between stack-only and stack-nest plastic boxes was found when used at sea. Ashore there was a difference in favour of stack-only if boxes were stood on an open quay or lorry on a windy day.

8.6 When used in the fishroom the stack-nest boxes were shown to have handling advantages.

8.7 Trials vessel crews preferred to use the stack-nest box.

8.8 When used on the working deck the system devised for the stack-nest boxes allowed them to be successfully used in place of wood. However further work is still required in this area to solve some residual problems.

8.9 The quality of fish landed in both types of plastic box was excellent when compared to that in wooden boxes and demonstrated what could be achieved if boxes are not overfilled and are adequately iced.

8.10 Overall the prices paid for fish in correctly filled plastic boxes was better than for wood reflecting the merchants confirmation of the improved quality of fish landed in plastic boxes.

8.11 When 50kg (8 stones) instead of 45kg (7 stones) of fish was put into the trials plastic boxes this had a detrimental effect on fish quality.

8.12 The trial demonstrated the importance of good fishroom insulation. Ice loss to both box types was significant at the fishroom sides, floor and deckhead.

8.13 Some remedial work in the fishroom is inevitable if plastic boxes are used. This work is minimised if the box has the same length and breadth as the wooden one.

8.14 Seafish have produced a set of recommended fishroom conversion procedures to follow when stack-nest boxes are to be used. These should be closely followed for best results.

9. REFERENCES

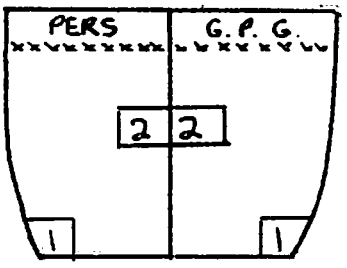
1. H. McDiarmid, R.J.A. Nicholson. Internal Report No. 1213. April 1985. North of Scotland Box Pool Proposal - A Feasability Study.

2. H. McDiarmid. Internal Report No. 1267. March 1986. Some Points on the Selection of Boxes for North of Scotland

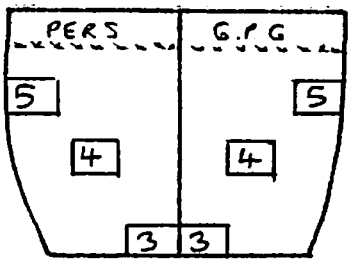
BOX TRIALS ICE LOSS DATA — TABLE 3

VESSEL	ROSEBAY	AMBIENT °C	13-16	TRIP No.	1
PORT	PETERHEAD.	FISH °C	10-15	JUNE 22-27	

BOX CODE	AGE (days)	SPECIES PERS / G.P.G.	FISH WT. (kg) PERS	FISH WT. (kg) G.P.G.	ICE WT. (kg) PERS	ICE WT. (kg) G.P.G.	ICE DIF. +/- (kg)	CONDITIONS EFFECTING ICE LOSS
1	4	W	45.0	45 0	1.9	1.6	-0.3	No bottom ice - fishroom floor
2	3½	H	45.0	45.5	5.2	4.2	-1.0	Most ice in box bottom
3	2½	W / H	45.9	45.1	6.5	9.5	+3.0	Pers little bottom ice. Floor.
4	2	L	46.3	46.6	10.7	10.9	+0.2	
5	1½	He	45.3	45.3	9.1	7.3	-1.8	
6	1	H	45.0	45.2	9.2	12.6	+3 4	Pers less top ice. Deckhead warmer out PERS side.
MEANS			45.4	45.4	7.1	7.7	+0.6	



TIER 1 (Bulkhead)



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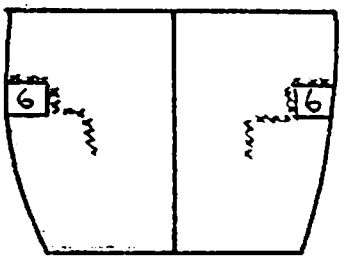


TIER 3

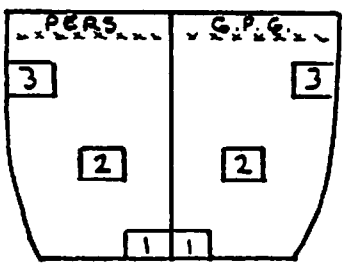
NOTE

1. H - Haddock W - Whiting L - Ling He - Herring
2. Ice scoop top and bottom of each box Scoop 8.0kg. tube ice.

BOX TRIALS ICE LOSS DATA — TABLE 4

VESSEL	ROSEBAY	AMBIENT °C	12-15	TRIP No.	2
PORT	PETERHEAD	FISH °C	10-14	30 JUNE-4 JULY	

BOX CODE	AGE (days)	SPECIES PERS / G.P.G.	FISH WT. (Kg) PERS	FISH WT. (Kg) G.P.G.	ICE WT. (Kg) (TOP & BOTTOM) PERS	ICE WT. (Kg) (TOP & BOTTOM) G.P.G.	ICE DIF. +/- (Kg)	CONDITIONS EFFECTING ICE LOSS
1	4	H	44.6	45.1	2.1 0.6	3.4 1.0	+1.7	Little bottom ice - floor
2	3½	H	45.0	45.6	3.9 4.4	3.2 2.3	-2.8	
3	3	H	44.9	46.1	4.6 3.4	2.3 2.7	-3.0	
4	3	H	44.6	45.3	5.4 3.0	3.2 1.2	-4.0	G.P.G. little bottom ice - floor .
5	2½	H	44.5	44.9	4.7 2.2	2.2 3.4	-1.3	
6	2½	H	44.8	46.0	3.8 5.9	3.1 6.3	-0.3	
7	2	H	45.0	44.8	3.5 4.6	4.3 4.8	+1.0	
8	2	H	44.7	45.0	3.7 4.7	4.1 4.8	+0.5	
9	1½	H	44.7	44.8	3.2 5.9	4.6 5.4	+0.9	
10	1	H	45.2	44.9	3.9 5.4	3.1 5.6	-0.6	
MEANS			44.8	45.2	7.9	7.1	-0.8	



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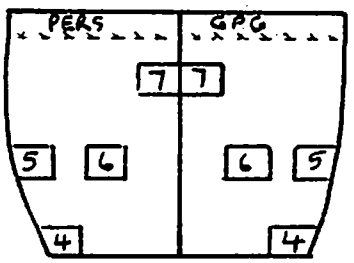

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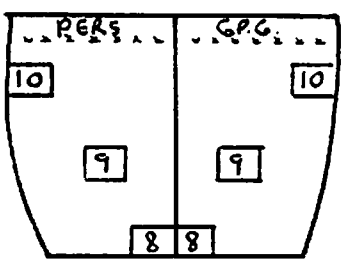


TIER 3

NOTE

1. H - Haddock
2. Ice scoop top and bottom of each box. Scoop 8.0kg tube ice.

BOX TRIALS FISH AND ICE WEIGHT DATA TABLE 5

VESSEL	ROSEBAY JULY 7-11 TRIP 3 G.P.G.										
AGE (days)	4	4	4	4	3	3	2	2	2		
SPECIES	H	H	H	H	H	C	H	H	H		
FISH WT.(Kg)	47.1	50.3	51.7	54.4	56.7	58.0	50.3	53.5	49.4		
ICE (Kg) Top.[2]	–	–	–	–	–	–	–	–	–		
Bottom	1.8	2.2	2.2	1.8	2.7	0	1.3	1.8	3.1		
COMMENT	1. FISH NOT WEIGHED AT SEA. 2. BOXES RE ICED ON MARKET. NO TOP ICE MEASUREMENT. 3. FISH QUALITY POOR, SOME CRUSHING.										

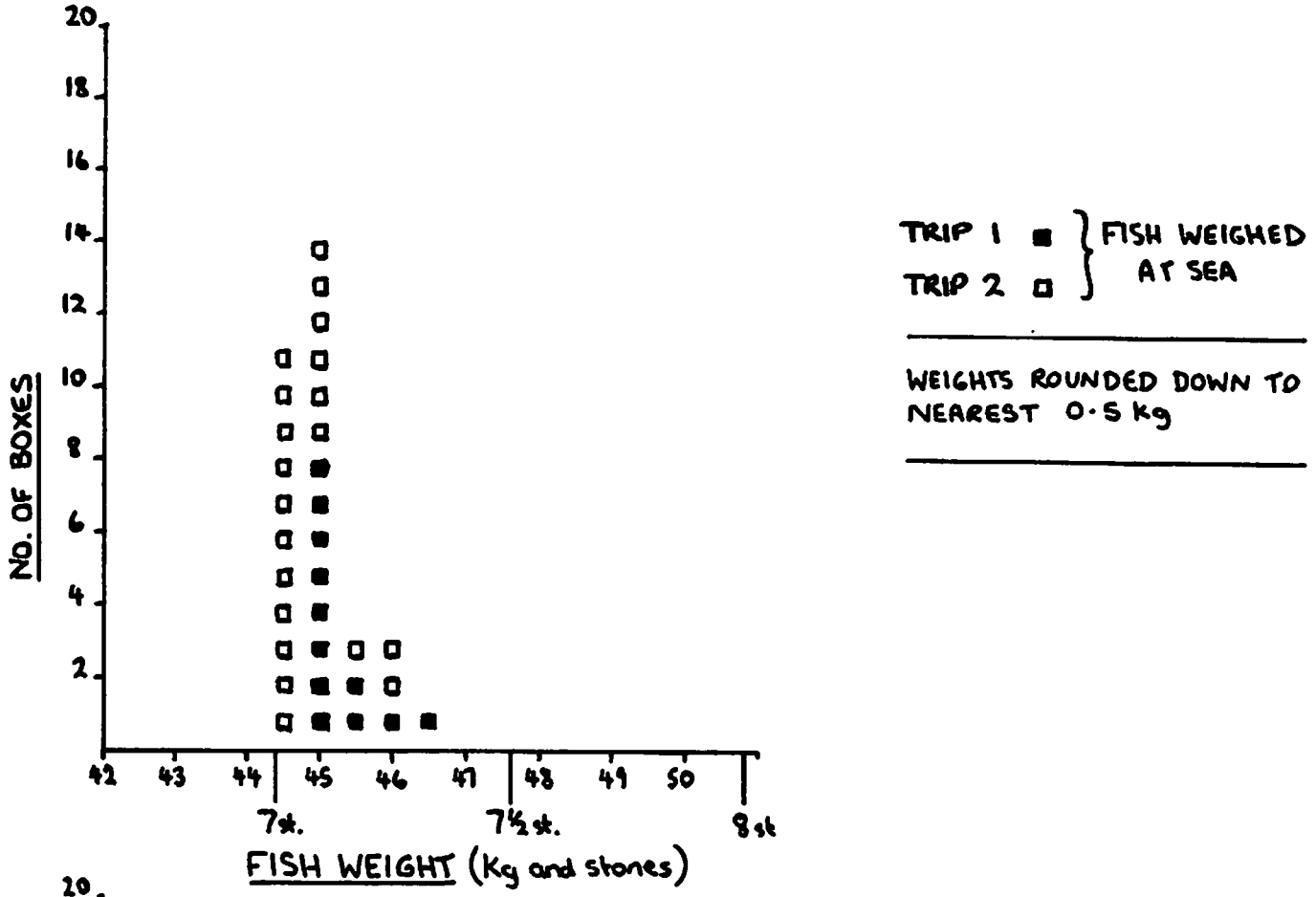
VESSEL	ROSEBAY JULY 14-17 TRIP 4 G.P.G.										
AGE (days)	–	–	–	–	–	–	–	–	–	–	
SPECIES	C	C	C	C	H	H	W	S	S	M	
FISH WT.(Kg)	55.0	48.0	51.0	53.0	50.5	49.0	52	54	49	57	
ICE(Kg) Top	–	–	–	–	–	–	–	–	–	–	
Bottom	–	–	–	–	–	–	–	–	–	–	
COMMENT	1. Readings, courtesy of D.A.F.F.S.										

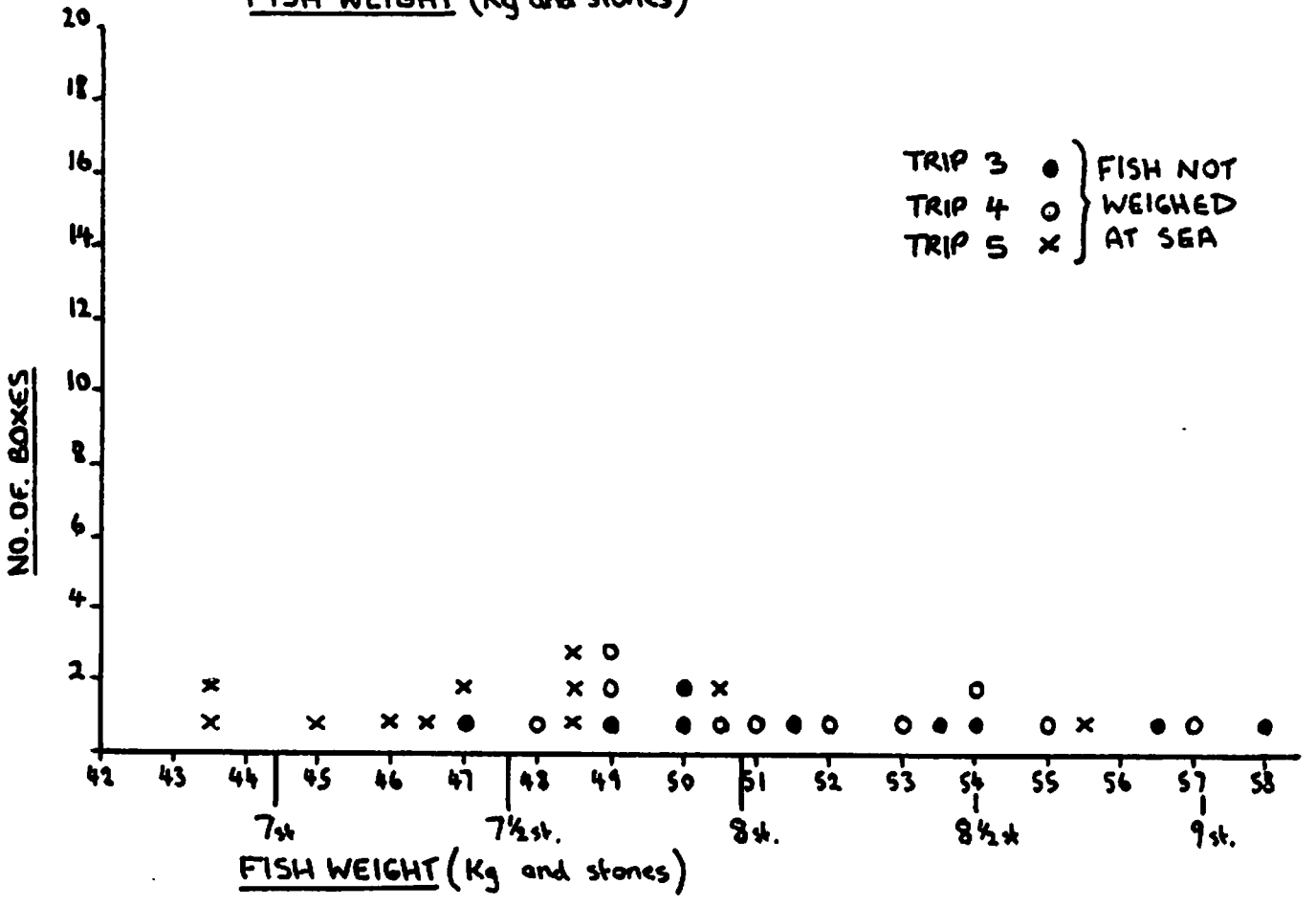
VESSEL	ROSEBAY July 21-25 TRIP 5 G.P.G.										
AGE (days)	–	–	–	–	–	–	–	–	–	–	–
SPECIES	H	H	H	H	H	C	C	H	H	H	W
FISH WT.(Kg)	43.8	43.5	48.8	47.1	45.1	46.5	55.7	48.7	48.8	46.2	50.6
ICE(Kg) Top	–	1.9	2.5	4.8	2.7	3.3	1.0	1.8	2.7	2.0	3.1
Bottom	5.6	7.5	3.6	5.1	5.3	4.1	3.9	2.6	4.8	4.6	0.2
COMMENT											

H - Haddock
C - Cod
W - Whiting
S - Saithe
M - Monkfish

COMPARISON OF FISH WEIGHTS WITH AND WITHOUT ON BOARD WEIGHING - ROSEBAY

TABLE 6

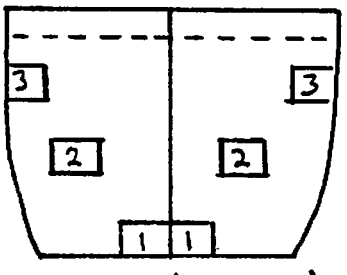




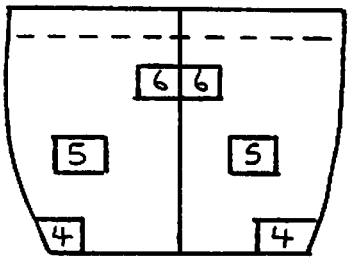
BOX TRIALS ICE LOSS DATA — TABLE 7

VESSEL	RIVAL			AMBIENT °C	12.2 – 16.8	TRIP No.	1
PORT	BUCKIE			FISH °C	—	JULY 6-11	

BOX CODE	AGE (days)	SHRIMP + ICE (kg) PERS	SHRIMP + ICE (kg) G.P.G	SHRIMP (kg)	ICE WT. (kg) PERS	ICE WT. (kg) G.P.G.	ICE DIF. +/− (kg)	CONDITIONS EFFECTING ICE LOSS
1	4	36.3	36.4		8.8	8.9	+0.1	EXTRA 1/2 SCOOP IN BOX BOTTOMS FALSE FLOOR
2	3½	33.0	31.1	G.P.G 27.1	5.5	3.9	-1.6	
3	3	32.1	31.1	PERS 28.7	3.4	3.6	+0.2	
4	2½	32.2	33.0		4.7	5.5	+0.8	FALSE FLOOR
5	2½	36.4	35.1	G.P.G. 27.3	7.9	7.8	-0.1	
6	1½	32.1	34.5	PERS 27.1	5.0	7.0	+2.0	
7	1½	36.1	37.9		8.6	10.4	+1.8	FALSE FLOOR
8	1	35.0	35.2	G.P.G. 27.5	7.5	7.7	+0.2	
9	1	31.5	33.0	PERS 27.5	4.0	5.5	+1.5	
MEANS					6.2	6.7	0.5^{+}	



TIER 1 (Bulkhead)



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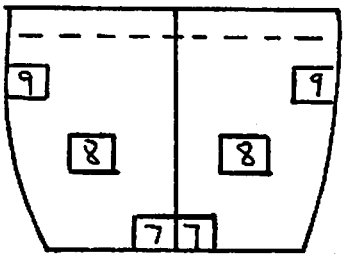


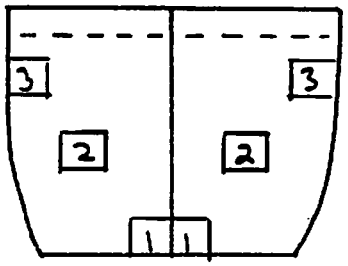
TIER 3

NOTE
1. ALL BOXES CONTAIN PINK SHRIMP.
2. MEAN SHRIMP WEIGHT OF 27.5kg ASSUMED FOR OBTAINING ICE WEIGHTS.
3. FALSE FISHROOM FLOOR FITTED TO SQUARE WITH BULKHEAD.
4. SHRIMP + ICE WT. OBTAINED AS UNLOADED FROM FISHROOM ONTO QUAY.
5. ICE SCOOP TOP AND BOTTOM OF EACH BOX. SCOOP 7.5kg PLATE ICE

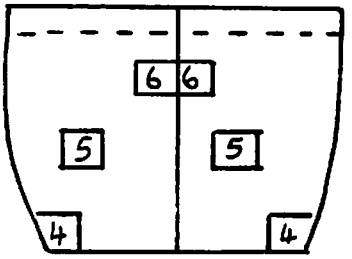
BOX TRIALS ICE LOSS DATA — TABLE 8

VESSEL	RIVAL			AMBIENT °C	12–16	TRIP No.	2
PORT	BUCKIE			FISH °C	SHRIMP 13·5		

BOX CODE	AGE (days)	SHRIMP + ICE (kg) PERS	SHRIMP + ICE (kg) G.P.G	SHRIMP (kg)	ICE WT. (kg) PERS	ICE WT. (kg) G.P.G.	ICE DIF. +/− (kg)	CONDITIONS EFFECTING ICE LOSS
1	3	29.3	21.6	PERS	1.6	1.9	+0.3	EXTRA ½ SCOOP IN BOX NOTE 5. BOTTOMS
2	3	31.9	29.6	26.7 28.2	5.2	1.4	−3·8	"
3	2½	29.2	30.7	G.P.G	1.5	3.0	+1.5	"
4	2	32.3	30.4		4.2	2.5	−1.7	"
5	2	33.1	28.3	PERS 28.0	5.1	0.6	−4·5	"
6	1½	31.0	28.2		3.3	0.5	−2·8	"
7	1½	34.6	30.3	PERS	6.9	2.6	−4·3	"
8	1	30.2	29.1	27.1 28.2	3.1	0.9	−2·2	"
9	1	32.7	33.4	G.P.G	5.0	5.7	+0.7	"
MEANS					4.0	2.1	−1.9	



TIER 1 (Bulkhead)



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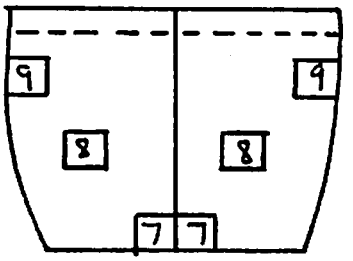


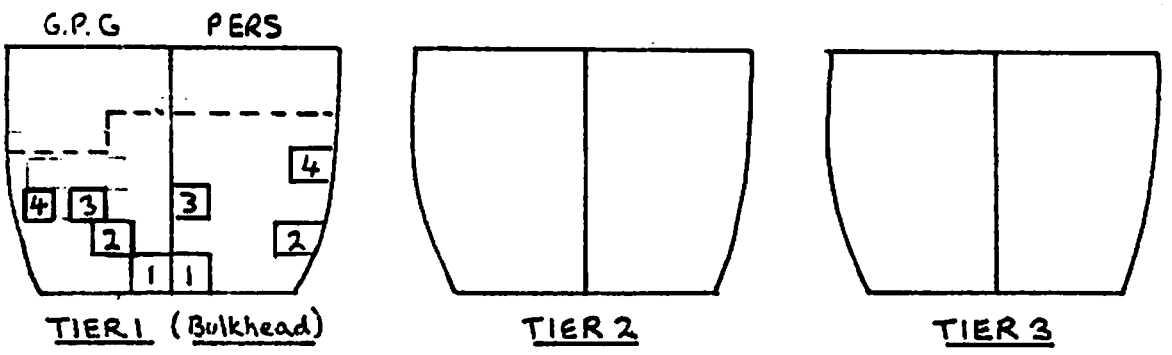
TIER 3

NOTE
1. ALL BOXES PINK SHRIMP
2. MEAN SHRIMP WEIGHT OF 27·7 kg ASSUMED FOR OBTAINING ICE WEIGHTS
3 FALSE FISHROOM FLOOR FITTED TO SQUARE WITH FISHROOM
4 SHRIMP + ICE WT. OBTAINED AT FACTORY SOME 2 HOURS AFTER UNLOADING.
5. BOXES EXPOSED ON QUAY IN STRONG WIND WHILST UNLOADED.
6. ICE SCOOP TOP AND BOTTOM OF EACH BOX. SCOOP 7·5 kg PLATE ICE

BOX TRIALS ICE LOSS DATA — TABLE 9

VESSEL	RIVAL	AMBIENT °C	—	TRIP No.	3
PORT	BUCKIE	FISH °C	—	JULY 20-24	

BOX CODE	AGE (days)	SPECIES PERS / G.P.G.	FISH WT. (kg) PERS	FISH WT. (kg) G.P.G.	ICE WT. (kg) PERS	ICE WT. (kg) G.P.G.	ICE DIF. +/- (kg)	CONDITIONS EFFECTING ICE LOSS
1	3		24.9	25.4	4.9	4.9		EXTRA ½ SCOOP IN BOX BOTTOM. FALSE FLOOR.
2	2½		26.3	24.9	6.3	2.7		NOTE 2
3	1½		26.3	26.7	5.4	5.8		"
4	1		26.3	25.4	8.1	7.2		"
			25.4	26.7				
			25.4	25.8				
			25.4	25.8				
			25.4	25.4				BOX WTS. TAKEN TO CHECK ACCURACY WHEN WEIGHING PRAWNS AT SEA
			24.9	26.7				
			28.5	26.3				
			26.7	26.3				
			24.0	26.3				
MEANS			25.8	25.9				



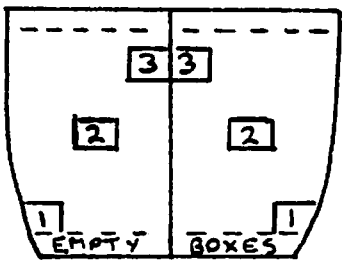
TIER 1 (Bulkhead) TIER 2 TIER 3

NOTE : 1. ALL BOXES CONTAIN PRAWNS - MAINLY TAILS
2. BOX WEIGHTS OBTAINED 1½ HOURS AFTER UNLOADING FISH ROOM.
3. CREW SET UP CODED SAMPLES AT SEA.
4. WHEN UNLOADED SUN SHINING AMBIENT 11.5 °C.

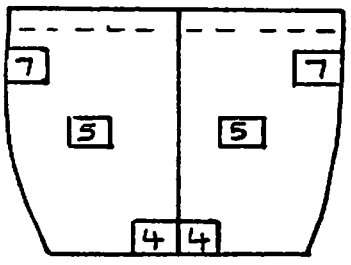
BOX TRIALS ICE LOSS DATA — TABLE 10

VESSEL	FRAGRANT CLOUD	AMBIENT °C	12-16	TRIP No.	2
PORT	PETERHEAD	FISH °C	—	AUG. 11 – 19	

BOX CODE	AGE (days)	SPECIES PERS / G.P.G.	FISH WT. (Kg) PERS	FISH WT. (Kg) G.P.G.	ICE WT. (Kg) PERS	ICE WT. (Kg) G.P.G.	ICE DIF. +/- (Kg)	CONDITIONS EFFECTING ICE LOSS
1	7	W	45.0	45.1	3.3	4.1	+0.8	
2	7	C	45.5	47.5	6.1	2.6	-3.5	
3	6	H	44.5	47.2	1.5	2.6	+0.9	
4	6½	W	—	46.6	—	0.5	—	No bottom ice. Fishroom floor
5	6	W	45.1	45.0	6.4	8.2	+1.8	
6	5	W	45.9	46.1	0.5	1.7	+1.2	No bottom ice. Fishroom floor
7	4½	H	45.5	45.6	4.1	1.1	-3.0	
8	4	H	45.6	45.5	6.8	6.5	-0.2	
9	4	H	45.9	45.1	9.0	4.5	-4.5	
10	3½	H	44.5	47.0	1.5	2.0	+0.5	Ice top and bottom. Fishroom floor
11	2	HR	—	45.3	—	6.2	—	
12	2	HR	45.2	44.8	1.0	4.0	+3.0	
MEANS			45.2	45.9	4.0	3.7	-0.3	



TIER 1 (Bulkhead)



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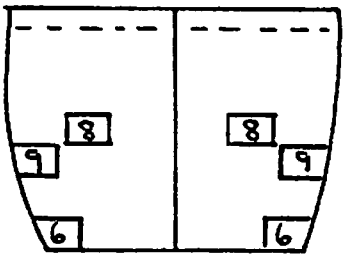
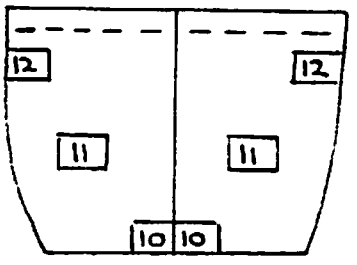


TIER 3

NOTE 1. H - Haddock
HR - Haddock Round
C - Cod
W - Whiting

2. Samples 4 and 11 Pers slipped from unloading hooks

3 Ice scoop top and bottom Scoop 9.0kg tube ice

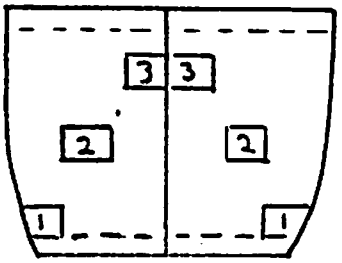


TIER 4

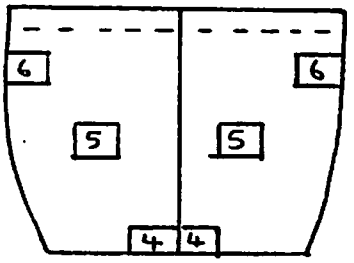
BOX TRIALS ICE LOSS DATA — TABLE 11

VESSEL	FRAGRANT CLOUD	AMBIENT °C	13–16	TRIP No.	3
PORT	PETERHEAD	FISH °C	12	AUG	21–28

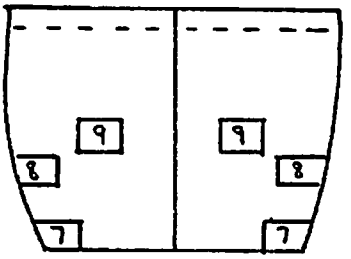
BOX CODE	AGE (days)	SPECIES PERS / G.P.G.	FISH WT. (kg) PERS	FISH WT. (kg) G.P.G.	ICE WT. (kg) (TOP + BOTTOM) PERS	ICE WT. (kg) (TOP + BOTTOM) G.P.G.	ICE DIF. +/− (kg)	CONDITIONS EFFECTING ICE LOSS
1	6	H	45.0	44.8	4.0 0.0	1.3 1.0	−1.7	Fishroom floor, No empty boxes under
2	6	H	44.7	46.0	2.2 1.8	2.3 1.9	+0.2	
3	5½	C	48.4	47.7	2.9 1.7	4.4 1.0	+0.8	
4	5	W / H	50.8	45.4	1.5 0	1.6 0	+0.1	No bottom ice. Fishroom floor
5	5	W	48.2	46.0	3.0 2.8	3.2 3.4	+0.8	
6	4	H	45.7	46.2	3.9 3.4	3.1 1.2	−3.0	
7	4½	H	—	46.0	—	1.4 1.0	—	Little bottom ice. Fishroom floor.
8	4	H	46.4	—	2.4 2.6	—	—	
9	4	W / C	46.3	47.5	3.6 5.1	1.4 2.4	−4.9	
10	4	H	46.3	44.9	2.5 0	3.0 1.9	+2.4	PERS no bottom ice. Fishroom floor
11	3½	W / HR	47.9	44.7	5.4 3.2	2.4 2.8	−3.4	
12	3	HR / WR	46.8	45.3	1.7 1.5	1.3 1.4	−0.5	
MEANS			46.9	45.8	5.0	4.1	−0.9	Results 7 and 8 not included.



TIER 1 (Bulkhead)



TIER 2

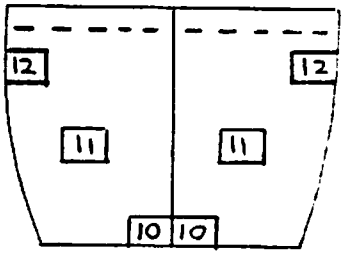


TIER 3

NOTE 1. H - Haddock
HR - Haddock Round
W - Whiting
WR - Whiting Round
C - Cod

2 Samples 7 PERS & 8 GAC lost when unloading

3. Ice scoop top and bottom Scoop 9.0 Kg tube ice

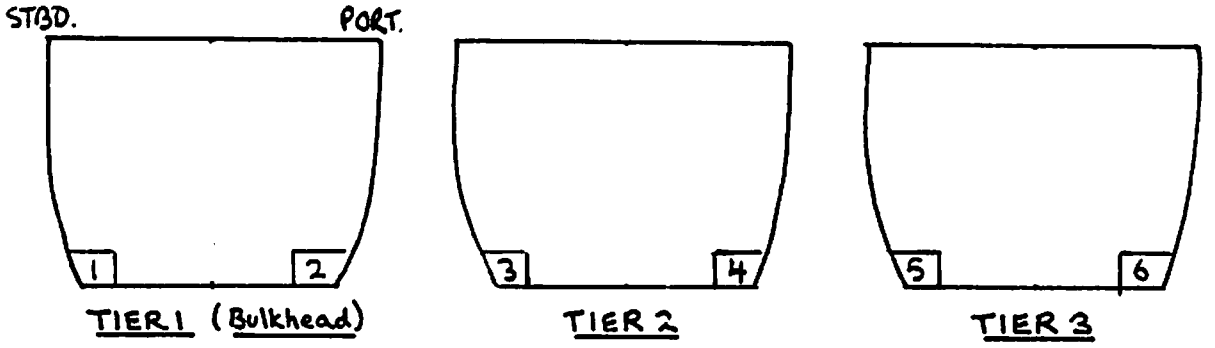


TIER 4

BOX TRIALS ICE LOSS DATA — TABLE 12

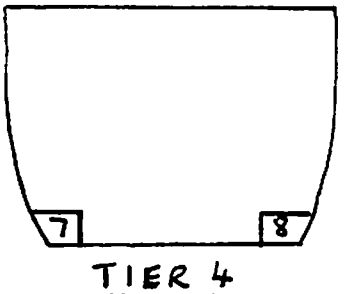
VESSEL	FRAGRANT CLOUD	AMBIENT °C	—	TRIP No.	4
PORT	PETERHEAD	FISH °C	—	AUG 30 - SEPT 6	

BOX CODE	AGE (days)	SPECIES PERS / G.P.G.	FISH WT. (Kg) PERS	FISH WT. (Kg) G.P.G.	ICE WT. (Kg) (TOP + BOTTOM) PERS	ICE WT. (Kg) (TOP + BOTTOM) G.P.G.		CONDITIONS EFFECTING ICE LOSS
1	6	H		44.5		2.0 0		FISH TEMP BOX TOP 0.5 - 2.0°C BOTTOM 2.0 - 3.0°C
2	6	H		46.7		0		FISH TEMP BOX TOP 1.5 - 2.5°C BOTTOM 2.0 - 3.5°C
3	5	H		45.4		1.6 0		FISH TEMP BOX TOP 0.0 - 0.7°C BOTTOM 1.7 - 2.8°C
4	5	C		47.2		0.4 0		FISH TEMP BOX TOP 0.0 - 1.4°C BOTTOM 1.4 - 2.5°C
5	4	W		46.8		2.1 0.5		FISH TEMP BOX TOP 0°C BOTTOM 0.6 - 1.1°C
6	4	H		47.4		2.6 0.5		FISH TEMP BOX TOP 0°C BOTTOM 0.9 - 1.5°C
7	3	H		46.0		2.9 3.0		
8	3	H		47.8		1.7 2.0		
	<3	H		46.8		4.0 0		
	<3	HR		52.3		0.5 2.7		THIS BOX HAD FISH ADDED.
	<3	H		46.3		1.1 2.3		
MEANS				46.4				



NOTE

1. H - Haddock HR - Haddock Round C - Cod W - Whiting
2. Crew assist in obtaining samples
3. No row of empty boxes on bottom of TIER 1
4. Boxes 1-8 taken from known worst positions.
5. Vessel laid in harbour 30hrs before unloading. Water in fishroom.

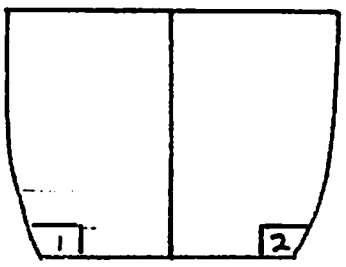


BOX TRIALS ICE LOSS DATA — TABLE 13

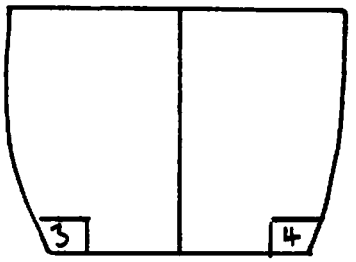
VESSEL	FRAGRANT CLOUD	AMBIENT °C	—	TRIP No.	5
PORT	PETERHEAD	FISH °C	—	SEPT 9 – 18	

BOX CODE	AGE (days)	SPECIES PERS / G.P.G.	FISH WT. (kg) PERS	FISH WT. (kg) G.P.G.	ICE WT. (kg) (TOP & BOTTOM) PERS	ICE WT. (kg) (TOP & BOTTOM) G.P.G.	ICE DIF. +/− (kg)	CONDITIONS EFFECTING ICE LOSS
1	8	W		45.3		0		FISH TEMP BOX BOTTOM 3.8 – 4.6°C
3	7	H		45.3		1.3 0.5		FISH TEMP TOP 0.6°C BOTTOM 2.6°C
4	7	H		45.5		0 0.5		FISH TEMP TOP 0.4°C BOTTOM 2.5°C
5	6	H		46.2		2.1 0.6		FISH TEMP TOP 0.7°C BOTTOM 2.7°C
6	6	M		*58.6		1.2 0.5		FISH TEMP TOP 1.0°C BOTTOM 2.7°C
7	5	H		46.0		1.5 0.7		FISH TEMP TOP 1.0°C BOTTOM 1.8°C
8	5	H		45.6		2.5 4.5		FISH TEMP TOP 0.7°C BOTTOM 0°C
	2	H		46.7		4.9 3.5		
	2	HR		47.1		3.1 3.0		WOODEN BOXES
	2	H		45.6		2.0		
	2	HR		46.1		4.0		
MEANS								

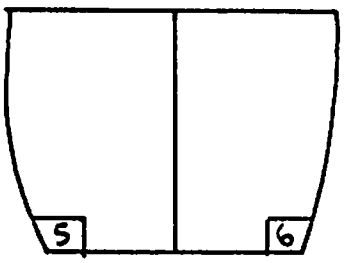
STBD. PORT.



TIER 1 (Bulkhead)



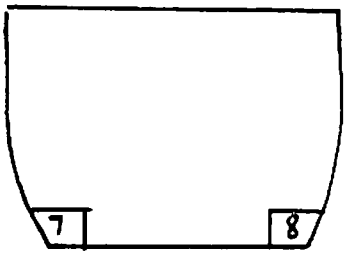
TIER 2



TIER 3

NOTE H - Haddock HR - Haddock Round.
W - Whiting
M - Mixed (Monk & Catfish)

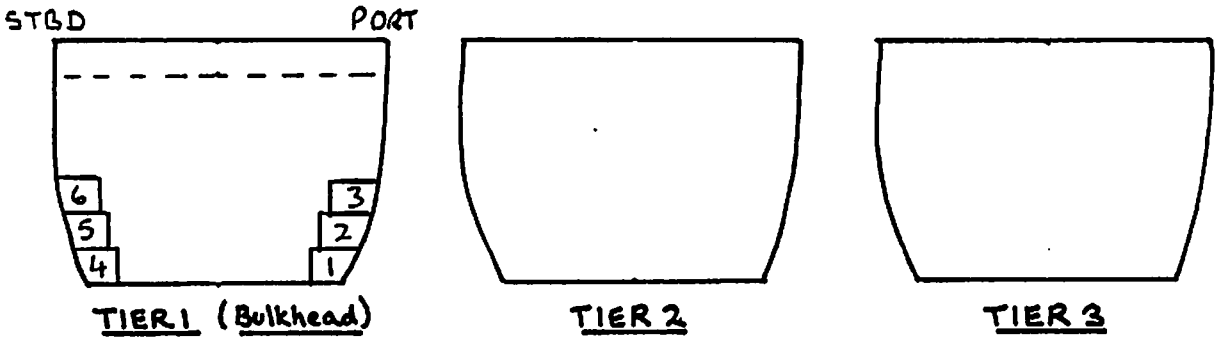
* Mixed fish not weighed



BOX TRIALS ICE LOSS DATA — TABLE 14

VESSEL	SEAGULL	AMBIENT °C	10 - 13	TRIP No.	2
PORT	KINLOCHBERVIE	FISH °C	—	16.10.86	

BOX CODE	AGE (days)	SPECIES PERS / G.P.G.	FISH WT. (kg) PERS	FISH WT. (kg) G.P.G.	ICE WT. (kg) TOP + BOTTOM PERS	ICE WT. (kg) TOP + BOTTOM G.P.G.	ICE DIF. +/- (kg)	CONDITIONS EFFECTING ICE LOSS
1	1	H		45.8		0.5 2.3		
2	1	H		45.4		0.9 2.3		
3	1	H		47.1		1.3 0.2		
4	1	H		45.4		0.9 0.2		
5	1	H		46.7		2.6 2.0		
6	1	H		46.3		1.4 2.0		
	1	H		45.8				Taken at random.
	1	H		47.9				
	1	H		45.4				
	1	H		46.0				
	1	H		44.6				
MEANS								



TIER 1 (Bulkhead) TIER 2 TIER 3

NOTE 1 H - Haddock.
2 Fishroom Fitted with chillers

BOX TRIALS FISH AND ICE WEIGHT DATA TABLE 15

VESSEL	SEAGULL OCT 12-14 TRIP 1 G.P.G.										
AGE (DAYS)	1	1	1	1	1						
SPECIES	H	H	H	H	H						
FISH WT. (Kg)	42.7	48.5	46.0	46.2	47.6						
ICE (Kg) Top.											
Bottom											
COMMENT											

VESSEL	SEAGULL OCT 14-16 TRIP 2 G.P.G.										
AGE (DAYS)	5	5	5	5							
SPECIES	H	H	H	H							
FISH WT. (Kg)	43.5	45.1	44.9	44.2							
ICE (Kg) Top	0.9	1.2	3.0	0							
Bottom	0	0	0	0							
COMMENT	CHECKED AT FISH MERCHANT 1. PREMISES GRIMSBY ON 20.10.86. RECEIVED 18.10.86. TOPS RE-ICED. CHILL NOT OPERATING CORRECTLY (4°C MEASURED) FISH 0-4°C.										

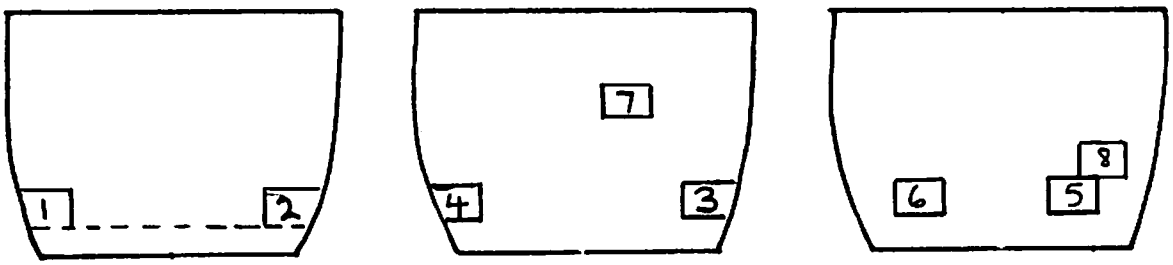
VESSEL	SEAGULL OCT 14-16. TRIP 2 G.P.G										
AGE (DAYS)	5	5	5	5							
SPECIES	H	H	H	H							
FISH WT. (Kg)	47.3	46.0	45.3	45.9							
ICE (Kg) Top	2.4	2.5	1.9	3.8							
Bottom	1.0	0.5	1.6	0.8							
COMMENT	CHECKED AT FISH MERCHANT 2. PREMISES GRIMSBY ON 20.10.86. RECEIVED 18.10.86 AS ABOVE. NO RE-ICING. FISH -0.6 to +0.8 °C										

H - Haddock
C - Cod
W - Whiting

BOX TRIALS ICE LOSS DATA — TABLE 16

VESSEL	SUNBEAM	AMBIENT °C	5.3-9.8	TRIP No.	1
PORT	PETERHEAD	FISH °C	—	NOV 19 - 28	

BOX CODE	AGE (days)	SPECIES PERS / G.P.G.	FISH WT. (kg) PERS	FISH WT. (kg) G.P.G.	ICE WT. (kg) (TOP & BOTTOM) PERS	ICE WT. (kg) (TOP & BOTTOM) G.P.G.	ICE DIF. +/- (kg)	CONDITIONS EFFECTING ICE LOSS
1	9	H		—		—		UNABLE TO ASSESS DUE TO START OF AUCTION. NO ICE ON 2 WITH LITTLE ICE ON 1.
2	9	H		—		—		
3	7	H		45.3		2.8 2.1		
4	7	C		47.6		3.0 2.7		
5	6	C		46.3		4.8 9.5		
6	6	C		44.3		4.1 7.3		
7	4½	HR		45.5		4.0 4.5		
8	4½	HR		45.1		3.2 5.5		
		H		45.0		3.2 6.6		
MEANS								



TIER 1 (Bulkhead) TIER 2 TIER 3

NOTE

1. H - Haddock HR - Haddock Round C - Cod.

BOX TRIALS PRICE COMPARISON TABLE 17

VESSEL	BOX TYPE	FISH WT. / BOX (Stone)	AVERAGE FISH PRICE PER STONE													COMMENT
			COD						HADDOCK					WHITING		
			COD 1	LARGE 1	MED 2	SEL. 3	SMALL 4	BABY 5	LARGE 1	MED. 2	SEL. 3	SEED. 4	ROUND 4	4	ROUND 4	
ROSEBAY 28.6.86	G.P.G.	7	—	5.28	5.42	4.85	3.57	—	—	4.28	3.86	—	2.00	—	1.42	
	PERS	7	—	5.28	5.14	4.07	4.28	—	5.28	4.28	3.42	—	2.00	—	—	
	G.P.G. +/−				O	+ 0.28	+ 0.78	− 0.71		O	+ 0.44		O			
ROSEBAY 4.7.86	G.P.G.	7	—	6.71	5.00	4.28	3.92	—	3.85	3.57	3.35	2.50	—	—	—	
	PERS	7	6.80	6.42	4.00	4.42	—	—	4.00	3.57	3.42	2.50	—	—	—	
	G.P.G. +/−			+ 0.29	+ 1.00	− 0.14			− 0.15	O	− 0.07	O				
MARKET AVERAGE	WOOD	8½	5.80	6.11	4.11	3.76	3.17	—	3.76	3.29	3.29	2.58	—	—	—	
ROSEBAY	G.P.G.	8	8.68	9.23	6.12	5.55	3.75	—	4.92	5.00	4.25	4.06	2.57	2.58	2.83	5 DAY TRIP
FRAGRANT CLOUD	WOOD	8½	8.35	8.39	6.56	5.16	4.82	4.58	4.28	3.48	4.13	3.06	—	—	—	8 DAY TRIP
17.7.86	G.P.G. +/−		+ 0.33	+ 0.84	− 0.44	+ 0.39	− 1.07		+ 0.64	+ 1.52	+ 0.12	+ 1.00				
ROSEBAY	G.P.G.	7½	8.80	7.48	5.82	5.33	4.00	4.00	5.33	3.82	3.48	2.80	—	—	—	
25.7.86																
ROSEBAY	G.P.G	7½	—	8.00	6.66	6.00	4.00	4.16	5.33	4.26	3.93	2.26	—	2.13	—	
1.8.86																

BOX TRIALS PRICE COMPARISON TABLE 18

VESSEL	BOX TYPE	FISH WT./ BOX (Stone)	AVERAGE FISH PRICE PER STONE													COMMENT
			COD						HADDOCK					WHITING		
			COD 1	LARGE 1	MED. 2	SEL. 3	SMALL 4	BABY 5	LARGE 1	MED 2	SEL 3	SEED 4	ROUND 4	4	ROUND 4	
FRAGRANT CLOUD 8.8.86.	PERS & GPG	7	9.14	11.00	6.00	5.46	3.57	2.71	—	2.85	2.85	2.42	—	2.00	—	ONLY 56 BOXES, NOT SEPARATED
FRAGRANT CLOUD 20.8.86.	G.P.G.	7	3.85	4.95	4.45	4.44	3.42	2.57	5.71	5.57	3.88	3.00	3.27	3.04	4.57	REACTION OF BUYERS TO 7 stone UNIT OF
	PERS	7	4.71	6.02	4.28	—	3.42	2.57	5.71	5.28	3.71	2.92	2.42	3.20	2.85	SALE AND ALLEGED UNDERWEIGHT
	G.P.G +/−		− 0.86	− 1.07	+ 0.17		0	0	0	+ 0.29	+ 0.16	+ 0.08	+ 0.85	− 0.16	+ 1.72	
MARKET AVERAGE	WOOD	8½	*7.11	*7.38	5.82	5.11	3.82	3.23	6.41	6.29	5.41	3.11	3.00	3.11	2.64	* 9 stones
FRAGRANT CLOUD 28.8.86	G.P.G	7	8.62	8.87	7.85	8.00	6.71	4.71	5.57	5.57	4.18	3.72	3.67	4.62	4.28	LARGE COD GIVEN
	PERS	7	8.25	8.12	7.14	6.85	5.71	4.85	6.0	4.28	4.15	4.09	3.57	4.42	4.00	GOOD MEASURE. ASSUME 8 stones
	G.P.G. +/−		+ 0.37	+ 0.75	+ 0.71	+ 1.15	+ 1.00	− 0.14	− 0.43	+ 1.29	+ 0.03	− 0.37	+ 0.10	+ 0.20	+ 0.28	
MARKET AVERAGE	WOOD	8½	*8.38	*9.55	8.11	6.47	5.41	4.11	5.82	5.00	4.29	3.58	3.23	3.00	3.47	* 9 stones.
FRAGRANT 6.9.86	G.P.G	7	9.79	9.08	8.23	7.71	7.14	5.41	6.42	4.44	3.45	2.90	2.57	3.73	2.85	
FRAGRANT 18.9.86	G.P.G.	7	10.17	9.37	8.28	7.20	7.21	5.00	6.14	5.57	4.00	2.59	2.28	2.85	—	SAME TRIP.
	WOOD	7			8.28	8.85	7.07	4.28	—	6.42	4.00	2.85	2.65	2.84	2.42	G.P.G. 3-8 days WOOD 1-3 days.
	G.P.G. +/−				0	− 1.65	+ 0.14	+ 0.72	—	− 0.83	0	− 0.26	− 0.37	+ 0.1	—	
FRAGRANT 25.9.86	G.P.G.	7	9.71	9.57	—	8.00	5.52	3.71	8.42	6.28	2.86	2.57	2.43	2.51	2.32	

BOX TRIALS PRICE COMPARISON TABLE 19

VESSEL	BOX TYPE	FISH WT./ BOX (Stone)	AVERAGE FISH PRICE PER STONE													COMMENT
			COD						HADDOCK					WHITING		
			COD 1	LARGE 1	MED. 2	SEL. 3	SMALL 4	BABY 5	LARGE 1	MED 2	SEL 3	SEED 4	ROUND 4	4	ROUND 4	
SEAGULL 14.10.86.	G.P.G.	7			6.14		4.85		7.50	5.92	4.57	3.78	—	3.85	3.14	
	WOOD	9					4.88		7.11	6.05	4.88	3.88				PRICES FOR FISH FROM PAIR PARTNER.
	G.P.G. +/−						− 0.03		+ 0.39	− 0.12	− 0.31	− 0.10				
SEAGULL 16.10.86.	G.P.G	7							5.64	5.07	3.42	2.77	1.85			
	WOOD	9								5.22	3.66	2.77	1.94			PRICES FOR FISH FROM PARTNER VESSEL
	G.P.G. +/−									− 0.15	− 0.24	0	− 0.9			BUYERS NOT CONVINCED 7 stone in boxes.

APPENDIX 1

SPECIFICATION FOR A PLASTIC FISH BOX

With the introduction of a box pool to service the North East Scottish fishing ports a unique opportunity has arisen to introduce a plastic fish box and phase out the existing wooden units. Although this outline specification considers a replacement for the wooden box, due consideration has also been made for the use of such a plastic box in other parts of the U.K., where boxing at sea is either established or being introduced.

It is important to remember that because of the nature of the fishing industry in the U.K. the fish box has to be used by both catching and processing sectors. With the operational environment of each being so different it is inevitable that some compromise is necessary.

1. MAIN FEATURES

1.1 Material

High density polyethylene stablished against the effects of ultra violet light, box washing detergents and extremes of temperature. Although a working temperature will be between $-5^{o}C$ and $+30^{o}C$, extremes can occur in cold storage ($-30^{o}C$) and washing ($+80^{o}C$).

1.2 Type

1.2.1 **Box Type - Stack/Nest** - The stack and nest type box is recommended in order to take advantage of the reduction both in stowage and handling requirements for empty boxes when nested. The potential for mechanical handling of this type of box is also much more straightforward.

1.2.2 **Nest Facility** - When nested, boxes will nest to less than 50% of their stacked volume.

The boxes must pull apart easily and not be prone to jamming into one another.

1.2.3 **Stack Facility** - The stacking location to be positive and easy to locate.

Positive location must not be susceptible to minor box damage or small pieces of ice.

Obvious visual means of ensuring correct box orientation must be provided and include colour identification.

1.3 **Volume - Fish and Ice Capacity**

The box shall have a working storage capacity of at least 70 litres. The gross weight of a box carrying its designed load of 45kg (7 stone) of fish and 15kg of ice shall not exceed 70kg.

1.4 **DIMENSIONS**

1.4.1 **Length, Width** - Prefered external length and width dimensions of the box are to be the same as the existing wooden box i.e. 815mm and 483mm respectively. Boxes of dimensions other than those given may be acceptable to the purchasers but in no case should the dimensions exceed 850mm for length and 555mm for width. (These dimensions relate to restrictions of vessel hatches and refrigerated road vehicle spaces).

The box internal length should be no less than 700mm.

1.4.2 **Depth** - The internal stowage depth to be a minimum of 200mm and maximum of 250mm.

1.5 **DRAINAGE**

Drainage holes with a total clear opening of at least $900mm^2$ to be provided. Such holes to be at least 12mm diameter and to be located along the box sides.

The box must be able to drain when placed on a flat surface. The base of the box should be sloped from its centre to provide positive drainage of melt water to the box sides when the box is carrying its specified load of fish and ice.

1.6 BOX LIFTING

1.6.1 **Manual lifting, handgrips** - Smooth handgrips (hand-holes) to be provided at the box ends whereby the load is taken across the hand and not directly onto the finger tips.

Adequate clearance to be provided to prevent crushing of fingers and must allow for heavy gauge work gloves being worn.

1.6.2 **Mechanical lifting - hoist** - Direct lifting by hoist of up to four loaded boxes in a vertical stack must be allowed for. Although the box design must cater for existing handling methods (section 2.2) these are not ideal for plastic boxes and the opportunity must be taken to introduce the use of specially designed lifting beams or hooks that do not subject the boxes to unnecessary stress.

Direct lifting by hoist of up to 25 empty boxes in a nested vertical stack must be allowed for. Once again the opportunity exists to make use of lifting equipment designed to suit the box.

1.6.3 **Mechanical lifting - fork lift truck** The box outer rim must allow for the lifting of up to four loaded boxes by the tines of a powered or manual fork lift device. The tines must locate at the ends of the box, although some preference will be given to boxes capable of being lifted on their long edge as well. The width of this lip to be at least 20mm.

Where a box is capable of being fork lifted on its base, the box structure must equally be able to withstand the stresses of four loaded boxes lifted together.

1.7 **BOX TOP RIM**

The box top rim structure running along the long side of the box should have a minimum external depth of 50mm and remain vertical throughout this distance. This is to prevent boxes from riding up on one another when stowed at sea and need not be a complete downward extension of the top rim.

1.8 **BOX SIDES**

Ideally, the internal surface of the box walls along its length should have smooth sides. It is accepted however that in order to achieve the required strength criteria (section 2) that some corrugation may be necessary. In order to prevent marking of the fish this must be kept to a minimum, particularly in the lower half of the box.

1.9 **BOX BASE**

Sufficient allowance in the form of rubbing strips or the equivalent must be made for abrasion of the box base during the expected life of the box.

1.10 **BOX WASHING**

All surfaces of the box must be accessible for cleaning. Pockets on box rims must have drain holes to enable wash water to drain away with the box turned upside down. These to have a minimum diameter of 5mm.

2. FEATURES OF THE BOX IN USE

2.1 Stacking in loaded condition

2.1.1 **Vertical loading** - The boxes must be strong enough to stack 3 metres high in a loaded condition at sea. Due consideration must be given to vessel pitching motion which can give additional vertical accelerations of 1g. Although only applied momentarily this additional loading must be allowed for.

2.1.2 **Lateral loading** - When boxes are stacked in loaded condition at sea part of the vertical load is transferred laterally through the box rim as the vessel rolls and is effected once again by vessel pitching motion. Some distortion of the box ends is inevitable but compression in the width of the box should not exceed 10mm when a load of 150kg is applied.

2.2 Unloading boxes from fishroom to quayside

The existing method of removing loaded boxes from the fishing vessel is by means of a double leg sling with hooks locating into the handholds of the bottom box. Although it is intended that lifting systems designed specifically for the box will eventually be used (section 1.6.2) this method of unloading will no doubt continue and the box handle must be able to withstand this. In addition the top rim of the box must withstand the compressive load created by the sling legs.

2.3 DRAGGING BOXES

Manual dragging of loaded or empty boxes, individually or in stacks with long handled hooks is normal practice with wooden boxes. Although more efficient means of moving boxes exist the practice will no doubt remain and box handles and/or rims must allow for this.

2.4 GENERAL HANDLING

2.4.1 **Empty boxes** - Empty boxes are often thrown around and due to their low weight this is not necessarily as individual boxes. An empty box must be able to withstand dropping onto a solid floor through a height of 3 metres without cracking.

2.4.2 **Loaded boxes** - A loaded box must be able to withstand dropping from a height of 1 metre.

APPENDIX 2

COMPARATIVE TRIALS OF PLASTIC BOXES ON SWFPA VESSELS
FISHROOM CONVERSION - M.V. ROSEBAY PD 65

This appendix records and gives a brief outline of the work carried out on the above vessel. The work was undertaken by R. Irvin (Peterhead) during the period 17th-23rd June 1986.

Initial discussions were held with the Skipper - Mr. W. Lawson - during which he stated his wish to use the GPG stack-nest boxes after the trial was complete and not revert back to the use of the conventional wood boxes. It was pointed out to him that we could only let him use the boxes in our possession until they were required for another vessel in the project. This was acceptable to him and he would make approaches to purchase his own.

We therefore agreed that the fishroom would be fully converted to take stack-nest boxes of the GPG design with the main part of the fishroom converted temporarily to experimental standards necessary for the trial and the remainder fitted with 'open plan' posting.

Initial assessment of the main part of the fishroom indicated that the stack-nest boxes could be stowed 7 wide x 6 high with further boxes on a '1 box width' step each side. The height of the boxes was acceptable to the skipper being the same as when wood boxes are used.

A more detailed assessment of this part of the hold showed:

a) the heights of the bilge stringer above the fishroom floor were different between the two sides of the vessel - this would affect the height of the steps.

b) the lining on the engine room/fishroom bulkhead was out of line in two planes - this would affect the stowage of the boxes.

c) the fishroom floor was level between the side keelsons and sloped outboard of these - the slope would affect the stowage of the boxes.

d) the bulkheads and ice pound divisions are not perpendicular to the floor. This does not affect one side of the fishroom but does the other when compounded by the twist in the bulkhead lining.

e) only provisional measurements could be taken in the fore part of the hold on account of the dunnage and empty wood boxes. However it would probably give a better box arrangement and increase ice capacity if the ice pound divisions were moved aft in the order of 10 to 12 inches.

CONVERSION DETAILS

The floor was levelled athwartships by removing the slope of the outer boards. From this base the correct dimensions of the stowage area were determined. Initially the width was determined for the stack-nest boxes and the length determined for the stack-only boxes (the longer of the two being compared). Thus the step side and top positions were fixed together with the position of the aft division of the ice pound.

It was noted that the difference in bilge stringer height necessitated a '2 box' high step being constructed and that the engine room/fishroom bulkhead misalignment necessitated an increase in length of some 2 inches.

The construction of the steps was 1" thick wood boards on 4"x2" frames and th sides ½" thick ply on 4"x2" posts spaced '1 box length' centres.

For the comparison experiment the main part was divided into two by means of a plywood division set ½ a box width to port. The starboard half of the area was selected to stow the stack only boxes since these

boxes required a false lining on the bulkhead and the majority of the twist in the bulkhead occured on the starboard side. The division was in two parts cut from standard sheets and held in place but not fastened, by battens forming a slide on the deckhead. The lower edge of the division was positioned by a batten on one side and held in place by the boxes.

From the division the position of a temporary step and side was determined to suit the stack-only boxes. This side was constructed from 4 x 2" posts sheathed with ½" thick ply.

At this stage of the conversion we were able to remove the dunnage and empty wood boxes from the fore end of the fishroom and determine the requirements for repositioning the forward ice division and the open plan posting to suit the carriage of stack-nest boxes.

A sonar housing was found to be fitted adjacent to the fore bulkhead and partially to port. This housing dictated the fitting of a raised floor and the position of the posts.

It was found that by moving the foremost ice pound division aft 12" and removing the fore and aft board retaining bars a row of boxes lined fore and aft and a row of boxes lined athwartships could be fitted and in addition the ice pound capacity would be marginally increased.

A false floor approximately 5" higher was laid and the sonar housing extended to suit box sizes and the whole posted open plan with 4 x 2" posts.

In order to facilitate the filling of the last row of boxes at the sides abaft the ice pounds, a series of hooks was fitted to retain them from toppling due to the ship motion.

Steel shelf bearers were attached to the inside of the ice pound divisions to enable boxes to be stowed in the pounds in the event of a full fishroom being achieved.

24 boxes could also be stowed in the void under the hatch.

A series of 1" diam. drain holes were drilled in the floor at the aft end.

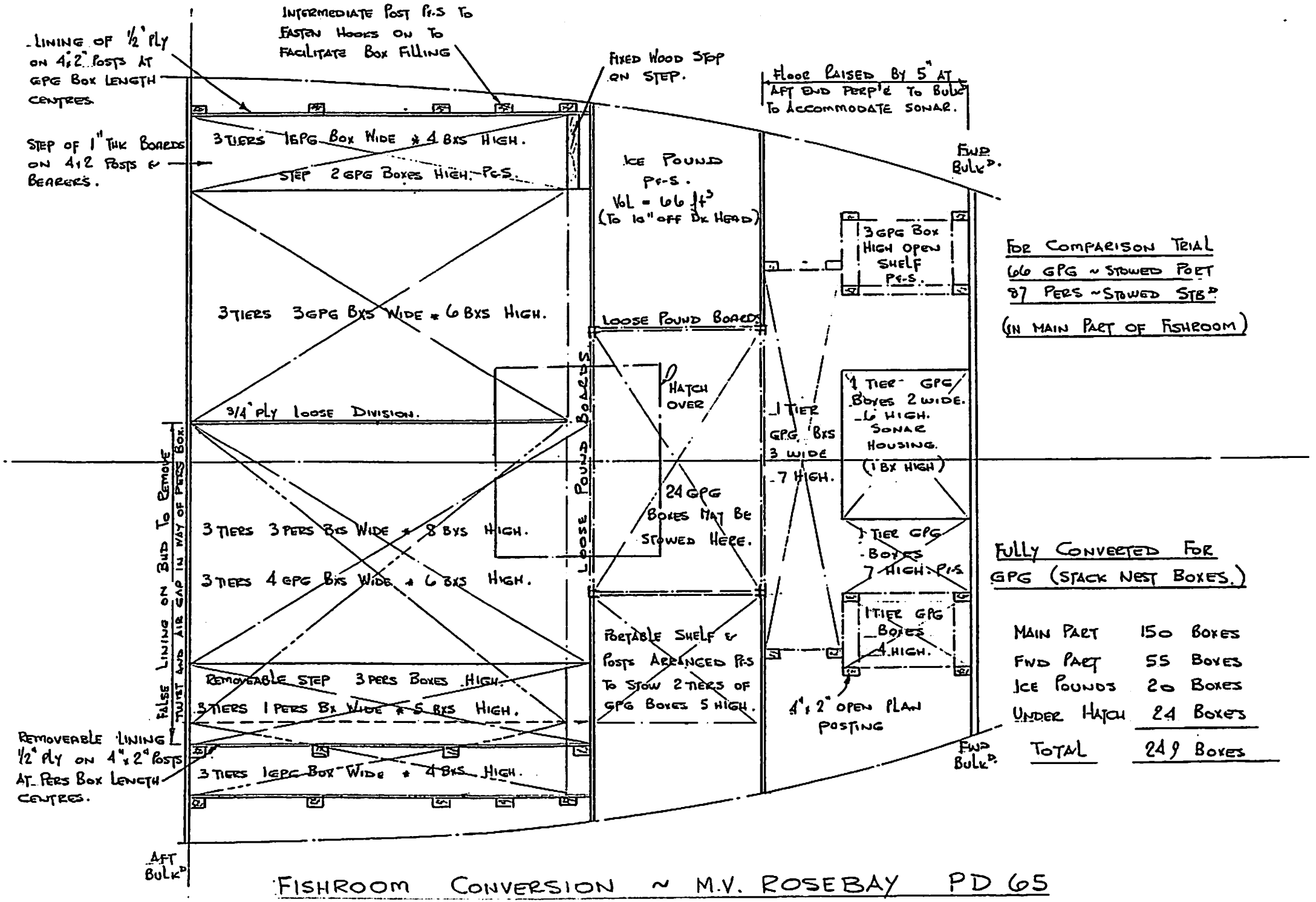
Box stops were also provided for each type of box to prevent forward movement.

Prior to the conversion the vessel carried approx. 220 wooden boxes.

After the conversion the vessel carries 249 GPG stack nest boxes.

A plan of the conversion is attached.

C. BRADY
SENIOR NAVAL ARCHITECT



Fishroom Conversion ~ M.V. Rosebay PD 65

APPENDIX 3

COMPARATIVE TRIALS OF PLASTIC BOXES ON SWFPA VESSELS

M.F.V. RIVAL - FISH ROOM CONVERSION

M.F.V. RIVAL is a trawler which was built in 1953, is 73 feet overall length and fitted with a 200 H.P. engine.

The vessel is used as a prawn and shrimp trawler and at the time of the conversion was fishing for shrimp on approximately four day trips.

The fishroom has two areas for box stowage, forward and aft of the fishroom hatch. The fishroom is divided by the ice pounds adjacent to the hatch.

The normal mode of stowing the catch is to put all shrimp into the aft part of the fishroom and all white fish by-catch into the forward part of the fishroom.

As M.F.V. RIVAL would have to go back to wood boxes immediately after the two week trial period, only a temporary conversion was planned, using only the aft part of the fishroom for plastic box stowage. The white fish was to be stored in wood boxes in the usual place.

The existing stowage arrangement for wood boxes is shown in Fig 1. The quoted number of wood fish boxes capable of being stowed in the aft part of the fishroom was 200.

As the aft part of the fishroom from engine room bulkhead to ice pound bulkhead was exactly three wood boxes long, the ice pound bulkhead was moved forward by 150mm to allow for the planned arrangement of plastic boxes shown in Fig 2.

The longitudinal centreline division was moved further to port than planned in order to a) more nearly balance the number of boxes of each

sort carried and b) keep the total width of box tiers within the limits of the hull frames.

Due to pipework obstructions it was decided to raise the floor at the aft end to make it square to the engine room bulkhead rather than vice versa.

The terracing on the G.P.G. box side was built up to give the required level and even box arrangement. However this arrangement was not used on the PERS box side as the levels of this do not necessarily have to be equal. This arrangement is shown in the profile drawing of Fig 2.

The sides of the fishroom, terracing and floor were all sealed with plywood, but the fishroom bulkhead was fitted with battens to level up the box stacks.

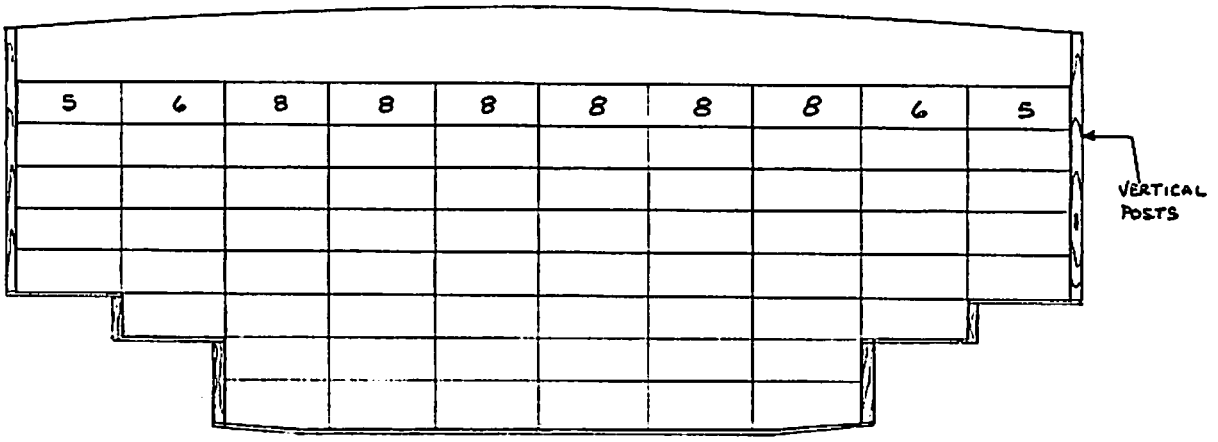
The maximum number of plastic boxes to be stowed in the aft fishroom was 174, divided into 93 G.P.G. and 81 PERS.

N. WARD
NAVAL ARCHITECT

FIG. 1. M.F.V. RIVAL BCK 53

EXISTING FISHROOM ARRANGEMENT

SECTION IN WAY OF AFT FISHROOM



PROFILE OF FISHROOM

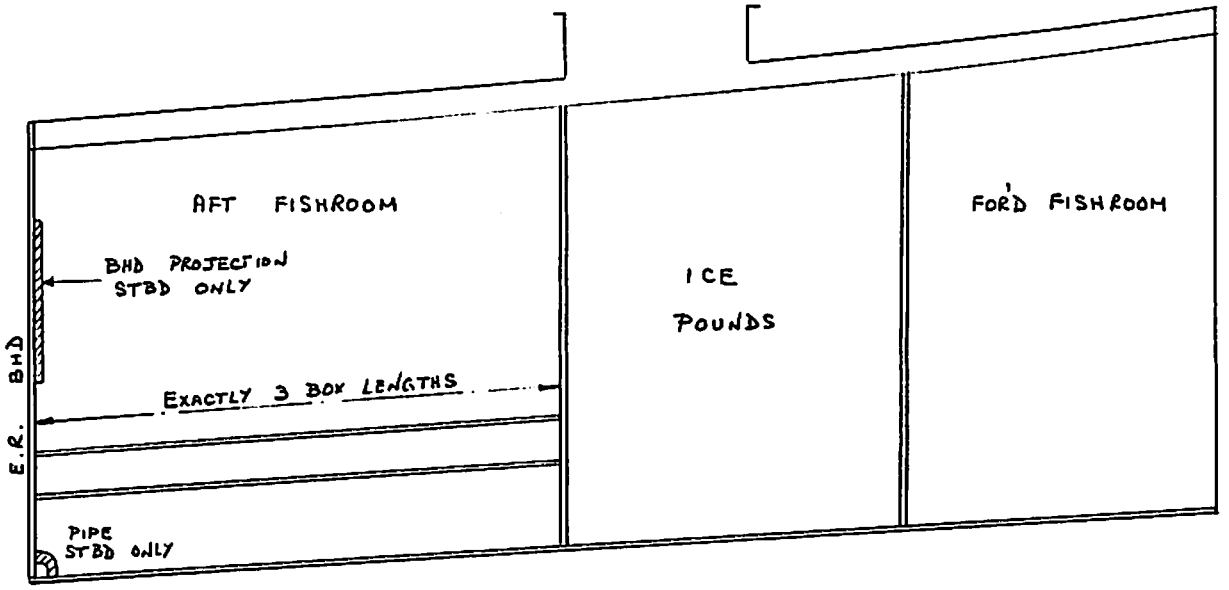
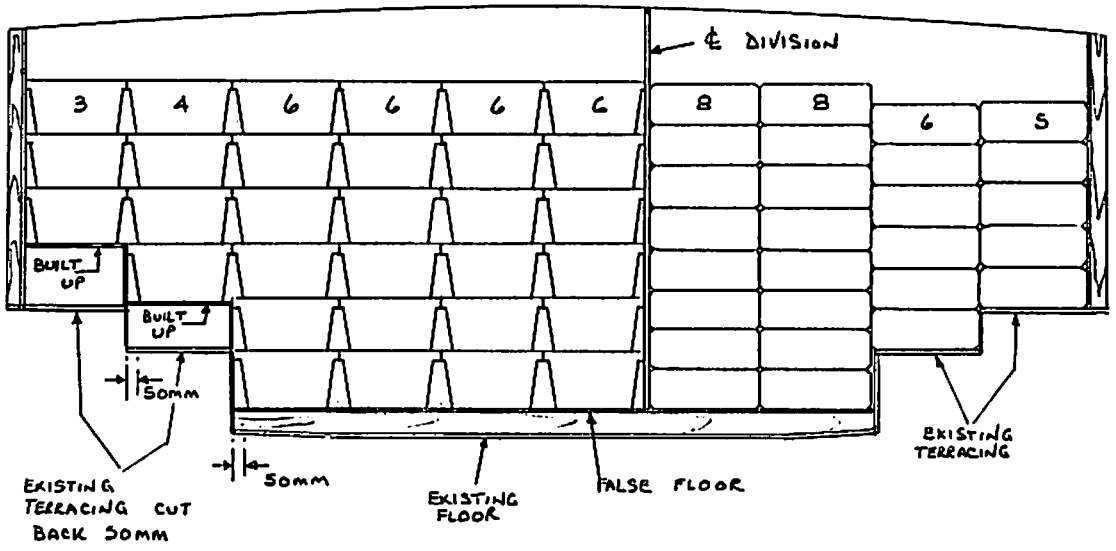


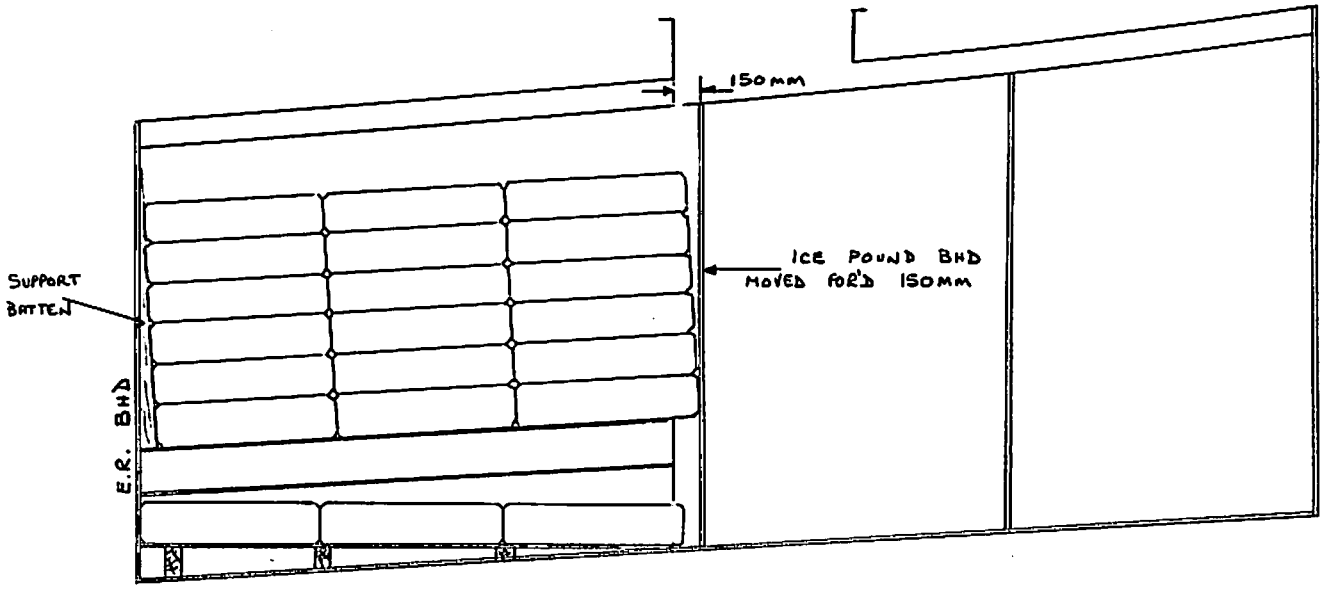
FIG. 2. M.F.V. RIVAL BCK 53

TEMPORARY FISHROOM ARRANGEMENT

SECTION IN WAY OF AFT FISHROOM (LOOKING AFT)



PROFILE OF FISHROOM
LOOKING TO PORT
SHOWING RELATIVE SLOPE OF PERS BOXES ON TERRACES



APPENDIX 4

COMPARATIVE TRIALS OF PLASTIC BOXES ON SWFPA VESSELS
FISHROOM CONVERSION - MV FRAGRANT CLOUD II PD. 233

This appendix records and gives a brief outline of the work carried out on the above vessel. The work was undertaken by R. Irvin (Peterhead) during the periods 30th July - 1st August 1986 and 8th-11th August 1986.

Initial discussions were held with the skipper - Mr. J. McLean - to inform him of the requirements for the trial. It was agreed that the fishroom would be fully converted to take stack-nest boxes of the GPG design with the main part of the fishroom converted temporarily to experimental standards necessary for the trial. The fore part of the vessel would be fitted with 'open plan' posting. It was also agreed that the conversion would be done in two stages such that it would demonstrate that when the decision is made to form a box pool for plastic boxes conversions of fishrooms can be achieved between fishing trips and thus fishing time will not be lost. The first stage would be the conversion of the main part of the fishroom.

Initial assessment of the main part of the fishroom indicated that the stack-nest boxes could be stowed 7 high x 9 wide with further boxes on a 1 box width step each side. The height of the boxes was acceptable to the skipper, being the same height as when wood boxes are used.

A more detailed assessment showed:-

a) the main part of the fishroom to be wood lined but not insulated.

b) the floor to be level athwartships but having no drainage.

c) The engine room bulkhead was not perpendicular to the floor and for a 7 box high stowage it would be necessary to make it so. An engine removal panel in the bulkhead was proud of the remainder and had battens fitted over the joints. It would be necessary to make the new bulkhead lining in panels such that the engine removal panel could be removed without dusturbing the remainder.

d) It would be possible to stow the stack nest boxes 8 high. However at this height the access to fill the boxes in situ would be greatly restricted.

e) The existing steps catered for a ½ box width at the forward end - this would require to be increased to a full box width.

f) The height and distance apart of the existing steps would facilitate a simple cladding with new timber to suit the new box stowage tolerances.

CONVERSION DETAILS

The floor was checked for level and any high spots removed. The tops of the existing steps were cladded with new boards trimmed as necessary to maintain a level box line. The inside face of the starboard step was cladded with ½" ply to give the correct stowage tolerances. The half box step structure was removed and replaced with a full box step - allowance being made for the new engine room bulkhead lining and for the fitting of portable box stops.

The sides were then erected using a structure of ½" thick ply on 4" x 2" posts spaced '1 box length' centres. The plywood was carried up to the underside of the beams to prevent overspillage of fish behind the linings and yet allow for air circulation.

The battens over the joints of the engine removal section of the E.R. bulkhead were removed and replaced with tin plate. Horizontal

battens - reducing in scantling - were fitted to the bulkhead and cladded with ½" ply. This lining was fitted so that the centre section in way of the engine removal panel could be removed without disturbing the remainder. The lower edge of the lining was arranged so that the fishroom floor boards could be lifted giving access to the bilges.

For the comparison experiment the main part was divided into two by means of a plywood division set ½ a box width off centre to port. The starboard half of the area was selected to stow the stack only boxes. The division was in three parts cut from standard sheets and held in place but not fastened by battens on the deckhead to form a slide and a batten to port on the lower edge for position only. The division was therefore held in place by the boxes.

From the division the position of a temporary step 2 boxes high was determined for the stack only boxes. This side and step was constructed from ½" ply on 4" x 2" posting at 1 'box length' centres.

A series of 1¼" dia drain holes were drilled in the floor at the aft end in way of the stack-only boxes to assist in removing the melted ice water and to allow air temperatures and flows to be checked. (The skipper believed there would be a warm air circulation and thus relied on seepage through the floor to remove any water).

Prior to the conversion the vessel carried 300 wood boxes to the main part of the fishroom.

After the conversion the vessel carries 298 GPG stack nest boxes when stowed 7 high or 342 when stowed 8 high.

The second stage of the conversion was carried out after a short trip following the conversion of the main part of the fishroom.

During this short trip three observations were made to improve the arrangement of the main part of the fishroom viz:

1) On the port side where no drainage was provided there was a considerable build up of melted ice water. Since no warm air circulation was detected on the starboard side where drainage had been provided the skipper agreed to the drilling of drain holes on both sides.

2) The retaining of empty boxes against ship motion was difficult since they cannot be wedged in the traditional manner nor were there any lashing points. It was therefore decided to constrain the 'initial use' stack only boxes by fitting portable vertical wood posts such that the boxes were housed against the aft side of the starboard ice pound division. Large ¼" dia shank cup hooks would provide lashing points for the 'initial' use stack-nest boxes.

3) Warm air was circulating into the fishroom through ill fitting lining boards at the deckhead on the engine room bulkhead. These could be fitted with a stopper and finished with a timber lat.

A detailed assessment of the fore end of the fishroom showed that:

a) the forward bulkhead was unlined, uninsulated steel and was not perpendicular to the floor;

b) the ship sides were uninsulated and unlined;

c) the stack nest boxes could be stored 8 high with 9 high if necessary on the foremost two tiers though at this height access would be limited.

CONVERSION DETAILS

A false floor of 1½" boards on 2" wide tapered bearers extending aft for 3 box lengths was fitted to provide a base perpendicular to the

bulkhead. The height of this floor was approx. 5½" at the aft end and a ramp approx. 16" wide was fitted to assist in discharging the stacked boxes.

A two box high step was necessary to allow for the bilge stringer and a further 2 box step was fitted for the foremost tier. The box retention structure was of 4" x 2" open plan posting with 9" x 2" bearers on the steps (this 9" x 2" material was salvaged from the original structure). Portable vertical 4 x 2½ posts were fitted at the aft end to retain the boxes.

The improvements from the observations mentioned previously (items 1, 2 and 3) were also carried out.

Prior to the conversion approx. 112 boxes were carried in the fore part of the fishroom.

After the conversion 132 GPG stack-nest boxes when stowed 8 high or 144 when stowed 9 high.

Thus in total the numbers of boxes carried,

pre conversion	412
after conversion	430 when stowed 7 high aft and 8 high forward
or	486 when stowed 8 high aft and 9 high forward.

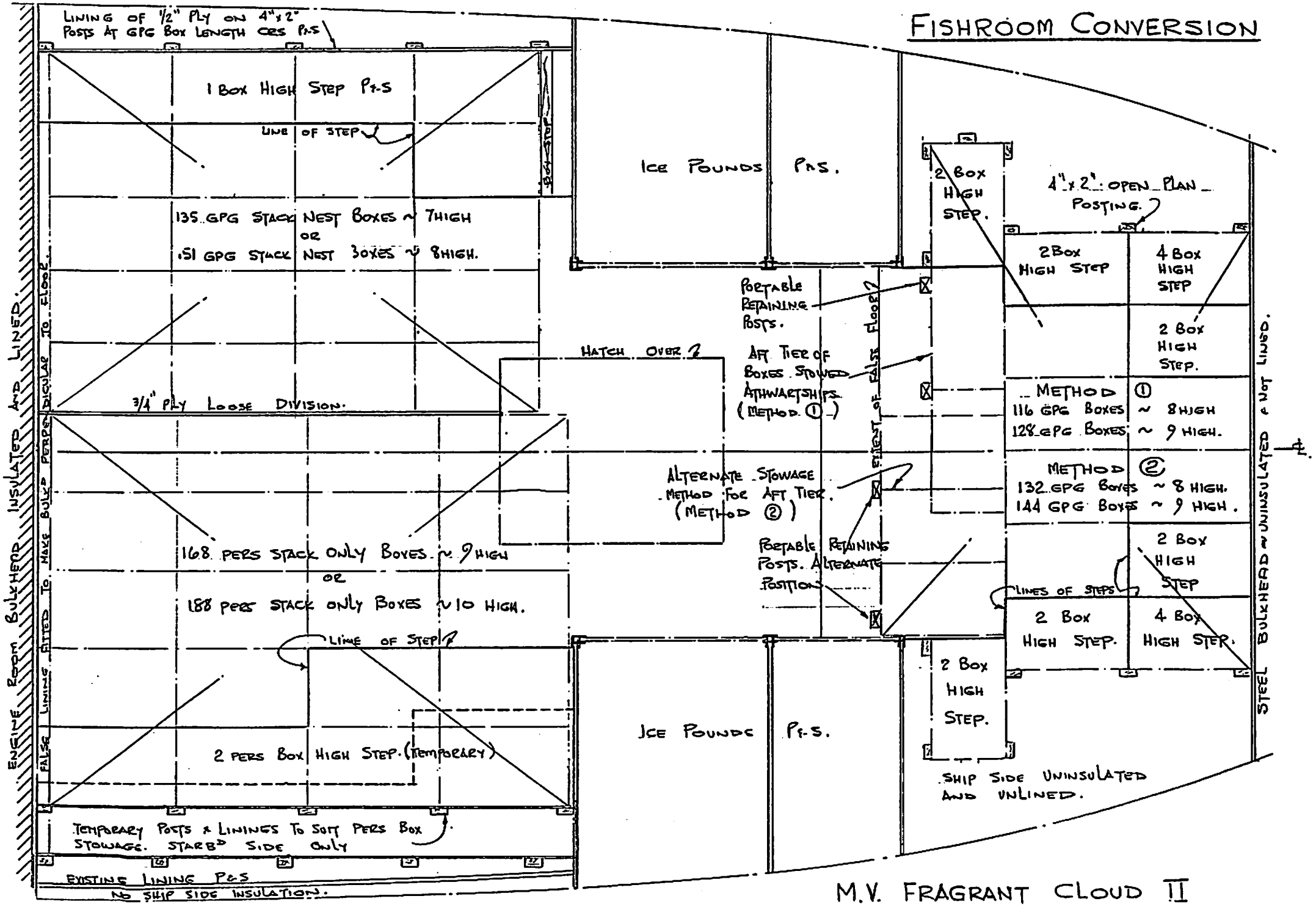
Approx. 80 more boxes could be carried between the ice pounds.

A plan and photos of the conversion are attached.

Hand gutting is conventionally done from the topmost of a 5 high stack of wood boxes set up on the deck as required. This cannot be done using unrestrained stack-nest boxes and to overcome this problem two portable benches on which a stack nest box can be seated were provided. These benches can be hooked onto the bulkwark stringer at any fore end aft position as required. The benches comprise two steel angle bars spaced to suit the frames, and fitted with a lipped ½" thick ply top.

C. BRADY
SENIOR NAVAL ARCHITECT

FISHROOM CONVERSION



M.V. FRAGRANT CLOUD II

APPENDIX 5

DEMONSTRATION TRIALS OF PLASTIC BOXES ON THE WEST COAST OF SCOTLAND
FISHROOM CONVERSION - M.V. SEAGULL BF83

This appendix records and gives a brief outline of the work carried out on the above vessel. The work was undertaken in Kinlochbervie by R. Irvin (Peterhead) during the 10th and 11th October 1986.

The trials were to demonstrate the use of the GPG stack-nest box being proposed by Scotbox for acceptance by their members, to the fishermen on the West Coast of Scotland.

It was agreed with the skipper - Mr. K. West - that the conversion would be of a temporary nature and affect the main part of the hold only. No attempt would be made to maximise on box numbers nor would the existing structure be removed.

Initial assessment of the fishroom showed (i) the floor to be level and in good condition, (ii) the distance between the inboard faces of the first step was suitable without modification though a 10mm tolerance would not be achieved, (iii) boxes could be stowed 8 wide x 8 high with further boxes on step each side.

CONVERSION DETAILS

The floor level was checked and some high spots were removed. Battens were fastened to the engineroom bulkhead at the lip level of the bottom and middle boxes to account for the non perpendicularity of the bulkhead to the floor.

Having determined the level and position of the bottom layer of boxes the first step heights were found and the steps were raised to suit (2 boxes high) by the fitting of 4" x 2" bearers cladded with 2

thicknesses of 3/8" thick ply. The second step height was then found (a further 2 box heights) and the existing step raised in a similar manner to the first.

The existing retaining posts adjacent to the ships hull were not square with the floor and bulkhead and were therefore adjusted. The posts were also increased in width to accommodate the revised stowage of the boxes.

The drainage in the floor was excellent and required no further attention.

Two 6ft long box stops of 2" x 2" square steel tube with $\frac{3}{4}$" dia pins were provided to prevent forward movement of the boxes.

Prior to the conversion the vessel carried 384 wood boxes in this part of the fishroom.

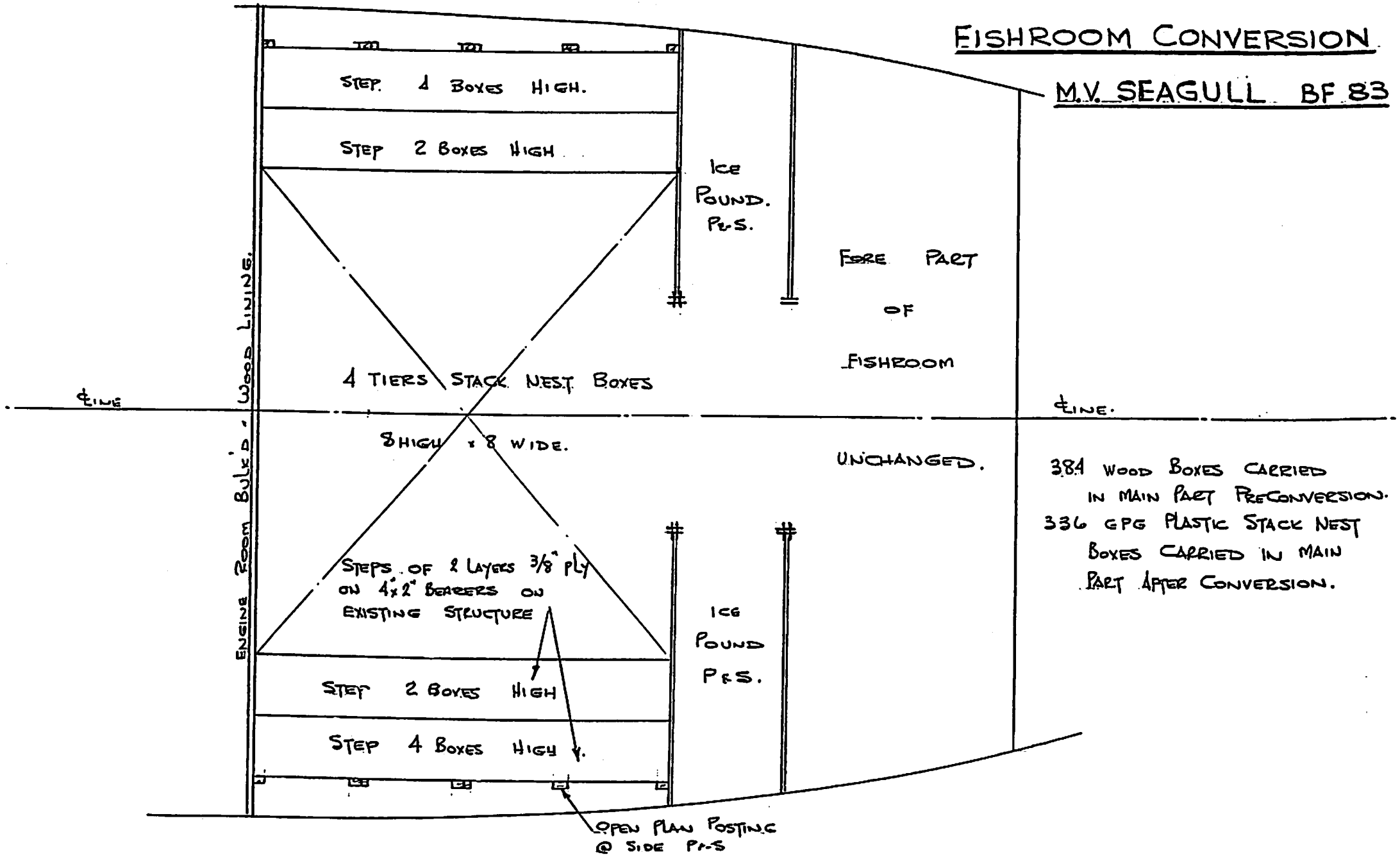
After the conversion 336 plastic stack nest boxes could be carried in the same part of the fishroom.

A plan of the conversion is attached.

C. BRADY
SENIOR NAVAL ARCHITECT

FISHROOM CONVERSION

M.V. SEAGULL BF 83



384 WOOD BOXES CARRIED IN MAIN PART PRECONVERSION.

336 GPG PLASTIC STACK NEST BOXES CARRIED IN MAIN PART AFTER CONVERSION.

APPENDIX 6

TRIALS OF PLASTIC BOXES ON SWFPA VESSELS
M.V. SUNBEAM INS 189

This appendix records and gives a brief outline of the work carried out on the above vessel. The work was undertaken by R. Irvin (Peterhead) in November and December 1986.

The main purpose of the trial was to examine the aspects of handling fish on the deck using the GPG design of stack-nest box. However the main part of the fishroom was also converted to permit the carriage of GPG stack-nest boxes and thus add further experience to that part of the project.

The vessel was examined and measured prior to the conversion and a deck handling system was formulated. The ideas were discussed with the skipper and mate of the vessel and the system was agreed. This system is described under the heading 'System MkI'.

Subsequent trials demonstrated that whilst the system worked it tended to be slow and that difficulties would arise if hauls in excess of 50 boxes were taken. The system was therefore modified such that the handling was speeded up and larger hauls could be handled. This modification is described in 'System MkII'.

Further trials showed that the modified system (System MkII) worked well but further refinements would improve it. These refinements are described in 'System MkIII'. Reservations were held by the crew that given two successive hauls each in excess of 100 boxes taken in a normal tow period then there would be greater problems in transferring the catch below using plastic boxes on the deck than if the traditional boxes were being used.

Initial assessment of the main part of the fishroom showed that boxes could be stowed 9 high and a total of 485 boxes may be carried.

Currently the vessel carries 440 wood boxes in this part of the fishroom.

CONVERSION DETAILS

Deck handling system. The basis of the system is the same as is used on the vessel and is as follows:

(i) discharge the cod end into the starboard deck ponds aft.

(ii) box the catch and transfer to a holding area at the port and starboard forward corners of the deck shelter.

(iii) shoot the net for the next tow.

(iv) transfer the boxed fish to gutting/sorting positions along both sides of the shelter.

(v) gutted/sorted fish are washed and transferred down below to the fishroom for storage in boxes with ice.

SYSTEM MKI

The existing arrangements for the forward holding areas were inadequate for the retention of plastic boxes and were removed. A new holding area was arranged both port and starboard constructed with 2" x 2" x ¼" ordinary aluminium angles, 4" x 2" wood posts and angle keep bars resting in cleats. The arrangement is shown in Figure 1.

This new arrangement was found to be satisfactory and remained unchanged throughout the trial. It is also suitable for use with wood boxes without any modification.

In order to reduce the carrying of full boxes of fish each by two men from the aft ponds to the storage area, a track system was designed,

constructed and fitted. Details are shown in Figure 1. Three portable gutting tables are hung from the side of the track and provide 6 gutting stations (2 man per table).

It is the intention with this system that boxes are filled adjacent to the aft ponds - as is the current practice, lifted onto the track and pulled/pushed to the forward holding area. Only sufficient boxes are pulled forward to enable the entire haul tobe boxed. Gutting then commences with boxes being fed back from the holding area on to the track to form a magazine of boxed fish.

SYSTEM MKII

Following further discussion with the skipper a system where boxes would be dragged along the deck and orientated in such a way as to permit gutting from a stack of boxes was designed. This system is shown in Figure 2 and is as follows.

The forward holding area remains unchanged. Battens 2" x 2½" are fastened to the deck such that three track ways run from the aft deck ponds to the holding area. Wood posts were fixed vertically at the side of the shelter and portable posts were fited inboard such that stacks of boxes could be retained at positions where gutting would be carried out. The 'track' battens were cut on both fore and aft sides of the boxes in the gutting position to accommodate 'keep' battens and permit drainage.

The trials of this system showed it to work reasonably well but the dragging of boxes of fish stacked 3 high was difficult due to the large weight on rough wet wood - (water was actually being squeezed out of the timber) and this was compounded where deck fittings were becoming proud due to wear.

SYSTEM MKII

It was decided to try and improve the second system by fitting 6mm

thick polyethelene strips under the battens and at the same time change the location method of the 'keep' battens from slots to pins. The polyethelene was fitted under 2" x 2½" continuous battens scalloped on the underside for drainage. The polyethelene was only allowed to protrude 2 inches outside the batten such that crew safety was maintained whilst still providing a sliding surface for the boxes.

These improvements are shown in Figure 3. Because of bad weather and the Christmas holidays only a short trial was possible but the refinements appeared to make the system a viable one.

FISHROOM

The fishroom was converted in the manner now established on previous vessels.

The floor level was checked and some high spots removed. Battens were fastened to the engineroom bulkhead at the lip level of the bottom and middle boxes to account for the non-perpendicularity of the bulkhead to the floor. Having determined the level and position of the bottom layer of boxes, the first step height (1 box high) was raised and cladded with 7/8" whitewood. The second step (2 boxes high) and the third (1 box high) were treated in a similar manner.

The existing retaining posts adjacent to the ships hull were increased in width fore and aft to suit the revised box positions. The athwartship box - step and post clearances were reduced to give a total of 3/8" clearance by the fitting of plywood facings.

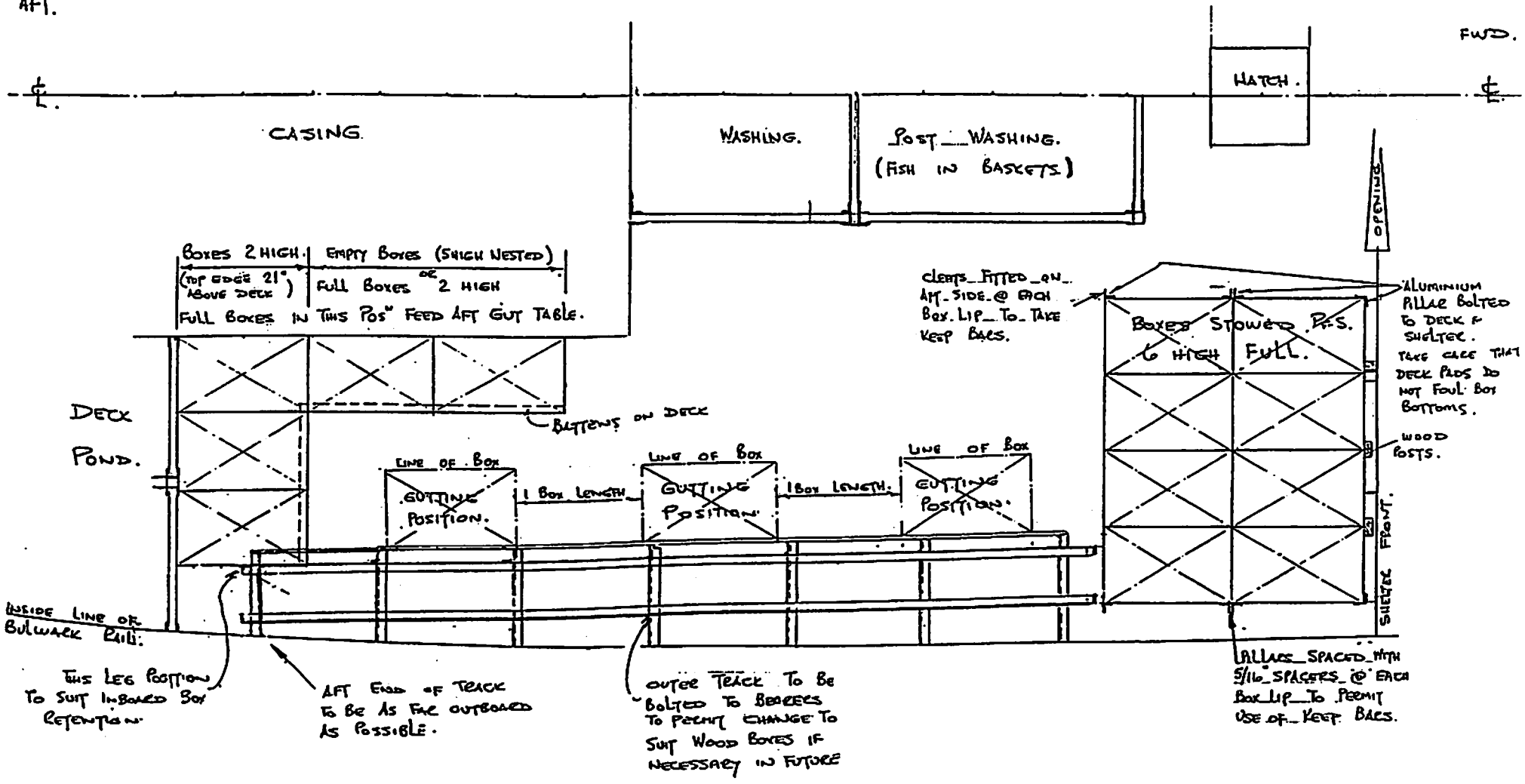
The drainage in the floor was adequate and required no further attention.

Two 5' - 6' long box stops of 2" x 2" square steel tube with 3/4" diameter pins were provided and arranged to fit in the floor on the fore side of each tier of boxes.

C. BRADY
SENIOR NAVAL ARCHITECT

M.V. SUNBEAM.

SYSTEM MK I.



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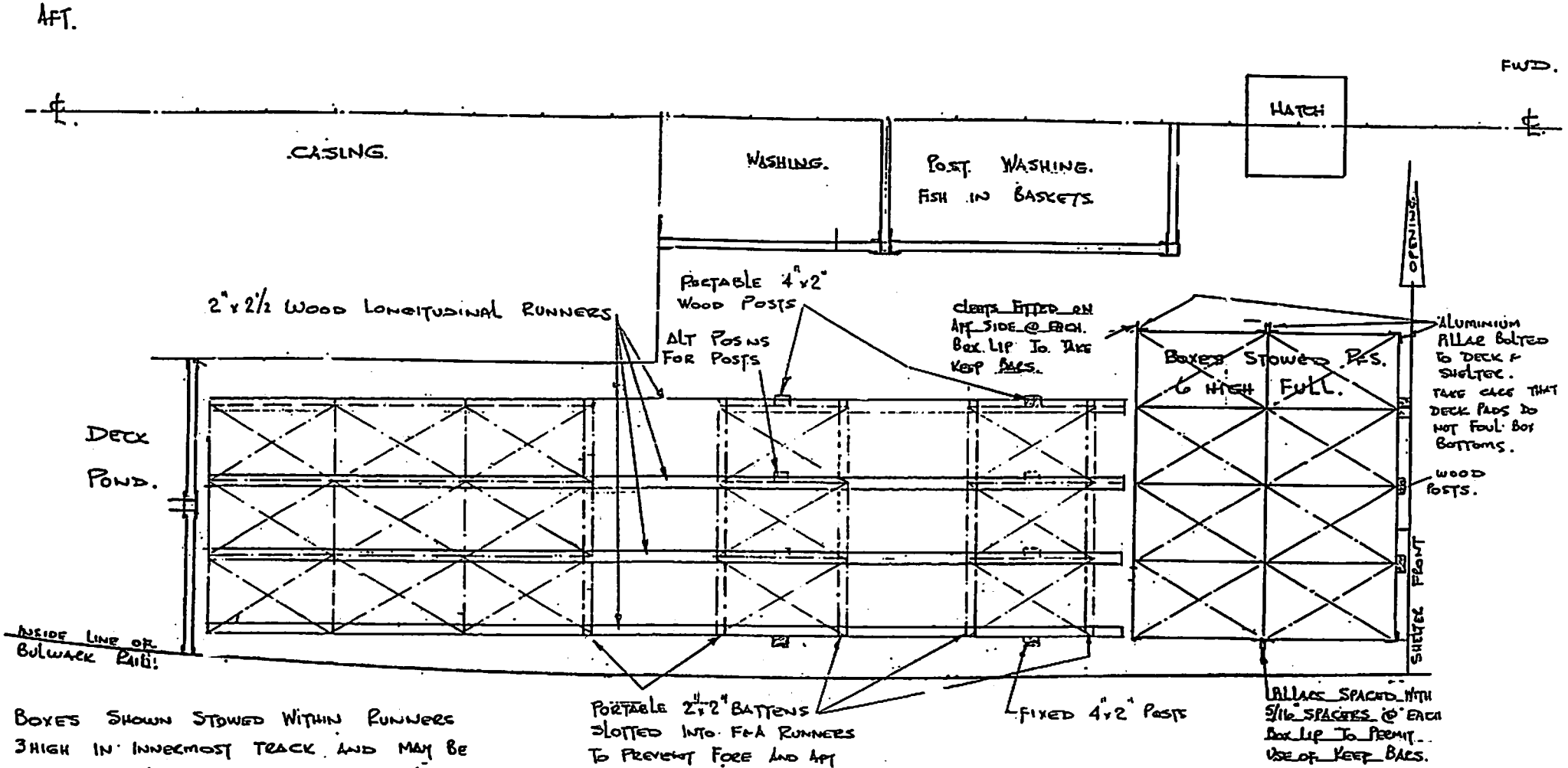
M.V. SUNBEAM.

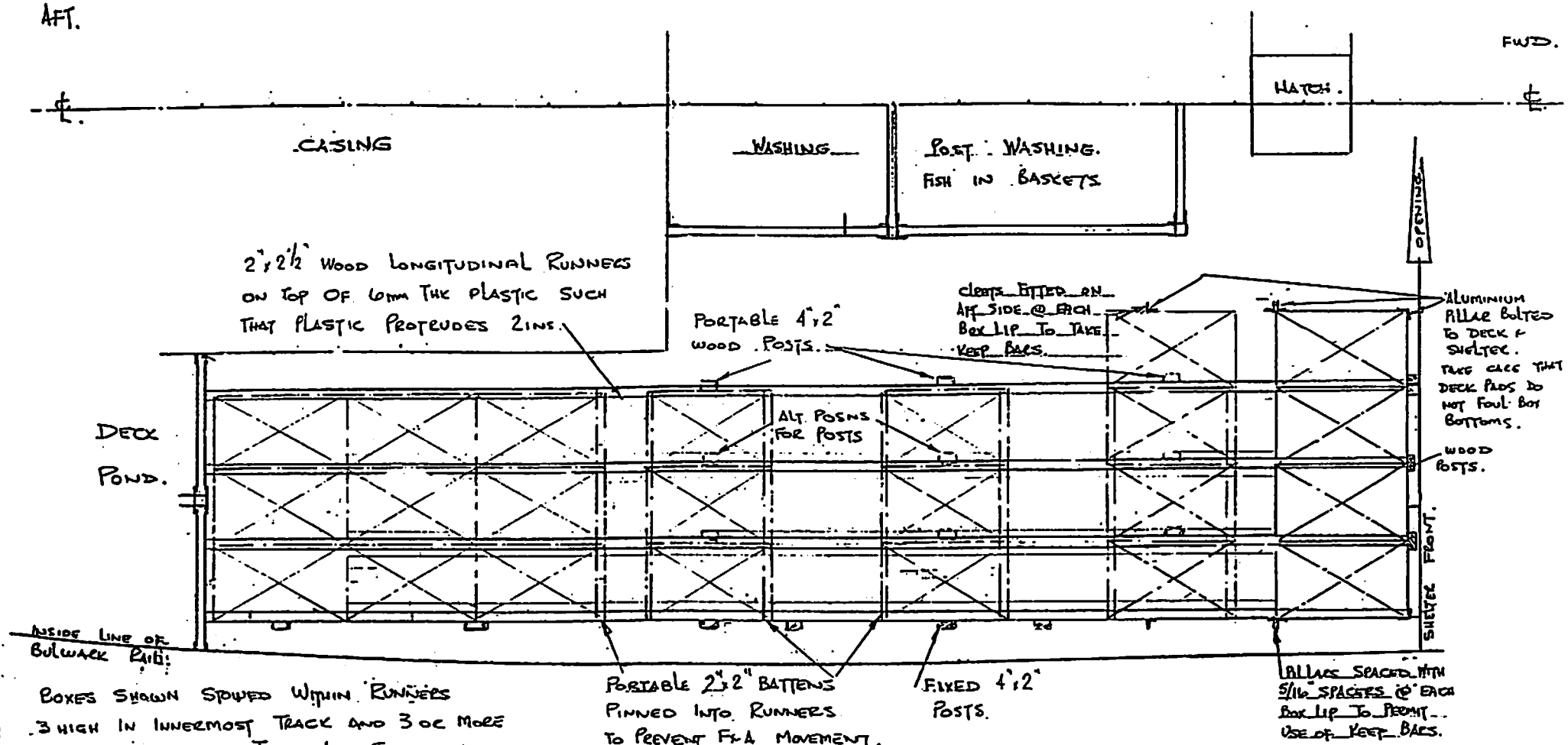
SYSTEM MK. II.



BOXES SHOWN STOWED WITHIN RUNNERS 3 HIGH IN INNERMOST TRACK AND MAY BE 3 OR MORE HIGH IN OTHERS. TIERS ARE SHOWN IN GUTTING POSITIONS WITH BOXES LIFTED FROM ALTERNATE STACKS TO WORKING HEIGHT.

TWO.

M.V. SUNBEAM.
SYSTEM MK III



TOP VIEW

BOXES SHOWN STOWED WITHIN RUNNERS 3 HIGH IN INNERMOST TRACK AND 3 OR MORE HIGH IN OTHERS. TIERS ARE SHOWN IN GUTTING POSITIONS WITH BOXES LIFTED AS NECESSARY FROM ALTERNATE STACKS TO WORKING HEIGHT WHEN GUTTING

APPENDIX 7

NOTES ON THE CONVERSION STRUCTURE TO ACCOMMODATE STACK-NEST BOXES

These recommendations apply to the conversion of a fishroom to accommodate plastic stack-nest boxes of the GPG type C 1519 manufacture as recommended by Scotbox. They also apply in general to the stowage of any stack-nest box.

The basis requirements for a good conversion are:

(i) a good level floor free from snags and having good drainage.

(ii) adequate support of the boxes on three sides arranged to give a close fit with tolerances to suit the practicalities of building a square structure.

The following recommendations are given in the order of procedure for undertaking a conversion.

1. **FLOOR**

The floor must be level both athwartships and fore and aft with any high spots or snags removed.

No one box should be more than 1½mm higher or lower than the level of the remainder.

2. **AFT BULKHEAD**

Usually the bulkhead is not perpendicular to the floor and the angle between them less than 20 degrees. It is also frequently the case that the bulkhead is neither true nor sufficiently flat.

It is therefore necessary to ensure that the bottom box is stood off from the bulkhead by an amount which allows the top box to

touch the bulkhead. This may be achieved by fastening a batten across the bottom of the bulkhead at the level of the lip of the lowest box. If the distance of the lip of the box off the bulkhead at mid height is greater than 35mm then a further batten should be fitted across the bulkhead. These battens should be trimmed as necessary in way of bulkhead misalingment and cut in way of the engine removal section of the bulkhead.

3. **BOX STOWAGE LENGTH**

It is important to check that in relation to the battens referred to under recommendation 2, the multiple of box lengths can be accommodated without fouling the ice pound. It may be found that a slight repositioning of the ice pound would facilitate an extra tier of boxes.

4. **BOX STOWAGE WIDTH**

To allow for the inaccuracy in constructing a square structure a tolerance of 10mm should be allowed across the total width of the boxes regardless of the number of boxes.

5. **STEPS**

It should be noted that half box width cannot be accommodated and thus the width of any step will be the width of a whole box. The height of a step is the height of one or more boxes less the location depth (25mm for the GPG box).

6. **POSTING**

The side structure of the fishroom may as a minimum comprise of 100mm x 75mm posts spaced 1 box length centres. However it is preferable that the posting be cladded with plywood if there is no lined insulation already fitted and cladded with plywood and insulation if none exists.

7. **FORWARD BULKHEAD**

It is usually necessary to construct a false floor perpendicular to the bulkhead and if the bulkhead is not true three horizontal battens, trimmed as necessary, should be fitted. If the false

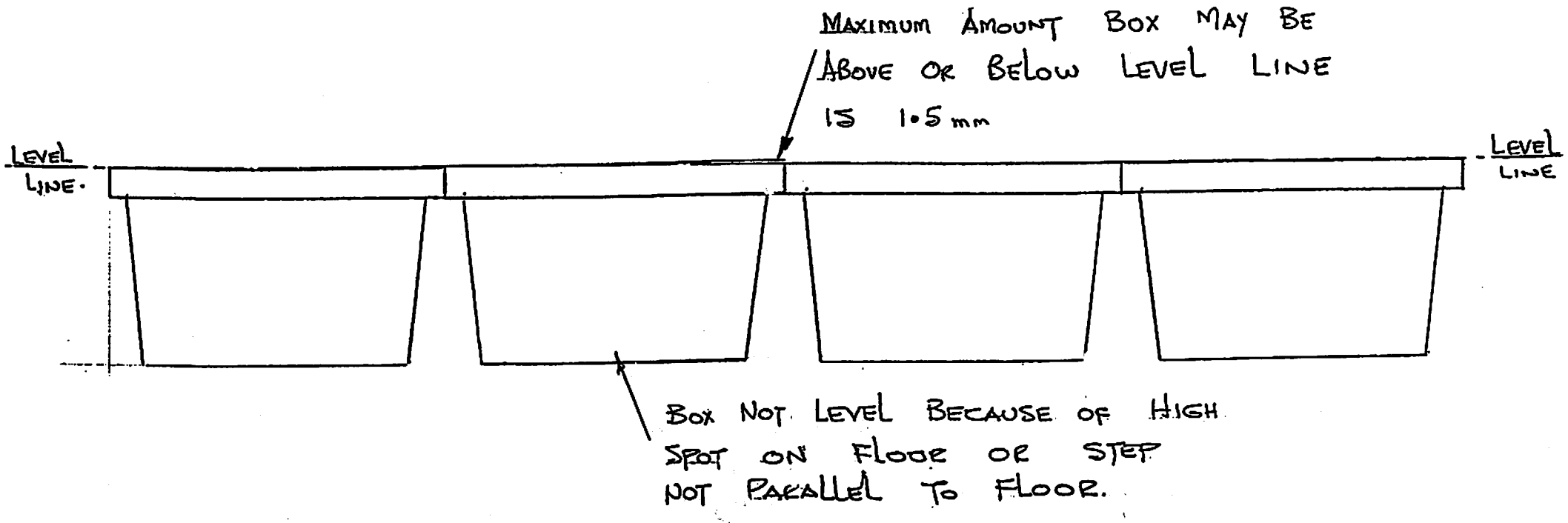
floor creates a substantial step then a portable ramp one box length wide should be provided.

8. BOX RETENTION

In the main part of the fishroom the boxes are restrained from forward movement by portable stop bars of 50mm x 50mm square steel tube with 15mm pins fitting into holes in the fishroom floor no further retention is necessary. When the main part is full it may be possible to use the stop bars, but at this stage the pound boards may be fitted between the ice pounds.

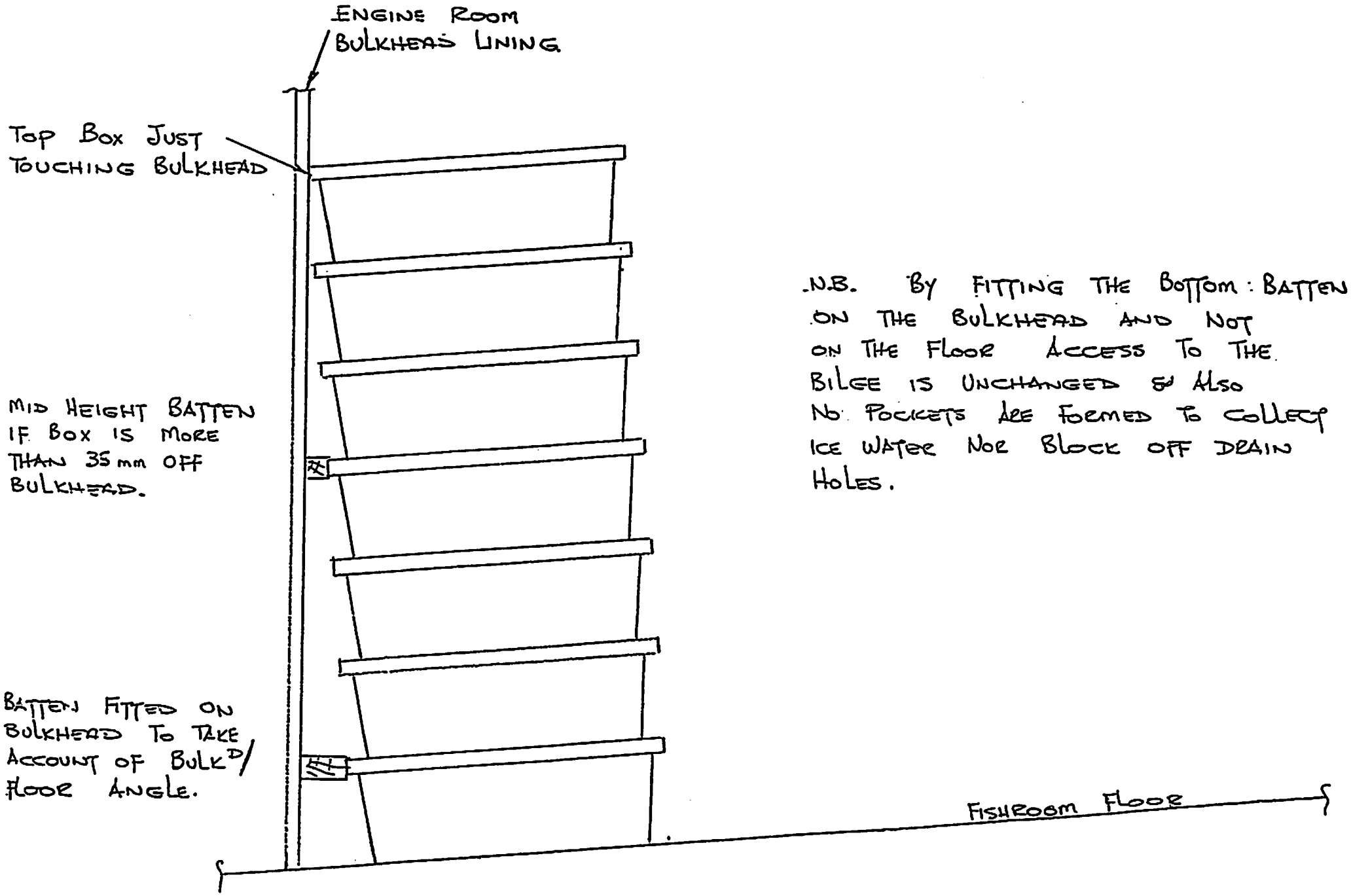
In the forward part of the fishroom the boxes may be retained either by use of pound boards fitted between the ice pounds or by portable vertical posting.

It should be noted that plastic boxes cannot be wedged when stowing and therefore it is necessary to retain the empty boxes by lashing or portable posting.



TOLERANCE ON LEVEL LINE.

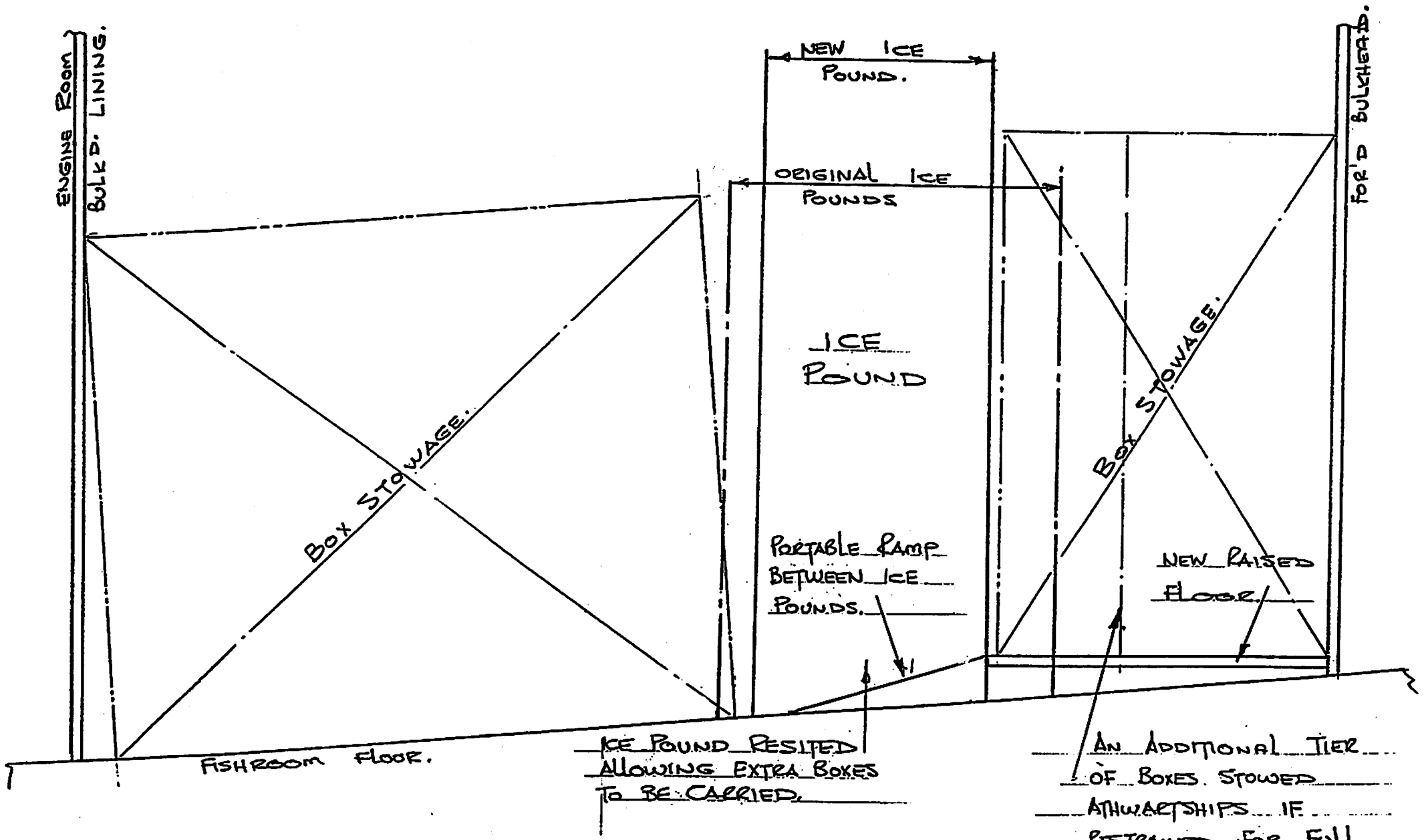
FIG 1



N.B. BY FITTING THE BOTTOM BATTEN ON THE BULKHEAD AND NOT ON THE FLOOR ACCESS TO THE BILGE IS UNCHANGED & ALSO NO POCKETS ARE FORMED TO COLLECT ICE WATER NOR BLOCK OFF DRAIN HOLES.

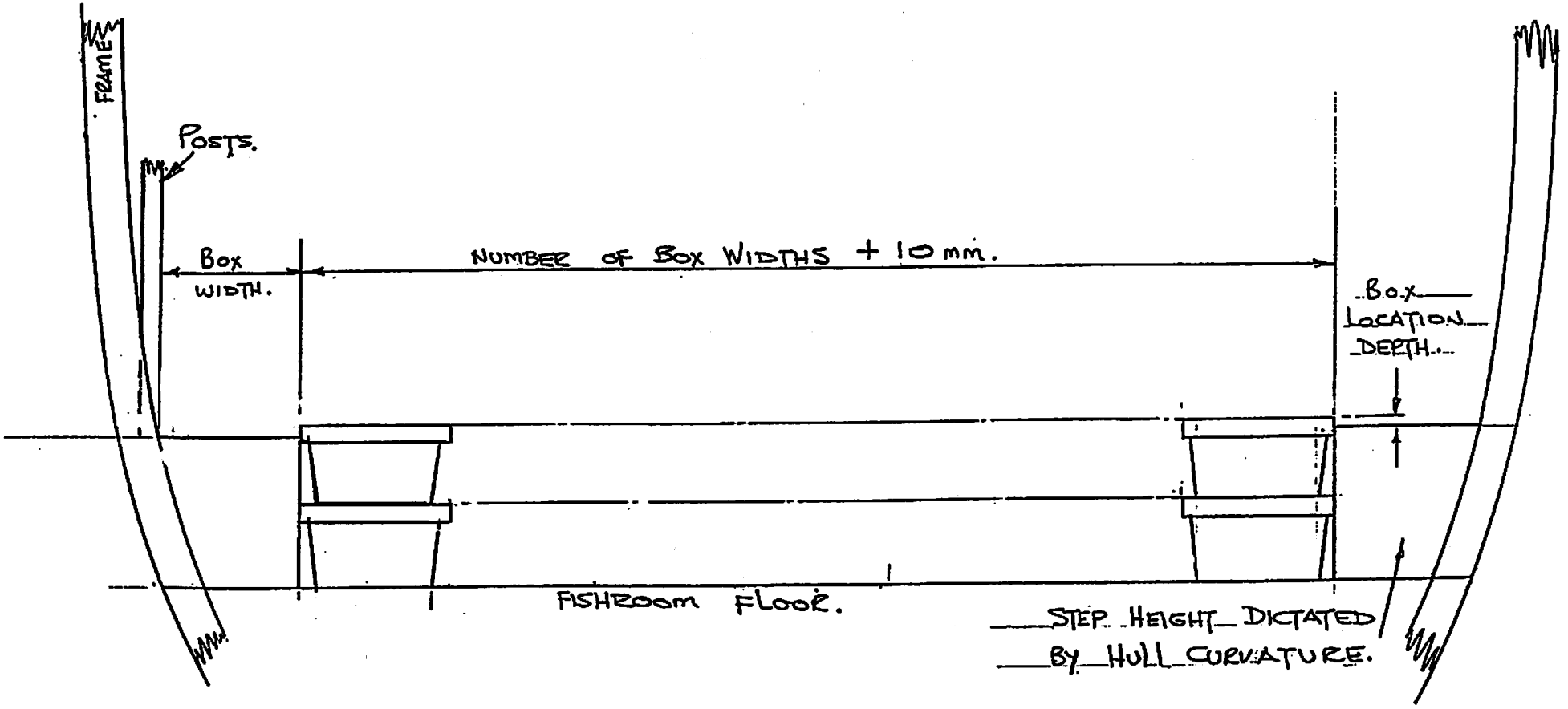
AFT BULKHEAD

FIG 2.



BOX STOWAGE LENGTH

FIG 3.



BOX STOWAGE WIDTH.

FIG. 4.

APPENDIX 8

FISHROOM TEMPERATURE DATA RECORDED DURING COMPARATIVE BOX TRIALS JUNE TO DECEMBER 1986

On all five trials vessels fishroom and ambient air temperatures were monitored and the data for each trip is given in Tables I to XI.

FISHROOMS WITHOUT DECKHEAD CHILLING (COMPARATIVE TRIALS)

ROSEBAY, RIVAL and FRAGRANT CLOUD have no fishroom chilling and little deckhead insulation. With the exception of RIVAL's second trip deckhead temperatures remained surprisingly high and consistent between the three vessels with most readings 7 to 11°C. Ambient temperatures were also consistent ranging from 10 to 16°C. However, on RIVAL's second trip deckhead temperatures were much higher at 10 to 13°C and corresponded to higher ambients of 15 to 19°C. Thermocouples mounted at half fishroom depth on engineroom bulkhead and sides showed a temperature drop of between 1°C and 4°C below that measured at deckhead until reached by the increasing height of boxes of iced fish.

Once covered with boxes the engineroom bulkhead temperatures fell on ROSEBAY to about 4°C and on FRAGRANT CLOUD 2°C. Throughout the trip fluctuations of up to 2°C occured and it was noticeable on both vessels that the temperatures started to rise toward the end of the fishing trip. On RIVAL the bulkhead temperature fell slowly throughout both trips but go no lower than 7.6°C on Trip 1 and 9.6°C on Trip 2. Both ROSEBAY and FRAGRANT CLOUD had plywood linings fitted to their rear bulkhead to square it to the fishroom floor. On RIVAL the floor was raised and no additional material put into the bulkhead. The bulkhead does have to cope with quite a large temperature differential and depending upon how effective it is, heat will enter. Ice in the boxes immediately up to the bulkhead melts to offset this and maintain low temperatures but once this has gone they will start to rise. It was noticed when examining boxes from bulkhead locations that more ice had gone from one end of the box (Figure 11) and no doubt this accounts for the temperature rises seen.

On ROSEBAY and FRAGRANT CLOUD temperature readings taken from the fishroom sides dropped to between 2°C and 4°C and remained so throughout the fishing trip. On RIVAL this was between 5°C and 6°C. On all three vessels, though, the temperatures measured at the GPG side of the fishroom was consistently some 1°C higher than that measured at the PERS side. Readings taken before thermocouples were covered by boxes were similar so this must be an effect of the box type. Although thermocouples on both sides were positioned to be clear of contact with boxes the probe on the GPG side was in the maximum air gap between boxes. The difference is only small and no doubt caused by the closer proximity of the probe to the cool PERS box surface than that of the GPG and not a result of some air flow through the boxes.

FISHROOMS WITH DECKHEAD CHILLING (NON-COMPARATIVE TRIALS)

SEAGULL and SUNBEAM have deckhead chilling units fitted, with fishrooms uninsulated apart from forward and aft bulkheads. As expected deckhead temperatures were much lower with 1 to 5°C on SEAGULL (ambient 10 to 12°C) and -1 to 4°C on SUNBEAM (ambient lower at 4 to 10°C). Temperature readings at half fishroom depth remained similar to deckhead readings until covered by boxes. On SUNBEAM's second trip the chiller broke down quite early in the fishing trip and the effect was clear with deckhead temperatures rising from 4 to 8°C over the remaining five days.

On SEAGULL and SUNBEAM thermocouples were put both at half bulkhead height and near to the fishroom floor. Mid bulkhead temperatures once probes were covered with boxes fell on both vessels to between 1°C and 3°C and it was noted on SUNBEAM that these temperatures were tending to rise toward the end of the trip as seen on the other trials vessels. This was particularly so on SUNBEAM's second trip when the chiller was not in use. Nevertheless temperatures were lower and no doubt reflected an indirect effect of the deckhead chilling in terms of much reduced quantities of meltwater running down from top boxes. On SUNBEAM the lower bulkhead temperature fell once covered by boxes but then quite consistently rose throughout the trip. On the first trip with the chiller working this rose from 2°C to 5°C. On the second, without

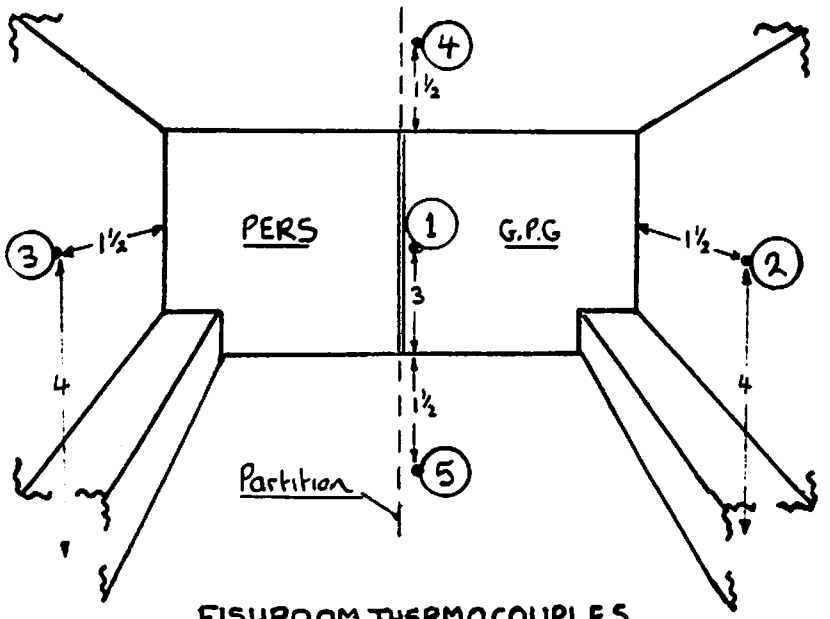
it from 3 to 9 ^{o}C. Clearly the fishroom chilling is having an effect, even at the bottom of the fishroom, but this is limited as the temperature rise shows.

On SEAGULL the trip length was too short to establish any conclusions from the fishroom sides but on SUNBEAM readings were quite interesting. With the chillers in operation the temperatures on the port side were low (0 to 2^{o}C) and compared with the deckhead readings. On the starboard side the readings were 2 to 3^{o}C higher. On the second trip whilst the chillers worked a similar situation occured until they broke down. The difference between port and starboard then increased to some 4^{o}C with the higher temperatures on the starboard side now relating to higher deckhead readings. On the three comparative trials vessels fishrooms were lined at the sides with ply but the SUNBEAM has open posting at its sides to contain the boxes and there is a quite considerable air gap corresponding to the curvature of the fishroom side behind them. Although the stack-nest boxes have air gaps between the tapered sides, no vertical air flow can occur as the top rims of the boxes seal the stack into layers. Nevertheless there is a lateral air path through the boxes. The temperature difference could be the result of some local effect in way of the thermocouples but one cannot ignore the possibility that some movement of air was occuring.

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE I

VESSEL	ROSEBAY	SEAWATER °C	10.0	TRIP No.	1
PORT	PETERHEAD	FISH °C	10.0/15.0	JUNE 22-27	

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C	CONDITIONS EFFECTING TEMPERATURE
		1	2	3	4	5				
SUN	17.00	–	–	–	–	–			–	6 Tonne ice put on board
"	22.00	12.7	12.2	11.6	15.9	6.6			9.1	Hatch open
MON	08.00	12.4	11.5	10.6	12.2	7.8			12.0	Hatch closed overnight
"	15.30	7.6	7.3	7.6	10.4	2.7			–	Boxes stowed to (1) "
TUES	08.20	4.6	5.7	4.7	8.6	2.5			10.2	First tier complete
"	13.00	–	–	–	–	–			16.0	
"	16.30	4.7	5.5	4.2	8.6	1.7			—	"
WED	07.00	4.7	4.3	3.3	7.5	0.7			12.4	Boxes stowed above (2) and (3)
"	13.00	–	–	–	–	–			15.0	
"	19.30	6.1	4.5	3.5	10.8	0.3			–	
THUR	06.00	6.1	4.5	2.7	9.7	0			–	



1. BULKHEAD
2. PORT SIDE
3. STBD. SIDE
4. DECKHEAD
5. FLOOR

FISHROOM THERMOCOUPLES
VIEW LOOKING AFT

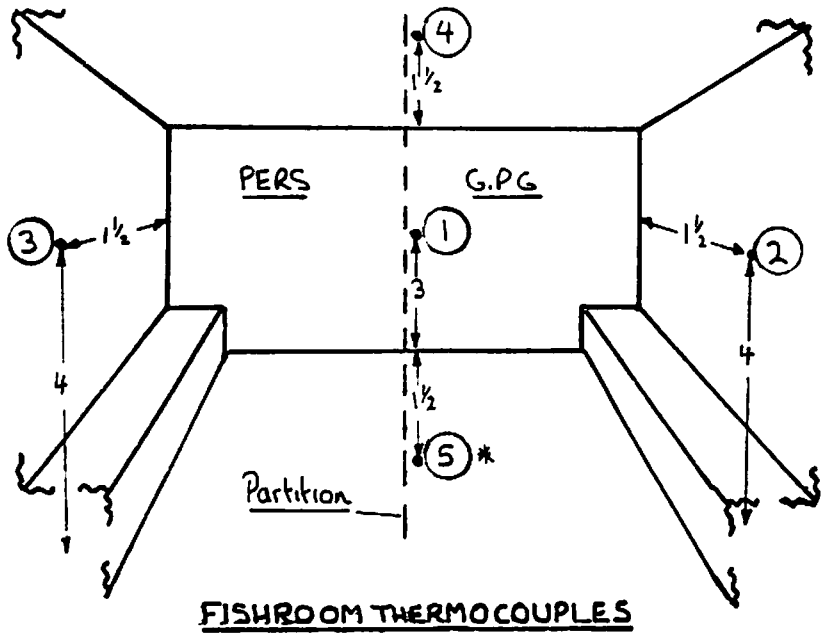
NOTE 1. Thermocouples positioned 5mm clear of fishroom surface at gap between boxes

2. Fishroom sides and bulkhead lined with 12mm ply

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE II

VESSEL	ROSEBAY	SEAWATER °C	13 (SURFACE)	TRIP No.	2
PORT	PETERHEAD	FISH °C	10 - 14	30 JUN - 4 JULY	

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C	CONDITIONS EFFECTING TEMPERATURE
		1	2	3	4	5	6			
MON	11.20	9.6	9.8	8.8	11.0	8.3	6.0		12.5	Hatch closed since icing at 02.00
	19.35	8.5	9.0	6.3	10.2	6.3	6.0		12.6	
TUES	03.00	4.9	8.3	5.3	—	6.0	6.2		12.2	Boxes stowed above (1)
	11.40	4.3	6.4	6.5	9.7	5.9	6.2		13.6	
	19 25	4.5	6.2	3.8	9.7	6.6	6.6		14.4	Boxes stowed above (3)
WED	03.58	4.8	5.2	3.0	7.8	5.9	5.9		12.5	Hatch closed 4 hrs
	12.07	5.0	4.6	3.3	10.3	5.3	6.7		13.0	Boxes stowed over (2) Hatch closed ½ hr.
	20.10	4.8	3.7	3.0	8.7	4.8	6.7		13.5	
THUR	11.15	3.7	3.5	2.5	8.3	4.9	6.5		13.6	
	19.10	5.5	4.3	2.7	10 0	5.0	6.2		13.5	Hatch open ½ hr before readings
FRI	02.40	6.9	3.8	2.8	8.2	4.4	6.5		15.0	Temp taken in harbour
	04.50	5.7	3.4	3.1	7.9	4.1	6.4		12.6	" " " "



1. BULKHEAD
2 PORT SIDE
3 STBD. SIDE
4 DECKHEAD
5. FLOOR
* (put under floor)
6. FWD BULKHEAD (centre)

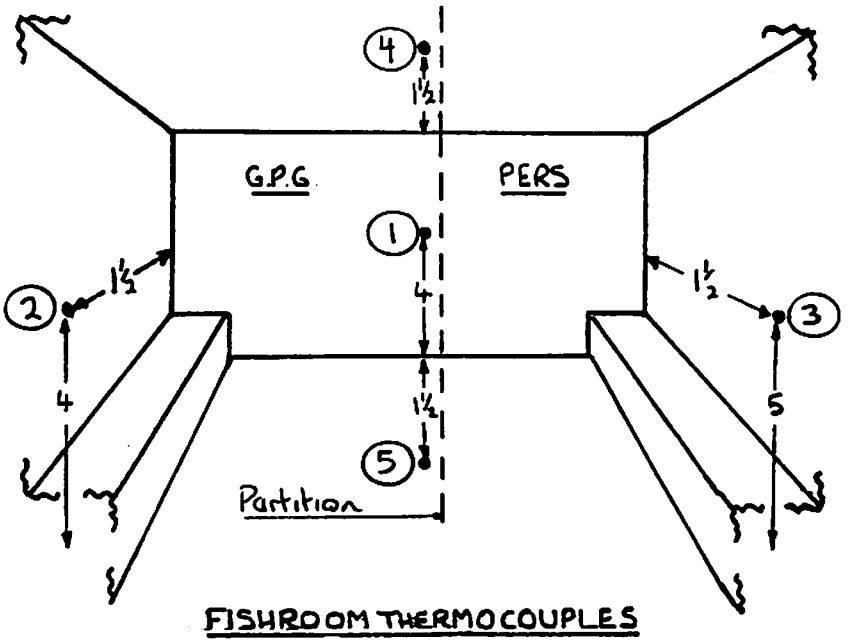
FISHROOM THERMOCOUPLES
VIEW LOOKING AFT

NOTE 1. Thermocouples positioned 5mm clear of fishroom surface at gap between boxes
2. Fishroom sides and bulkhead lined with 12mm ply

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE III

VESSEL	RIVAL	SEAWATER °C	—	TRIP No.	1
PORT	BUCKIE	FISH °C	—	JULY 6 - 11	

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C	CONDITIONS EFFECTING TEMPERATURE
		1	2	3	4	5	6			
SUN	21.00	15.0	16.8	15.3	17.0	15.2	16.2		—	ICE ON BOARD 2 hours FISHROOM OPEN PREVIOUS WEEK
MON	10.30	10.7	10.4	10.9	10.0	9.5	13.0		—	
"	17.00	10.3	10.5	10.1	10.8	8.0	13.2		12.7	
"	21.00	9.9	9.5	8.9	10.0	6.9	12.5		12.7	
TUES	10.30	9.1	8.2	7.5	9.4	5.1	12.6		—	BOXES UP TO 1
"	21.30	9.0	7.0	4.9	9.3	3.2	11.3		12.2	TIER 1 FILLED
WED	09.30	7.6	5.4	4.0	7.9	2.1	10.1		16.8	BOXES UP TO 2 AND 3
"	21.30	8.8	5.4	3.8	9.1	5.4	10.2		—	TIER 2 FILLED
THUR	09.45	7.6	4.4	3.9	7.4	0.2	9.2		—	
FRI	07.30	7.6	4.5	4.8	8.0	2.0	7.0		12.8	



1. BULKHEAD AFT.
2. STBD SIDE
3. PORT SIDE
4. DECKHEAD
5. FLOOR
6. FWD WOOD BHD.

FISHROOM THERMOCOUPLES
VIEW LOOKING AFT

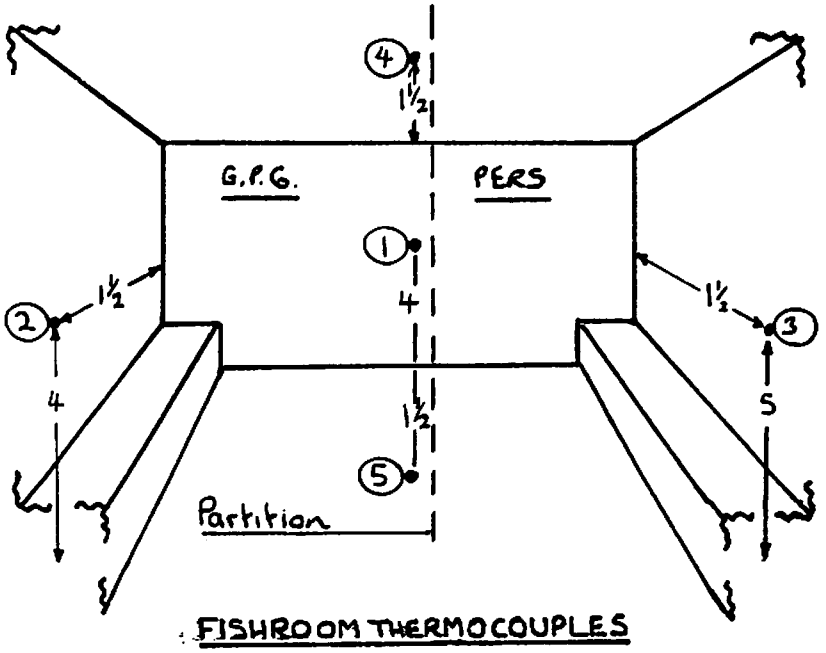
NOTE 1. Thermocouples positioned 5mm clear of fishroom surface at gap between boxes

2. Fishroom sides and bulkhead lined with 12mm ply

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE IV

VESSEL	RIVAL	SEAWATER °C	—	TRIP No.	2
PORT	BUCKIE	FISH °C	SHRIMP 13.5	JULY 13-17	

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C	CONDITIONS EFFECTING TEMPERATURE
		1	2	3	4	5	6			
SUN	22.00	14.9	14.5	15.1	16.2	14.6	16.1		—	TAKEN WHILST ICE PUT IN FISHROOM.
MON	13.00	12.3	10.3	10.5	13.4	8.7	15.3		16.1	
"	21.00	11.4	10.1	11.2	12.9	4.1	15.6		16.1	
TUES	09.15	10.9	9.1	8.9	11.3	5.6	14.0		16.1	BOXES UP TO 1
"	15.30	11.8	8.7	7.4	11.1	4.4	14.8		19.2	TIER 1 FILLED.
"	23 00	11.9	7.9	7.6	12.3	0.6	14.9		16.1	BOXES UP TO 2
WED	10.00	11.1	6.5	6.1	10.8	1.9	13.0		14.8	
"	16.00	10.6	5.7	5.8	10.3	2.0	12.9		16.2	TIER 2 FILLED. 1 2 AND 3 covered.
THUR	04.00	9.6	6.2	6.7	10.7	3.0	11.2		—	



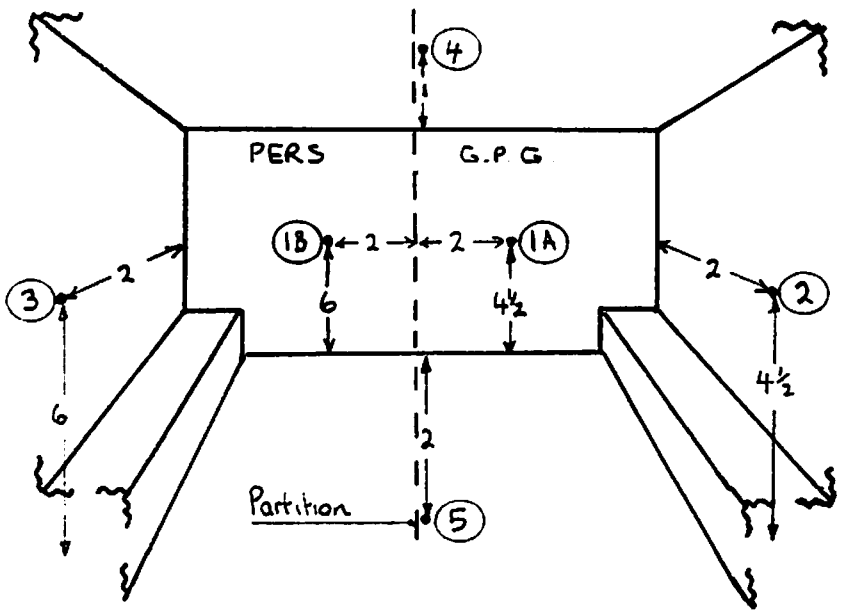
1. BULKHEAD AFT
2. STBD. SIDE
3. PORT SIDE
4. DECKHEAD
5. FLOOR
6. FWD. BHD.

FISHROOM THERMOCOUPLES
VIEW LOOKING AFT

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE V

VESSEL	FRAGRANT CLOUD	SEAWATER °C	—	TRIP No.	1
PORT	PETERHEAD	FISH °C	11–13	AUG 1 – 8	

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C	CONDITIONS EFFECTING TEMPERATURE
		1A	1B	2	3	4	5	6		
FRI.	18.30	11.4	12.1	11.7	12.3	13.9	9.5	–	15.1	30mins after ice taken. Hatch open during conversion
SAT	7.30	10.0	10.3	10.0	9.6	11.7	8.8	–	15.0	Hatch closed overnight
SUN	7.30	7.5	7.6	7.5	7.0	9.4	4.8	–	13.2	1 haul since last reading
"	16.30	6.5	7.2	7.2	7.0	9.4	4.6	15.1	13.6	
"	23.00	6.2	6.7	6.7	6.7	11.1	2.6	–	12.5	
MON	05.00	6.5	6.5	6.5	6.3	10.8	2.7	–	12.8	
"	20.30	6.5	6.1	5.8	6.3	10.3	3.5	–	12.5	
TUES	11.30	5.4	5.8	6 0	6.2	8.9	4.3	–	11.3	Fishroom closed since last reading
WED	14 00	6.2	6.7	6.1	6.6	11.7	3.6	15.3	13.2	Fishroom closed overnight
"	16.00	4.8	4.2	6.5	5.8	10.2	5.6	–	14.5	Boxes up to (1A) and (1B)
"	23.00	3.3	4.8	5.3	5.0	11.8	3.0	–	12.5	
THUR	11.00	3.3	4.7	5.5	5.3	10.3	3.6	14.2	12 5	



FISHROOM THERMOCOUPLES
VIEW LOOKIN AFT

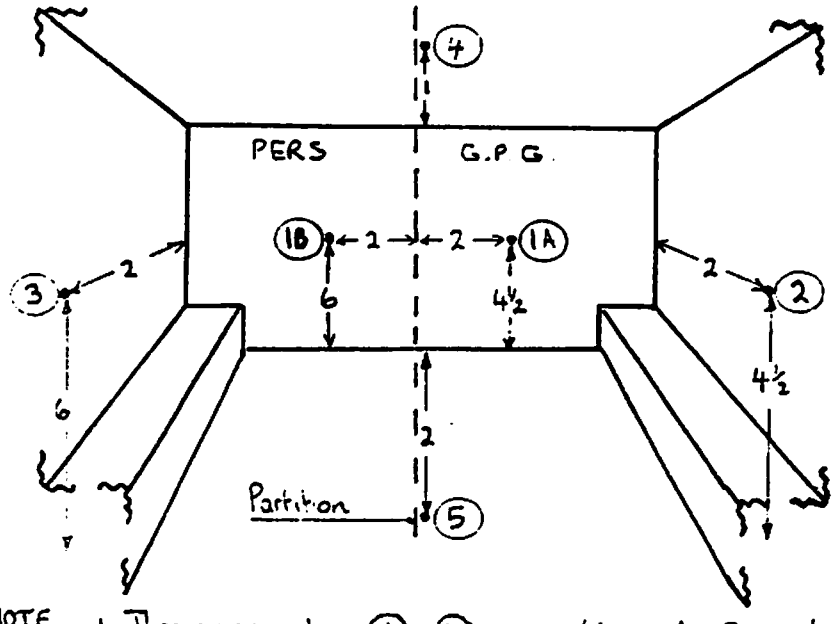
(1A) BULKHEAD PORT
(1B) BULKHEAD STBD.
(2) PORT SIDE
(3) STBD SIDE
(4) DECKHEAD
(5) FLOOR
6 SHELTERDECK AFT OF FISH HATCH

NOTE
1. Thermocouples (1)–(4) positioned 5mm clear of fishroom surface at gap between boxes
2. Thermocouple (5) 50mm clear of floor
3. Fishroom sides and bulkhead lined with 12mm ply

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE VI

VESSEL	FRAGRANT CLOUD	SEAWATER °C	—	TRIP No.	2/1
PORT	PETERHEAD	FISH °C	—	AUG 11 – 19	

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C		CONDITIONS EFFECTING TEMPERATURE
		1A	1B	2	3	4	5	6		7	
TUES	07.00	7.3	7.3	6.7	7.0	8.9	5.1		12.1	12.5	Hold closed 24 hrs
"	13.15	7.1	8.0	7.5	7.2	10.7	3.9		15.7	18.3	
"	20.50	3.0	3.8	5.4	5.3	9.0	2.6		14.2	14.6	Boxes over (1A) & (1B)
WED	07.20	2.6	1.9	4.7	4.9	8.0	2.0		13.3	14.6	Tier 1 complete
"	11.30	2.5	3.5	4.4	5.0	8.2	1.2		12.5	13.7	Boxes Tier 2 up to (2) & (3)
"	16.30	2.6	3.3	4.9	4.8	8.4	1.1		14.9	17.2	
THUR	06.45	2.0	3.1	4.3	4.4	7.7	0.9		14.1	15.3	
"	19.03	2.1	3.6	4.1	4.7	8.5	1.0		14.8	17.0	
FRI	07.00	2.3	3.4	4.1	4.8	6.6	1.5		15.7	15.7	Tier 2 complete
"	12.05	2.3	3.1	4.2	4.0	7.1	1.1		13.8	15.5	
"	16.35	2.6	—	4.7	5.6	8.7	1.2		14.3	16.2	Boxes Tier 3 over (2) & (3)
"	18.30	2.3	3.6	4.6	5.1	8.3	1.0		14.9	15.3	



FISHROOM THERMOCOUPLES
VIEW LOOKIN AFT

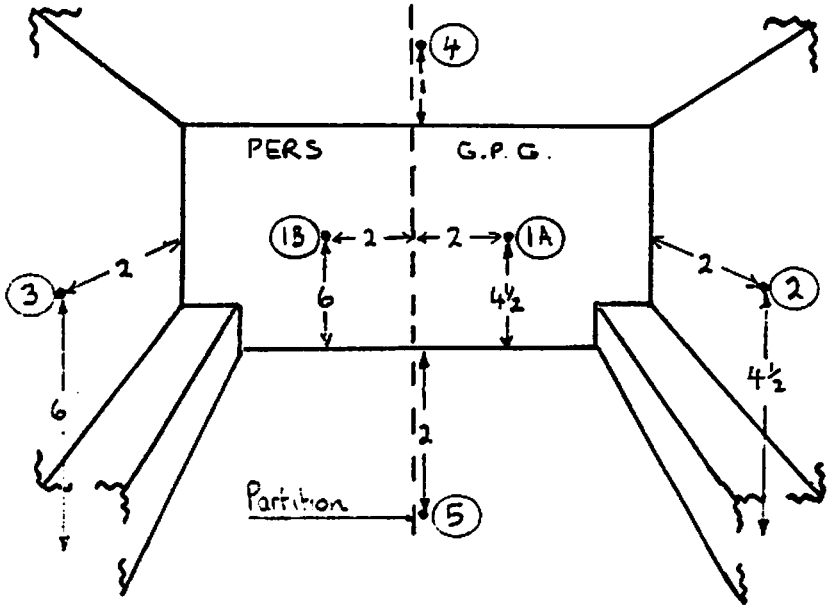
(1A) BULKHEAD PORT.
(1B) BULKHEAD STBD.
(2) PORT SIDE
(3) STBD SIDE
(4) DECKHEAD
(5) FLOOR
6 AIR GAP G.PG. MID. TIER 3
7 SHELTERDECK

NOTE
1. Thermocouples (1)–(4) positioned 5mm clear of fishroom surface at gap between boxes
2. Thermocouple (5) 50mm clear of floor
3. Fishroom sides and bulkhead lined with 12mm ply

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE VII

VESSEL	FRAGRANT CLOUD	SEAWATER °C	—	TRIP No.	2/2
PORT	PETERHEAD	FISH °C	—		AUG 11 -19

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C		CONDITIONS EFFECTING TEMPERATURE
		1A	1B	2	3	4	5	6		7	
FRI	22.40	2.7	3.2	3.3	4.8	8.5	0.9	0.6	13.2	14.9	
SAT	08.15	2.4	3.4	3.5	1.1	8.1	1.3	0	14.3	15.7	
"	12 40	2.7	3.7	3.1	2.9	8.5	1.5	0.6	15.1	17.8	
SUN	06.45	3.2	3.3	3.2	2.2	8.1	1.5	0.4	14.3	15.7	
"	12.00	2.7	3.1	3.8	2.4	9.1	1.2	0.1	15.2	16.2	
"	19.00	3.3	3.8	3.9	2.7	10.4	1.5	0.2	15.2	16.7	Tier 4 complete
MON	08.45	2.2	3.9	3.4	2.6	10.4	2.3	2.9	14.4	15.8	
"	12.55	3.1	4.7	3.5	2.0	10.0	2.0	4.1	14.2	18.0	
TUES	04.30	4.2	2.6	3.4	2.4	9.6	2.1	4.0	13.0	16.1	



FISHROOM THERMOCOUPLES
VIEW LOOKING AFT

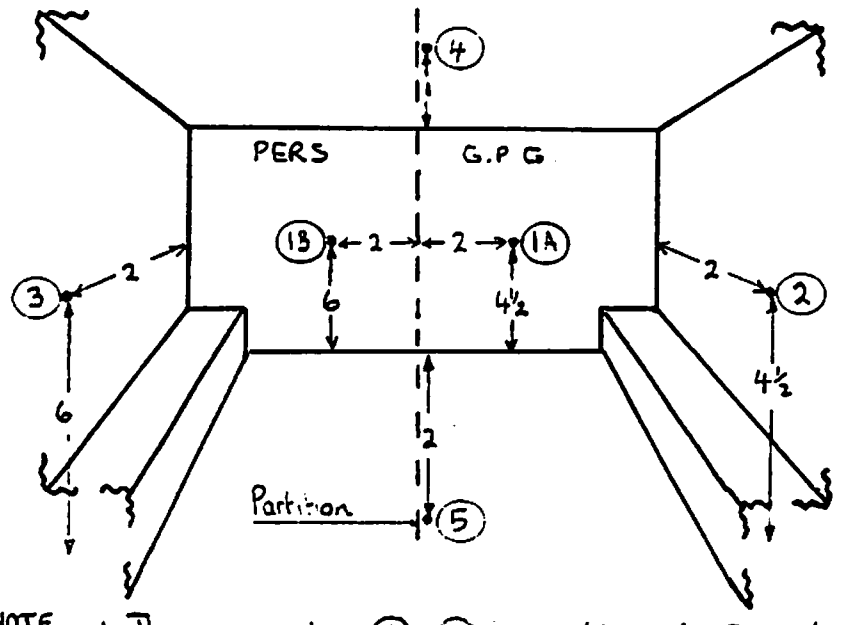
(1A) BULKHEAD PORT.
(1B) BULKHEAD STBD.
(2) PORT SIDE
(3) STBD SIDE
(4) DECKHEAD
(5) FLOOR
6 AIR GAP G.P.G MID TIER 3
7. SHELTERDECK

NOTE
1. Thermocouples (1)-(4) positioned 5mm clear of fishroom surface at gap between boxes
2. Thermocouple (5) 50mm clear of floor
3. Fishroom sides and bulkhead lined with 12mm ply

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE VIII

VESSEL	FRAGRANT CLOUD	SEAWATER °C	—	TRIP No.	3
PORT	PETERHEAD	FISH °C	12		AUG 21 - 28

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C	CONDITIONS EFFECTING TEMPERATURE
		1A	1B	2	3	4	5			
THUR	14.00	9.8	9.8	9.5	10.1	11.1	7.3		12.5	
FRI	07.00	8.2	8.2	8.2	7.6	10.7	6.7		13.7	
"	16.00	4.1	6.1	6.1	5.1	11.4	3.1		15.7	
SAT.	00.00	2.1	1.9	5.4	6.6	9.8	2.9		—	TIER 1 full.
SUN	20 00	1.7	3 2	4.1	—	8.1	1.0			TIER 2 full.
MON	12 00	2.2	4 0	2.6	—	8.3	0.8		—	TIER 3 full
TUES	12.00	2.1	4.6	3 0	—	8.6	1.1		—	TIER 4 full.
WED										
THUR	06 00	2.7	4.4	2.8	—	7.0	1.2		—	



FISHROOM THERMOCOUPLES
VIEW LOOKIN AFT

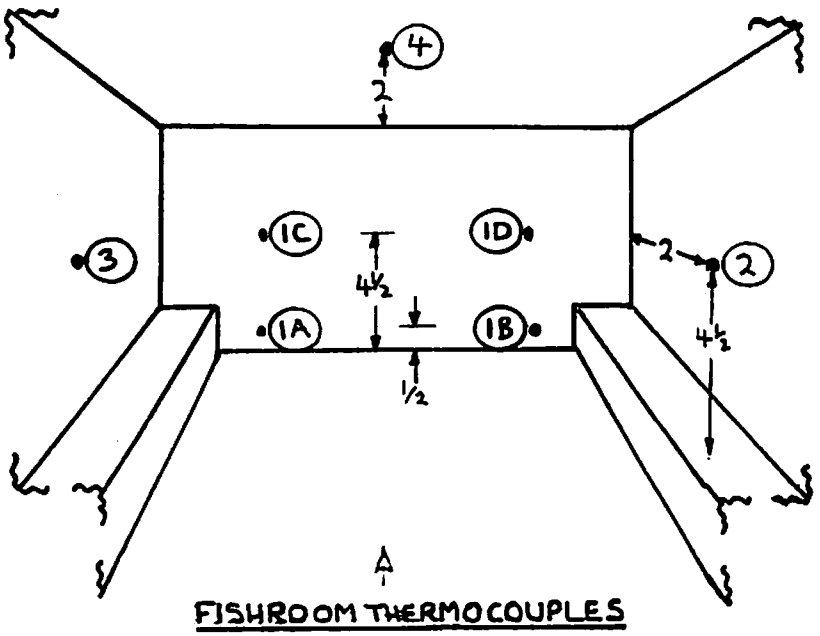
(1A) BULKHEAD PORT.
(1B) BULKHEAD STBD.
(2) PORT SIDE
(3) STBD SIDE
(4) DECKHEAD
(5) FLOOR

NOTE
1. Thermocouples (1)-(4) positioned 5mm clear of fishroom surface at gap between boxes
2. Thermocouple (5) 50mm clear of floor
3. Fishroom sides and bulkhead lined with 12mm ply

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE IX

VESSEL	SEAGULL	SEAWATER °C	—	TRIP No.	2
PORT	KINLOCHBERVIE	FISH °C	—		OCT 14-16

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C	CONDITIONS EFFECTING TEMPERATURE	
		1A	1B	1C	1D	2	3	4			
SUN	13.00	5.4	5.2	4.5	4.9	4.7	4.3	6.2		VESSEL IN HARBOUR. ICE IN FISHROOM. CHILLERS OFF.	
										7	
TUES	20.18	5.2	4.4	0.8	0.9	1.8	2.6	2.4	10.7		
WED	00.25								11.2	11.9	
"	05.15								10.6	11.4	
"	14.20	3.0	4.1	1.8	3.0	2.0	1.2	4.7	13.0	14.6	FIRST FISH INTO FISHROOM.
"	17.40	3.2	3.0	2.2	2.3	3.5	3.1	4.4	12.2	.	
"	22.20	2.9	2.3	1.4	1.1	1.4	1.8	4.0	11.2		THERMOCOUPLES (1) (2) & (3) COVERED.
THUR	09.10	1.0	2.8	0.7	0.6	0.9	0.9	1.1	12.0	12.4	



FISHROOM THERMOCOUPLES
VIEW LOOKING AFT

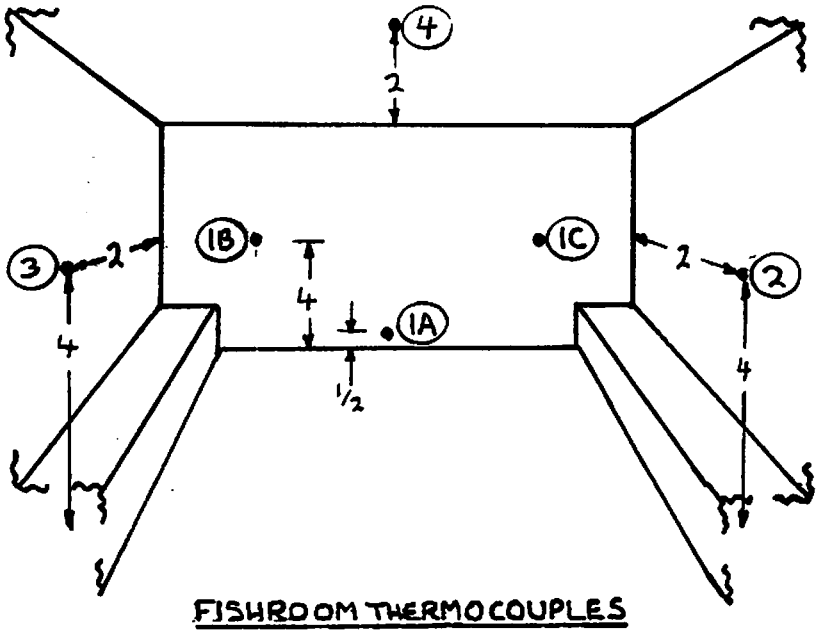
1A. BULKHEAD STBD. LOWER
1B BULKHEAD PORT LOWER
1C BULKHEAD STBD. UPPER
1D BULKHEAD PORT UPPER.
2 PORT SIDE
3. STBD. SIDE
4. DECKHEAD
7. SHELTERDECK.

NOTE 1. Fishroom sides open posted 2. Fishroom has chillers installed.
3. Thermocouples 1A-1D 5mm clear of surface. at gap between boxes
4. Thermocouple 4 50mm down from deckhead.

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE X

VESSEL	SUNBEAM	SEAWATER °C	8.7	TRIP No.	1
PORT	PETERHEAD.	FISH °C	—	NOV 19-28	

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C	6	CONDITIONS EFFECTING TEMPERATURE
		1A	1B	1C	2	3	4	5			
WED	18.05	4.5	4.9	5.0	4.5	5.6	3.5	4.2			ICE JUST TAKEN
THUR	10.45	2.7	1.6	0.2	-0.3	2.3	0.5	4.7	6.2	7.1	
"	13.40	2.0	1.2	0.5	0.8	3.0	1.6	4.4	5.5	6.5	
FRI	08.07	2.1	1.3	1.2	0.6	2.9	0.2	5.6	5.4	4.9	
"	16.09	2.1	1.4	0.7	1.2	3.7	3.7	4.1	5.3	6.4	BOX UP TO (2) AND (3) TIER 2
SAT	12.00	2.9	2.9	2.4	0.8	2.7	2.4	3.9	7.8	7.7	TIER 1 COMPLETE.
SUN	10.46	2.9	2.1	0.9	0.2	3.6	-0.8	3.0	8.0	7.7	
MON	11.00	3.3	2.5	1.6	0.5	2.8	0.6	3.9	8.3	7.7	
"	18.30	4.8	1.8	1.3	-0.2	1.3	0.2	3.3	7.9	8.5	
TUES	13.15	4.8	1.5	0.8	0.4	2.4	0.2	4.5	8.3	8.7	TIER 2 COMPLETE
WED	14.09	5.7	3.2	1.8	1.7	3.1	-0.3	3.4	7.7	8.1	TIER 3 NOT COMPLETE.
FRI	06.45	5.0	2.9	1.9	1.2	2.7	1.5	3.8	9.8	9.9	HOLD NOT OPENED FOR 36 HOURS



1A BULKHEAD LOWER
1B BULKHEAD STBD. UPPER
1C BULKHEAD PORT UPPER
2 PORT SIDE
3 STBD. SIDE
4 DECKHEAD
5. FWD BULKHEAD CENTRE.
6. SHELTERDECK.

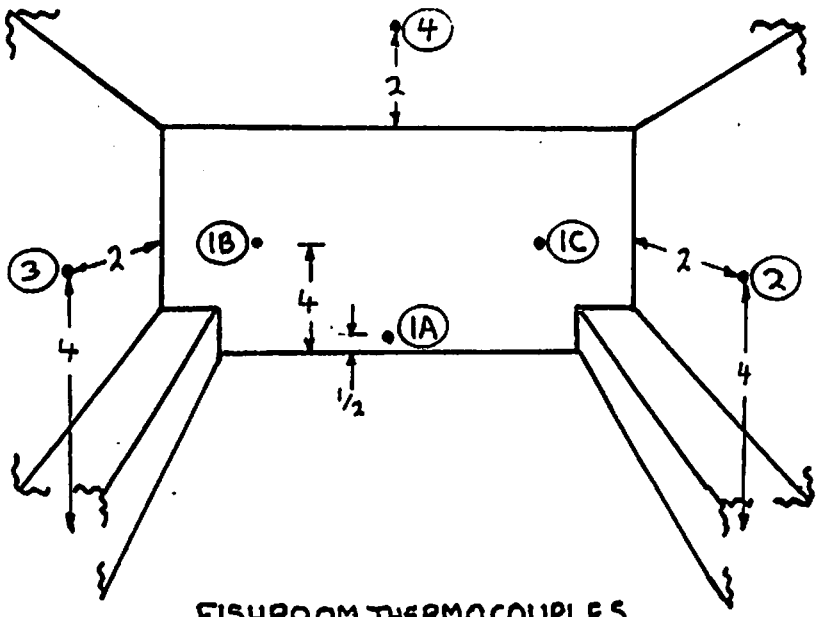
FISHROOM THERMOCOUPLES
VIEW LOOKING AFT

NOTE 1. FISHROOM SIDES OPEN POSTED.
2. FISHROOM HAS CHILLERS INSTALLED.
3. THERMOCOUPLES 5mm CLEAR OF SURFACE AT GAP BETWEEN BOXES.
4. THERMOCOUPLES 1B AND 1C CHAFED DURING TRIP

BOX TRIALS FISHROOM TEMPERATURE DATA — TABLE XI

VESSEL	SUNBEAM	SEAWATER °C	—	TRIP No.	2
PORT	PETERHEAD.	FISH °C	—		DEC 2–10

DAY	TIME	TEMPERATURE READINGS °C							AMBIENT °C	CONDITIONS EFFECTING TEMPERATURE
		1A	1B	1C	2	3	4	5		
WED	12.00	4.6	1.6	1.7	0.7	4.5	2.0	2.4	8.0	
"	17.25	3.4	2.2	2.5	2.6	4.4	3.3	2.6	9.0	
THUR	18.00	4.0	2.0	2.0	2.0	4.0	3.0	2.5	5.0	
										CHILL PLANT BREAKDOWN ON FRIDAY. NON OPERATIONAL
SAT	17.00	5.6	0.5	1.5	1.5	6.0	4.1	4.7	4.0	
SUN	10.00	6.0	0.4	1.0	2.7	6.8	6.2	3.4	5.6	
WED	03.00	9.0	3.8	2.1	2.9	7.4	8.2	5.1	6.1	ARRIVAL PETERHEAD.



1A BULKHEAD LOWER
1B BULKHEAD STBD. UPPER
1C BULKHEAD PORT UPPER
2 PORT SIDE
3 STBD. SIDE
4 DECKHEAD
5. FWD BULKHEAD CENTRE.

FISHROOM THERMOCOUPLES
VIEW LOOKING AFT

NOTE 1. FISHROOM SIDES OPEN POSTED.
2. FISHROOM HAS CHILLERS INSTALLED.
3. THERMOCOUPLES 5mm CLEAR OF SURFACE AT GAP BETWEEN BOXES.

FIGURE 1 - GPG C1519 STACK NEST BOX.

FIGURE 2 - PERS STACK ONLY BOXES IN FISHROOM LINED WITH PLYWOOD FOR TRIAL.

FIGURE 3 - FISHROOM MODIFIED TO CARRY STACK NEST BOXES ONLY.

FIGURE 4 - FISHROOM PARTITIONED TO CARRY BOTH STACK ONLY AND STACK NEST BOXES.

FIGURE 5 - FISHROOM BULKHEAD NOT PERPENDICULAR TO FISHROOM FLOOR.

FIGURE 6 - BATTENS ATTACHED TO FISHROOM BULKHEAD TO RETAIN VERTICAL BOX STACK.

FIGURE 7 - FISHROOM STEPS ALTERED TO MAINTAIN HORIZONTAL BOX LIP CONTACT.

FIGURE 8 - PORTABLE STEEL STOP BARS TO PREVENT FORWARD BOX MOVEMENT.

FIGURE 9 - COMMON PRACTICE OF BOX OVERFILLING WITH WOODEN BOXES.

FIGURE 10 - APPARENT 25% REDUCTION IN STOWAGE SPACE BETWEEN BOX TYPES.

FIGURE 11 - ICE MELTAGE TO ONE END OF THE BOX WHEN PLACED NEXT TO ENGINEROOM BULKHEAD.

FIGURE 12 - PERS AND GPG BOXES ON THE FISH MARKET AT PETERHEAD.

FIGURE 13 - ROSEBAY LANDING USING GPG BOX ONLY.

FIGURE 14 - BOXES ON FISHMARKET AT KINLOCHBERVIE.

FIGURE 15 - SEAFISH FISHWASHER INSTALLED ON FRAGRANT CLOUD.

FIGURE 16 - EMPTY BOXES LOADED 15 AT A TIME ONTO ROSEBAY. NOTE FOUR POINT LIFT.

FIGURE 17 - EMPTY BOXES TEMPORARILY STOWED ON SHELTERDECK OF RIVAL.

FIGURE 18 - EMPTY BOXES SECURED IN FISHROOM USING PORTABLE STANCHIONS

FIGURE 19 - EMPTY BOXES SECURED IN FISHROOM WITH ROPE LASHING.

FIGURE 20 - STACK NEST BOXES BEING FILLED ON SEAGULL.

FIGURE 21 - BOXES DISTORTED BY USING TRADITIONAL UNLOADING HOOKS.

FIGURE 22 - BOXES UNLOADED FROM SEAGULL USING EXISTING UNLOADING HOOKS.

FIGURE 23 - BOXES UNLOADED FROM ROSEBAY USING FOUR POINT LIFT.

FIGURE 24 - PORTABLE BOX HOLDING BENCHES INSTALLED ON FRAGRANT CLOUD.

FIGURE 25 - ALUMINIUM BOX TRACK FITTED ON BOARD SUNBEAM.

FIGURE 26 - PORTABLE GUTTING TRAY BEING FITTED TO TRACK.

FIGURE 27 - ALUMINIUM TRACK ON SUNBEAM WITH PORTABLE GUTTING TRAYS FITTED.

FIGURE 28 - GUTTING TRAYS ON SUNBEAM WITH BOXES IN POSITION.

FIGURE 29 - WOODEN TRACKWAYS AND STANCHIONS FITTED TO DECK OF SUNBEAM.

FIGURE 30 - PLASTIC BOXES SUCCESSFULLY USED ON WORKING DECK.

FIGURE 31 - PLASTIC BOXES OF FISH STOWED FORWARD AWAITING GUTTING.

FIGURE 32 - TRACKWAY ON SUNBEAM WITH P.T.F.E. STRIPS FITTED.

FIGURE 33 - WEIGHING AT SEA ONBOARD SEAGULL.

FIGURE 34 - SLIGHT BUCKLING OF NEST STOPS. (ARROWED)

FIGURE 35 - ONE INSTANCE OF TOTAL NEST STOP FAILURE.

FIGURE 36 - NEST STOP FAILURE AND DAMAGE TO BOX BELOW.

FIGURE 37 - SPLIT IN BOX CAUSED BY DISCONTINUITY OF COLOURED INDICATOR.