

# HMS 'BRAZEN' SALVAGE AND REPAIR

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## ABSTRACT

Volume 36(1) of the *Journal of Naval Engineering* contained an article on the Salvage of HMS *Brazen* in 1994, written by Principal Salvage Officer, Morgan DAVIES. This second account, whilst re-covering some of the material of the first article, takes the story through the repairs carried out in Chile and up to *Brazen's* return to the UK and is written from the viewpoint of the Naval Support Command. It is hoped that a third article will be published in due course recounting the process of restoring the underwater sensors once back in Devonport.

## The first news

In early September 1994, HMS *Brazen* was on passage from the Falkland Islands to Valparaiso, Chile. She had called at Punta Arenas and had started to make her way from the Straits of Magellan into the Patagonian Canals. A few minutes into the new day of the 12 September she struck, and rode up on a submerged rock, (FIG.1). She was then about two hundred miles north west of Punta Arenas. At the time of the grounding it was estimated that the ship was travelling at something in excess of 15 knots. Before she struck the rock on which she finally came to rest, her port aft stabilizer fin was struck a glancing blow as it passed another submerged rock. This left the stabilizer fin stuck in a downward angle, severely damaged and jammed against the ship's hull.

*Brazen* rode onto the submerged rock to a point about 20 metres from her forefoot before coming to rest. In so doing five major watertight compartments had been breached and a sixth, and much larger compartment housing the main sonar had a relatively small leak. The ship's HO29 and HO30 sonar domes (Hull Outfits) had been torn off by rocks before the ship came to rest.

The ship immediately alerted CINCFleet Northwood and other shore authorities with a 'FLASH' signal. However, as the Naval Support Command (NSC), Bath was not on the distribution it was not until some three hours later, 120800A, that the Surface Flotilla Operations and Maintenance Officer (SFOMO) at Northwood contacted the Warship Project Manager (WPM) and asked:

"What are you going to do about it?"

Salvage officers from the Chief Salvage and Mooring Officer's team (SALMO) had already been briefed and were preparing for the earliest possible departure. Nothing could be gained by their waiting to see if the ship re-floated on the next high tide: if she didn't, valuable time had been lost.

For the NSC this was to become a test of the almost brand new organization in terms of getting the damaged ship back to an operational state. All immediately available, relevant information was assembled in the Project and the first 'Sitreps' started to arrive from the ship.

By the afternoon of the 12 September it was apparent that there was not going to be a re-float on the next tide, the ship was making its best endeavours but had only achieved a relatively small movement using her own



FIG. 1—'BRAZEN' ON THE ROCK

powers. The Chilean Navy had dispatched a small tug, the *Yelcho*, but it was relatively old and lacked the necessary power for the job in question. *Brazen* was in an area where gales and blizzards spring up without warning, winds change direction rapidly and the climate is generally extremely hostile. The only saving grace appeared to be the fact that the tide range in the area was of the order of 1.6 metres at its maximum.

The Chilean Navy offered all the assistance they could but an ocean going tug, the *Cola-Cola*, could not reach the stricken vessel until, at best, late on the 14 September. (To bring distances into perspective, although the ship was only two hundred miles from Punta Arenas, the Chileans main naval bases and dockyards at Talcahuano and Valparaiso were at least a thousand miles away to the north.)

The decision was therefore taken to dispatch a small team from the NSC comprising:

- The project naval architect (NA/W2)
- Two members of the hull survey team.

Their initial and primary task would be to establish the condition of the hull structure and ship stability and advise the WPM to enable decisions on the way ahead to be taken. Therefore, at 1600 that Monday, flights were hastily booked, local transport arranged, support documents assembled, advanced warnings sent and bags hastily packed. NA/W2 and a Hull Survey CPO then caught up with the two salvage officers at Heathrow for the 2215 flight to South America. In parallel with this, WPM's Marine Systems Manager (MSM) was nominated as the 'Incident Project Manager.' This single point of contact for all material aspects of the operation was signalled MoD wide and proved invaluable, as all interested parties were able to focus their efforts and be co-ordinated within the proper framework.

For the travellers the long journey was, more than anything, frustrating because of our inability to update our knowledge of the ship's condition. However, by 1300 local time on 13 September we were in Santiago and were updated by the Defence Attaché (DA), CAPTAIN Robin JOHNS RN. By the time we arrived, CAPTAIN JOHNS had up-to-date situation reports on the ship and the short and long-term prospects for assistance. (It was interesting to note that CAPTAIN JOHNS had only taken up his appointment as DA, Santiago the previous morning and was by then in, as he described it, 'a baptism of fire'.

The technical update indicated that draughts at ship were approximately 1 metre forward and 6.3 metres aft, but that the tide range between low and high water was likely to only vary between 1 and 1.6 metres. The small Chilean tug had arrived, was standing by and giving support in terms of materials and advice. An ocean going tug would be with the stricken ship within 48 hours. Furthermore, two Chilean warships would be coming south and HMS *Iron Duke* was currently making her way from her deployment zone, (the Falkland Islands) and would arrive at Punta Arenas in about 48 hours time.

By way of forward planning, a sheltered anchorage had been identified five miles from the scene of the grounding where inspections could take place once *Brazen* was re-floated and early enquiries had been made with the 'Astilleros y Maestranzas de la Armada' (ASMAR) dockyard at Talcahuano (the nearest drydock!) with view to obtaining docking and repair facilities.

Little more could be done in Santiago at that time and preparations were made for the team to move south early the next morning, 14 September.

### Meanwhile, back in the UK . . .

As an aid to planning and managing the task ahead the WPM's team produced a basic Decision Tree, (FIG.2). It was around this that 'all the immediate staff work was conducted and against which the priorities of headquarters activities were compared for the next few days.

Having confirmed with SFOMO at Northwood that there were no casualties and that the ship was, for the time being at least, stable the immediate consideration was would she refloat or not? If not, what were the consequences? FIG.2 shows that the inevitable result of not refloating was the abandonment of the vessel leading to a wreck salvage operation. Underlying this scenario were considerations of the implications of the embarked ammunition and the potential environmental impact of the fuel and other substances carried which were subject to the Control of Substances Hazardous to Health (COSHH) Regulations. Flag Officer Surface Flotilla (FOSF) Portsmouth quickly provided a 'substances' list and also an estimate of the environmental

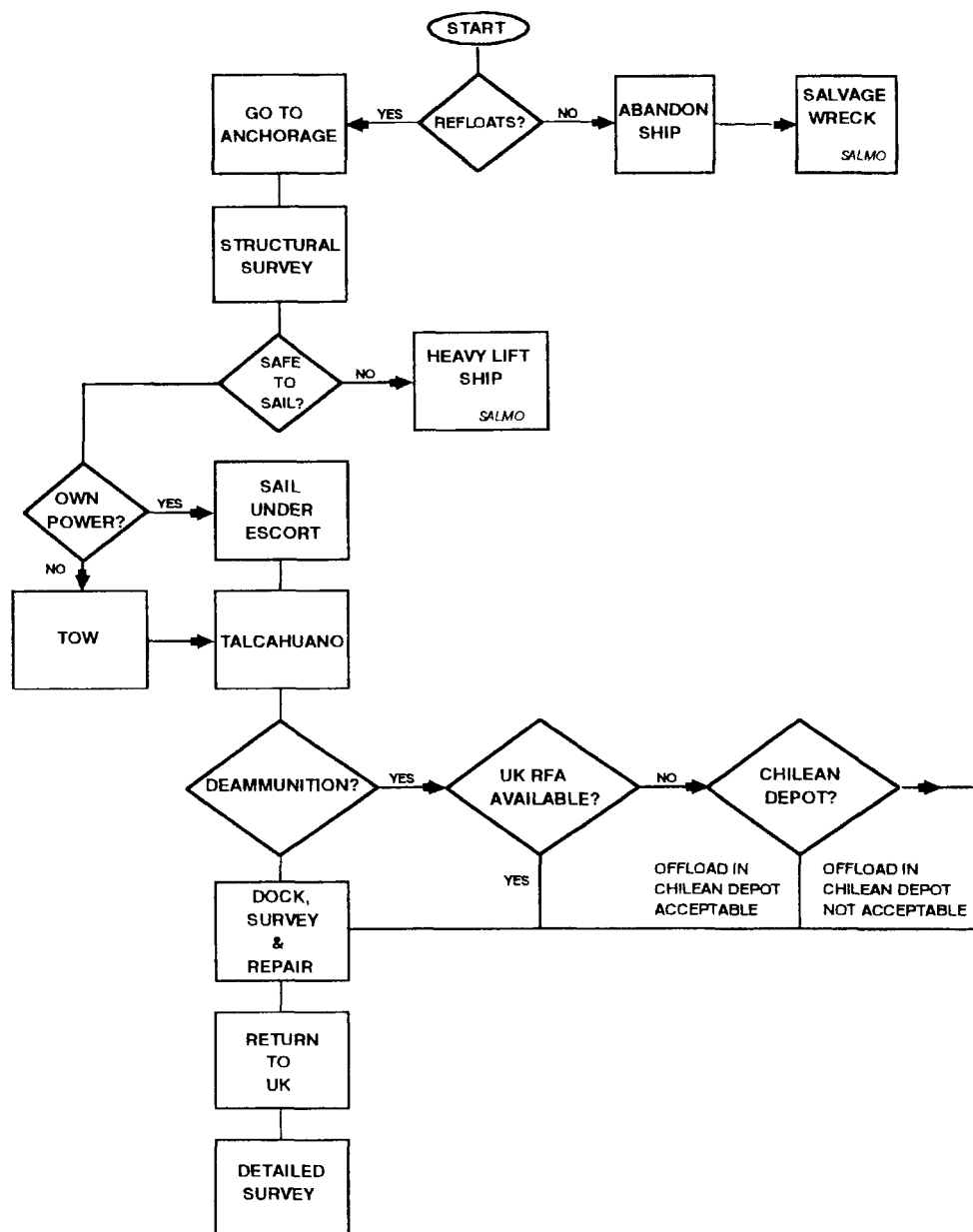


FIG. 2—BASIC DECISION TREE

problems (noting that Patagonia is an area of outstanding natural beauty and an area of special scientific interest). The Chief Inspector of Naval Ordnance and the Fleet Explosives Team also advised on the recommended course of action for the ammunition:

'Leave it where it was in the proper stowages and salvage it with experts later'.

Whilst the WPM's team were dealing with the worst case scenario and preparing defensive briefs, CSALMO was investigating the availability of salvage vessels and equipment. He also ascertained the whereabouts of all suitable heavy lift shipping world wide that might be chartered in the event of the *Brazen* refloating but not being able to proceed.

The more optimistic, and eventually realized scenario was the successful refloating of the ship, but then what? It was clear that the large amount of structural damage incurred would mean that the Certificate of Safety—Structural Strength (CSSS) would have to be suspended. This was a new procedure and provoked considerable discussion. It was eventually decided that the correct protocol was for the WPM to advise FOSF that HMS *Brazen* was no longer certified as structurally safe and that she should not proceed until certified by the WPM as materially safe to do so. This was subsequently done by signal, keeping the ship informed, and ensured that whilst FOSF/CINCFLEET remained unequivocally in command, the WPM was able to exercise his authority and responsibility for the material state of the vessel.

On 14 September MSM/W2 and CSALMO were summoned to Northwood to provide a brief. It was here that the detailed staff-work already carried out proved invaluable, in demonstrating that a workable plan to deal with all eventualities in priority order had been developed by the NSC.

By now there was an almost constant demand from many departments within the MoD for briefings. The Directorate of Naval Logistic Staff Duties (DNLSD) (now DNLP) provided a staff officer to handle this task and the assistance was invaluable, not least since Foxhill (WPM's base) was not on the communication network CHOTS, whereas DNLSD in Quay House were.

The next priority, regardless of whether or not the ship floated, was the provision of finance to cover the cost of the operation. It was also necessary to ensure that someone in Chile had authority to commit funds on behalf of the MoD and this required delegated contractual authority. These powers eventually fell to the DA, Santiago following two days of detailed discussion and exceptional flexibility on the part of Finance and Contracts staff.

In order to have a second opinion on the technical decisions, the Director of Naval Architecture provided structural advice and comments throughout. This ensured that the audit trail existed and that when the suspension of the CSSS was lifted, there had been proper consultation in the decision making process.

### **Whilst;—in South America . . .**

The NSC and SALMO teams travelled separately to Punta Arenas due to uncoordinated arrangements. On arrival at Punta Arenas the NSC team made contact with the local British Consul for update of information, whilst SALMO were flown direct to *Brazen* by Chilean Navy helicopter.

The plan for the NSC team was that they would stay in Punta Arenas until *Iron Duke* arrived and then sail with her, adjusting the programme to rendezvous with the stricken vessel and provide assistance as necessary.

An excellent service of support was provided by the Office of the British Consul in Punta Arenas, an honorary position held by a local shipping agent. From there we were able to keep abreast of developments with information provided from Santiago and Bath.

The morning of Thursday the 15 September brought the good news we had all hoped for. At approximately 1000 local time, using a combination of resources, (tugs, her own power, ballasting at the stern end and rocking by crew moving on the flight deck) *Brazen* came clear of the rock on which she had rested for more than three days. She immediately proceeded, slowly and under her own power, to a previously identified nearby sheltered anchorage.

*Iron Duke* arrived in Punta Arenas mid-afternoon on the Thursday. The NSC team, the squadron MEO (who had arrived that morning), and an engineering support team comprising an officer and twelve senior and junior ratings from NP2010 in the Falklands who had been flown in the day before. All embarked to move forward with her up the Magellan Straits and into the Patagonian canals that night.

It was evident that many authorities in the UK, Chile and the Falklands needed to keep abreast of developments and forward planning. It had therefore been agreed that CINCFleet, Northwood would be the official single point of contact with the ship to avoid confusion and duplication.

Meanwhile, most of the crew on *Brazen* had a well earned rest. They had endured three days and nights of continually changing weather and sea conditions, tide cycles and attempts to re-float. Adrenalin levels had been high but now there was respite and a little time for reflection. Further assessments of the damage were made and the SALMO team and the ship's divers took several underwater videos of the affected areas, which subsequently proved extremely valuable in briefing the NSC teams, ship-repairers and authorities in the UK.

Good weather on the morning of Friday the 16 September made the transfer to *Brazen* relatively straight forward. The flight in *Iron Duke's* LYNX took 1¼ hours flying low through the spectacular scenery of the southern Patagonian Canals. Emotions were stirred several times when on route we sighted the wreckage of vessels that never completed their passage through those treacherous waters.

### Damage assessment and way ahead

Once on board *Brazen*, an accurate assessment of the stability and structural condition had to be made as soon as possible, to enable decisions on the way ahead to be taken. From calculations already made, it was known that the ship had been subject to a grounding load of the order 500 tonnes at the pivot point. She had also been subject to six full tide cycles and some extreme weather conditions whilst aground. Questions to be addressed were:

- (a) How much buoyancy had been lost?
- (b) Could the trim be suitably adjusted for sailing?
- (c) Was there sufficient strength left in the hull girder, in the damaged area, to allow safe passage in a seaway?
- (d) Had fatigue or stress damage occurred, which would weaken the structure locally?
- (e) Had any damage occurred in maximum stress areas on the hull due to hogging or sagging on the tide cycles?
- (f) How had known class structural defect areas behaved? These needed to be inspected wherever possible.
- (g) Were shoring and blanking arrangements on hatches and structure adjacent to the damaged areas satisfactory for sea passage.

The five severely damaged compartments were flooded and inaccessible but in the sixth (HO29), the leak had been contained using one portable pump and cement boxing, (FIG.3). Inspection within the Hull Outfit 29 com-

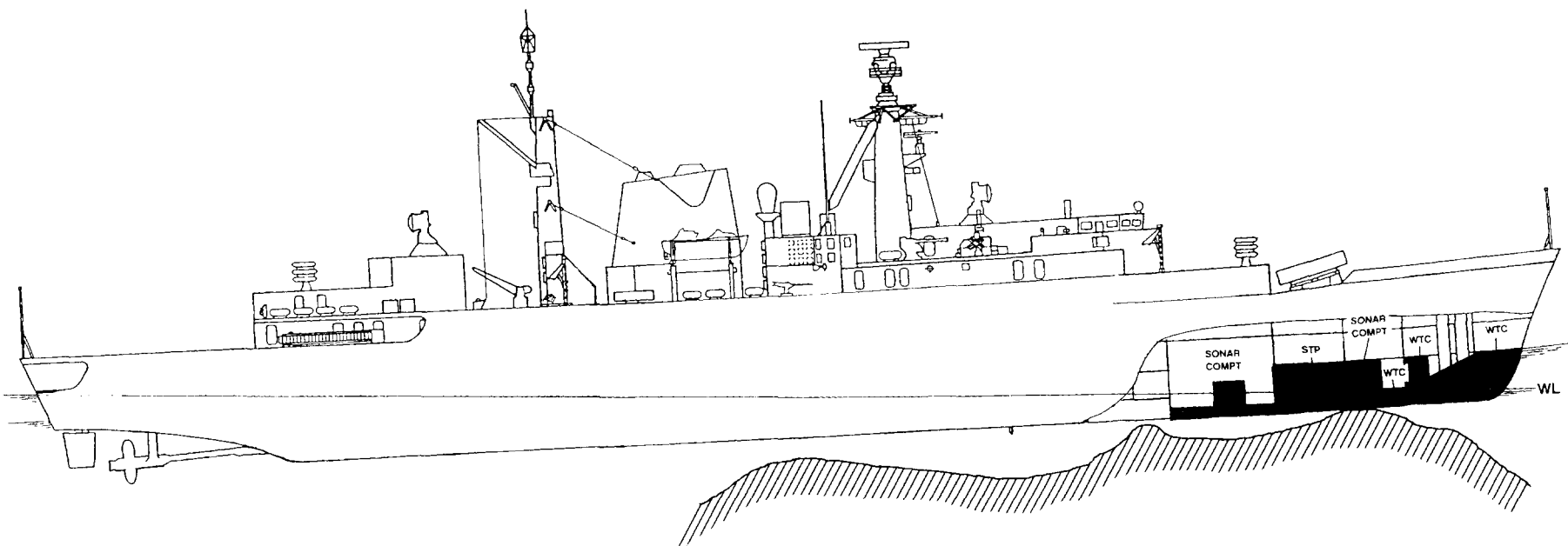


FIG. 3—'BRAZEN' GROUNDED—DAMAGE DIAGRAM  
STP—SEWAGE TREATMENT PLANT WTC—WATERTIGHT COMPARTMENT

partment was therefore straightforward. The only other indication of damage in that space was to:

- The watertight Sonar trunk which appeared slightly tilted
- The Sonar near field monitor, which had been broken off probably by the shock loading at impact.

The sewage treatment compartment forward of Hull Outfit 29 was flooded and the machinery badly damaged. Compressed air had been used to force out much of the flood water and provide an air cushion against some of the potential effects of slamming.

The next compartment housing the Sonar Hull Outfit 30 was breached, completely flooded and badly damaged. This area had been the final pivot point on the pinnacle of rock prior to the ship being freed and at that time Yokohama fenders had been placed in the compartment to provide added buoyancy. The watertight compartment forward of HO30 had been breached and was open to the sea. Finally, at the fore end, the fore peak was breached below No 3 deck but there were no signs of structural degradation above.

The damage control measures taken by the ship were described as 'text book', (FIG.4). Hatches and decks above breached compartments had been shored using damage control timber or AKROW props and the loads were well spread above.

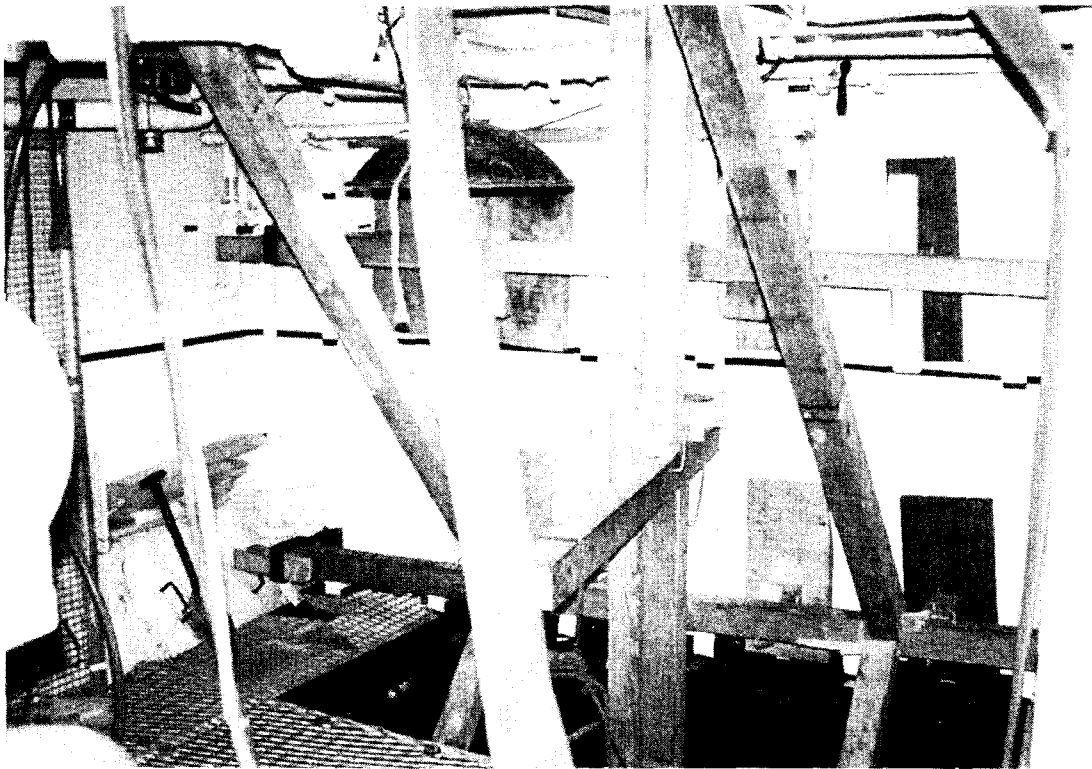


FIG. 4—DAMAGE CONTROL MEASURES IN THE HO29 COMPARTMENT

A thorough survey was carried out throughout the ship and no other signs of damage were detected. Areas of ship where class structural defects were known to occur did not appear to be any worse for the grounding. One longitudinal girder under No 01 Deck was found to be cracked, but it was evident that this well documented defect had recurred since her last survey but before the grounding.

Evidence from the divers and the video, which had been taken earlier, indicated that underwater damage was restricted to crushing. Ragged, damaged



material was only a minor problem, but a large open area into the sonar housing existed where one of the sonar domes had been torn off. On completion of the inspection, ship's and squadron staff, NSC representatives and the salvage officers gathered to assess the situation. The conclusion was quickly reached that the ship could move under her own power, but that there would be a restriction on her speed and the sea conditions she should be allowed to endure. Prime concern was that the fore end of the ship should not be subject to any slamming. A maximum speed of 10 knots was therefore agreed and the Command would be advised to take avoiding action in the event of encountering high sea states. This guidance was signalled to the WPM and on to the Operating Authority. Approval to proceed was formally given and the ship prepared to sail north on Saturday 17 September. Her course would keep her in the islands to the west of Chile for about 80% of her journey, thus minimizing exposure to the open Pacific Ocean. This would only be encountered for the last two to three hundred miles.

*Brazen's* ship's company were in remarkably high spirits considering the ordeal they had been through. The support party brought in from the Falkland Islands' Garrison were not therefore required and stayed in HMS *Iron Duke* for the return journey to their base. The salvage team could do no more for the ship and the NSC party saw their task quite clearly lay in helping to plan the necessary repairs for *Brazen's* return to the UK. We all therefore spent another night on the deck of the wardroom of *Iron Duke* and on the following day (Saturday 17 September) made our way with the assistance of *Iron Duke's* LYNX to Punta Arenas to fly north.

In the meantime, *Brazen*, was awaiting the arrival of a portable INMARSAT telephone to improve her communications. Those departing the area were delighted to see this equipment arriving from the UK on the incoming flight. That same flight also brought a Padre 'fresh' in from the Adriatic! who was on his way to the ship. The arrivals were ferried back to *Brazen* in the return journey of the LYNX.

*Brazen's* passage north was estimated to be about five days and this gave an ETA of early Thursday, 22 September. Before the ship's arrival in Talcahuano there was a lot to be done but, unfortunately, two of the days were Chile's national holiday. Everything stopped, the armed forces went on parade in Santiago and the whole population relaxed. Needless to say no progress would be made on the planning phase in this period.

### **Preparations for repair**

Whilst all efforts in the south were devoted to getting the ship under way, the DA in Santiago had been preparing plans for the future. Talcahuano had confirmed suitable docks, but not availability. This would be the subject of intense negotiation in days to come. So, after the festivities had subsided, Tuesday, 20 September saw us, in company with the DA, fly from Santiago to Concepcion and then travel on to the Talcahuano Naval Base some 16 kilometres away.

Within the naval base we found ASMAR, which is their shipbuilding and repairing yard. ASMAR is an autonomous state company (similar to UK agencies) with part naval and part civilian management and an almost entirely civilian workforce. At Talcahuano they have two graving docks, the larger capable of accommodating supertankers, and four floating docks. Because of their remote location they function almost entirely autonomously, i.e. no question of sending periscopes from ex RN submarines back to Barr & Stroud, or SSS Clutches back to SSS Gears; train the appropriate craftsmen and 'do it yourself' is the order of the day.

Two features became very clear during the early stages of the first meeting with the ASMAR management and it was a case of good and bad news.

*Firstly*

The good news was the extreme friendliness of the Chileans and their willingness to try and help.

*Secondly*

The bad news was that the yard had a full and very tight programme of work for their docks, particularly from their commercial customers.

Therefore, if we were to obtain the help we needed it was going to be necessary to give the shipyard as much information as possible about the condition of *Brazen*, assess what was realistically the minimum work necessary to allow her to make the 8,000 mile journey home safely and be as flexible as possible in our approach. Throw away lines by the company such as:

“This sort of work is our speciality—we get several casualties from the rocks to repair every year”

were encouraging to us and as we could see an ex RN LEANDER and an ex County class DLG tied up across the basin. Our confidence level quickly grew.

A quick comparison of *Brazen*'s docking plan and the dimensions of the smaller graving dock gave our confidence a further boost—close to a perfect match. It was a mere question of three, yes three, large trawlers in various states of repair, which currently occupied all the space. And what material was needed? Mainly 'B' quality plate and sections. Certainly none of that specific material was available but was there a commercial equivalent available either in Talcahuano or any other yard or supplier south of the Panama Canal? Investigations were set in motion and we made a quick FAX back to the UK in an effort to identify any other suitable material and obtain the specification. This needed resolving very quickly.

We also needed to know the standard to which the repair was to be carried out? was it to be:

- 'Patch and limp home'
- Repair to a less than build standard and bring to full standard in the UK
- Carry out the repairs to full build standard and therefore only pay for the job once in both time and materials.

Back at Bath, these and many more questions were being addressed by the WPM's team and a communication routine was rapidly established. The FAX machine was excellent value but the mobile telephone obtained by the DA was absolutely invaluable. It was very soon evident after our arrival in ASMAR that we would be working to tight schedules, odd hours and places and the ability to make contact at any hour inevitably saved the day on many occasions.

The various repair options were debated at length and on efficiency, time and cost grounds the way ahead, agreed in the UK, was to:

- Repair the hull to full build standard
- Reinstall the forward sewage treatment plant
- Paint to full specification
- Leave the reinstatement of all sonars until the vessel returned to the UK.

Hull outfit openings would therefore be blanked for the journey home. The availability of steel was still uncertain but an estimate indicated that a maximum of about thirty tonnes may be required. Data for cutting and forming was also required. ASMAR are fully equipped with Numerically Controlled (NC) machines and therefore hull offsets were required. Bath were requested

to obtain building data—for a ship constructed some 13 years earlier; could the shipbuilder help? did he keep data that long?—enquiries were made.

All this activity was under way by the time *Brazen* reached Talcahuano early on the morning of Thursday, 22 September. She had made good headway and had an uneventful five days' passage. The crew had had a little time to relax after their ordeal and were in good spirits on arrival. All damage control measures had worked well and first impressions were that no further structural degradation had occurred as a result of five days at sea.

Once alongside, time was spent further investigating the damage although, obviously, all would not be revealed until she was dry docked. *Brazen* was the centre of attraction and interest for a while, as shell plate petalling at the forefoot could be seen quite clearly from the jetty. With the ship alongside more detailed planning could be done. Regular reference was made to the ship's Datum Pack and to the analysis of the keel damage as charted by the divers.

Steel supply continued to concern us, there was no 'B' quality equivalent available either so Bath decided to collect the appropriate quantity of material of appropriate scantlings and fly it out to Talcahuano. This proved to be a monumental exercise. Small quantities were obtained from Devonport, Portsmouth, Rosyth, Clydeside and Tyneside and a grand marshalling exercise was conducted. Transportation was the next question; the RAF were unable to help due to other commitments and sea was far too slow; but all was not lost—a commercial freight company operating out of Stansted provided the answer. They had a ILLYUSHIN 76 available and our 30 tonne load was 'bread and butter' to them. However, landing the ILLYUSHIN at Concepcion brought its own problems as that airport is normally only used for internal traffic and does not have international facilities. Special clearances were therefore necessary with Customs and Air Traffic Control and plans were laid for the load to arrive on 29 or 30 September.

Plans for docking and repair were, meanwhile, being addressed but we had an insoluble problem which could not be resolved until the ship was docked—how much work would there be? We had to plan for the worst, namely that the hull would need to be renewed from keel to the underside of No 3 deck. We knew that No 3 deck was intact and that plating above that level was undamaged but forward of 21 bulkhead and below No 3 deck was still unsurveyed. ASMAR therefore **planned** to prefabricate all structure below No 3 deck and aft as far as 21 bulkhead in several sections and offer them up to the ship complete. The vessel would dock down, all necessary measurements be taken for alignment and marrying to the ship, then she would undock and dock a second time for damaged structure to be removed and new structure welded into place. By this means ASMAR felt able to minimize the disruption to their existing work programme and yet repair *Brazen* efficiently. The programme still involved the early removal of three fishing vessels from the graving dock prior to completion of their work packages but this was assessed by the shiprepairer as feasible.

So much for the preparations but we were dealing with a commercial ship repairer and with all the will in the world to resolve the technical problems nothing would happen without a formal contract. At a distance of some 8,000 miles from base and in a very short timescale this presented a considerable challenge. Firstly a specification, at least in general terms was needed and then an estimate of cost. This was produced by ASMAR with great efficiency. On-site negotiation over detail was necessary but much more important was the delegated authority which MoD had given to the DA. This would enable decision to be made quickly and on site and thus keep the negotiations moving.

*Brazen's* docking date was confirmed as 28 September and preparations commenced. The two docking programme remained the most likely option at that time and our logistics and movements were geared to that time-table.

Dry docking a ship is basically the same the whole world over, but there are inevitably various ways of achieving the same objective. The main difference between *Brazen* and a normal docking was the potential unsupported overhang and damage. Bath had already confirmed with the assistance of the Director of Naval Architecture that there was sufficient strength in the hull girder, even after damage, to support the fore end. However, buckled structure was due to be removed, leaving No 3 deck and its longitudinals as the lowest fore and aft strength member. Three brackets, port and starboard, were therefore positioned at intervals along the damaged length and at about the No 2 deck level, under which shores would be placed immediately after docking to help support the fore end. Also, ASMAR advised on the use of 'sand blocks' in way of the damage in case protrusions of damaged hull extended below the line of keel. ASMAR were provided with the ship's docking plan and the very quickly prepared detailed arrangements for positioning and supporting *Brazen*. We were somewhat surprised when their arrangements showed both centre line blocks with shores and side blocks (the latter usually only used when breast shoring is not feasible). We were slightly taken aback when it was explained that this was the norm because we were in a 'seismic zone'!

The numerous ship's domestic matters associated with moving and entering dry dock were being dealt with by ship staff; services to be provided, stores, safety—not least *Brazen's* ammunition. Here again the Chilean's experience with ex RN vessels and munitions was invaluable. The agreed way ahead was to keep explosive stores deep and aft (away from repair activities forward) and remove upper deck weapons to the safety of the Chilean shore magazine, which already complied with our own Naval Magazine and Explosive Regulations. This was done with the utmost efficiency and the compromise solution was complete.

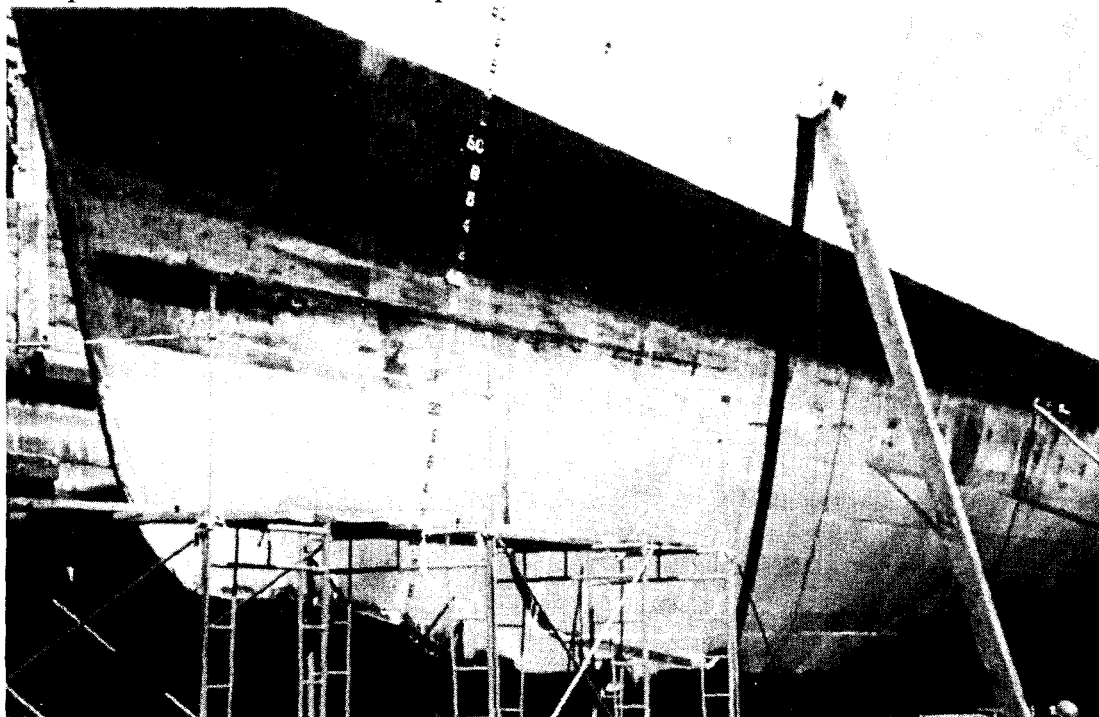


FIG. 5—IN DOCK—THE DAMAGE REVEALED

### In dock at last

Thus, with an outline of a basic work-package, materials due to arrive on Friday 30th and the dock cleared and ready to receive her, *Brazen* moved on Wednesday 28 and by 1600 all was revealed, (FIG.5).

Hull damage comprised, in simple terms, twisted and petalled plating at the fore foot and crushing by the reaction force on the rock back to frame station 21 at the fore end of the HO29 compartment. The extent of damage up the hull was not as bad as expected and an initial assessment put the maximum height above the line of keel for the removal of structure at about 2.2m at the fore end and as little as 1.2m at No. 21 station. A very rapid analysis of other aspects indicated that:

- The HO29 dome seat was unrecognisable at its fore end but only slightly distorted over the remaining 90% of its length.
- The sonar array was missing, but the sonar array seat was intact thus exposing the watertight 'top hat' structure above.
- HO30 dome and array were missing and the seatings were reduced to a mass of compressed metal.
- Most of the equipment in the sewage treatment plant was beyond repair.
- The starboard aft stabilizer was very badly damaged and jammed at an angle, (FIG.6).

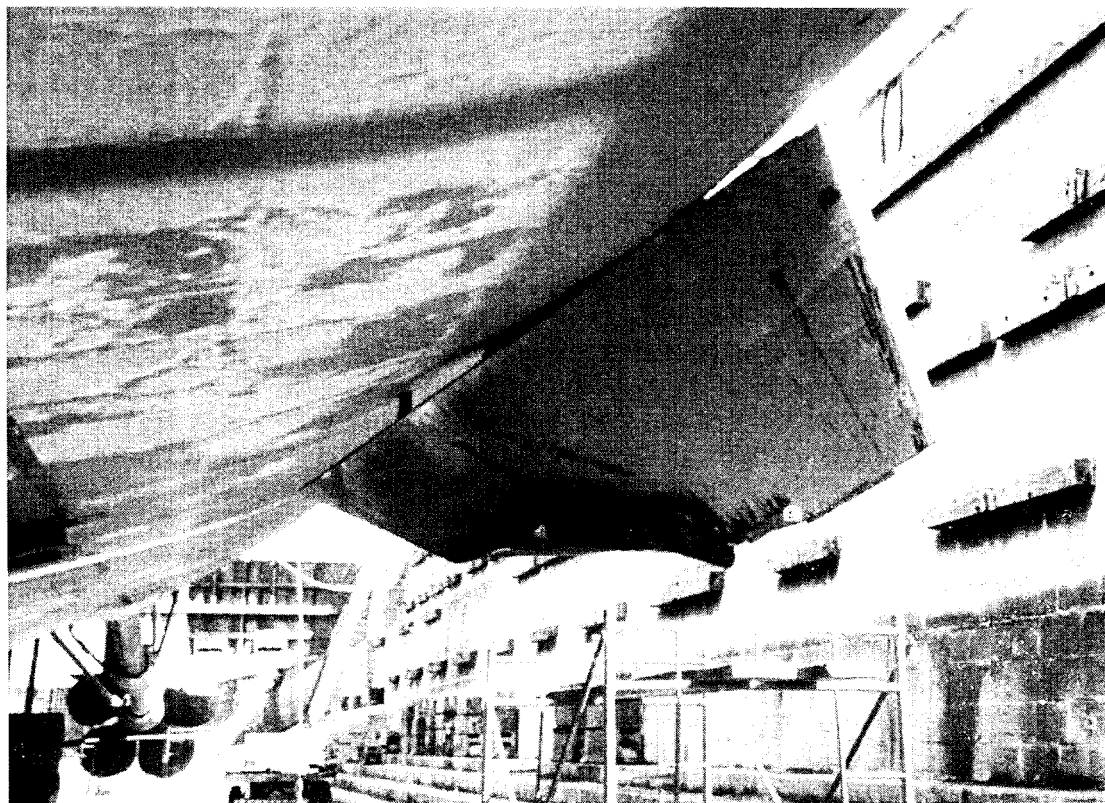


FIG. 6—THE DAMAGED PORT AFT STABILIZER

As soon as everyone had assessed the situation from their own particular viewpoints, (ASMAR, ship staff and the NSC) a meeting was convened that same day to determine the way ahead. Firstly the facts:

- (a) ASMAR assessed that prefabrication of structure was not generally possible because the damage was too shallow (much less in depth

than previous assumptions which had been made for planning purposes).

- (b) NC data had been loaded into the ASMAR machinery and now the extent of the repair work was known material cutting and forming could start (subject to the arrival of the 'B' Quality steel on the 30th).
- (c) Removal of damaged material could start immediately subject to agreement.
- (d) ASMAR were negotiating with their customers, who owned the vessels for which the dock had been booked. The outcome was expected in two days time.
- (e) A full contract would be produced by ASMAR and would be ready for scrutiny and consideration (and negotiation as necessary) on Monday 30th.
- (f) If the original pessimistic plan involving two dockings was pursued the ship would need at least two days notice of undocking for necessary preparations. The target date for a first undocking was Monday 3 October! Dates for the second docking period could not be predicted.
- (g) ASMAR's first estimate of time for the repair if done in one continuous period was 15 to 17 days.

Everything pointed towards attempting to achieve the single docking evolution but because of the yard programme uncertainties, we had to legislate for the worst case. However, we decided that the only way to gain ground was to make a start there and then. So, using his delegated financial authority, the DA asked ASMAR to make a start on clearing debris and preparing the ship to receive replacement structure in advance of a contract, using an agreed limit of liability (their target for a contract being five days hence). In the interest of progress this was agreed and by early that evening, only three hours after the water had left the dock, staging had been erected and four burning torches were at work on the twisted metal at the fore end.

A final decision on the way ahead with the large sonar (HO29) seating had not yet been taken as minds had focused, so far, on the hull structure. Bath had however clarified that there was no question of transporting any sonar outfits to Chile for reinstatement and it was therefore down to a local survey of exposed seatings to determine what represented the minimum amount of work to make a safe transit to the UK. This proved less difficult than anticipated. The sonar compartment was holed and cement boxes were in place. These would be removed, temporary plating repairs carried out and limited fairing installed, following the removal of broken and distorted dome securing bolts and the one remaining locating pintle.

As far as the smaller sonar (HO30) was concerned, a local redesign would be carried out by fairing the new hull structure over that area. On return to the UK this temporary piece of hull plating would be removed and a new sonar seating installed.

### **Repairs are underway**

So by Thursday 29 September cutting away the damaged structure was well under way. ASMAR had been given all available information on potential hazards and safety aspects (explosives had been removed from the area and work was well forward of fuel tanks). However, because of their narrow and congested design, the bow watertight compartments had been filled with bitumen at build to give a maintenance free zone, hopefully for life! It therefore came as something of a surprise to us; not so the Chilean burners how-

ever, when flames leapt skywards as they burnt their way into the fore end structure. Ship fire sentries stood by vigilantly, but were not called upon and the dismantling continued apace.

On site day to day supervision of the work had already been considered and it had been decided that professional and technical NSC representatives needed to be available throughout the repair period for oversight and rapid reaction consultation. This support was provided by two members of DGFS(S)/NA/W2 staff who arrived in Talcahuano during the week of the docking. They stayed with the ship until she sailed and their presence proved invaluable. The Chilean workforce had numerous questions and technical points of clarification at every stage of the job and an enormous amount of time was saved by avoiding the need to refer back to Bath at every turn.

On Friday 30, whilst the clearance of damaged structure continued at ASMAR, we awaited the arrival of the consignment of steel from the UK. Uncharacteristically it was a foggy morning at Concepcion and the first incoming passenger flights were delayed. A gathering of about 200 passengers waiting to travel north to Santiago or south to Punta Arenas and Puerto Montt was assembled and they peered into the gloom with increasing frustration. By 10.00 am it was evident that the fog was lifting at last and although no announcements were made the noise of an aircraft's engines in the distance stirred the awaiting passengers; one of the overdue scheduled services no doubt. However, looks of shock, amazement and disbelief appeared on everyone's faces as the largest aircraft ever to land at Concepcion touched down with our 30 tonnes of steel and came to a sedate halt alongside the small terminal building. The ILLYUSHIN 76, (FIG.7), simply dwarfed the Boeing 737s which thankfully came in soon after and it then became a talking point and material for local media for some while.

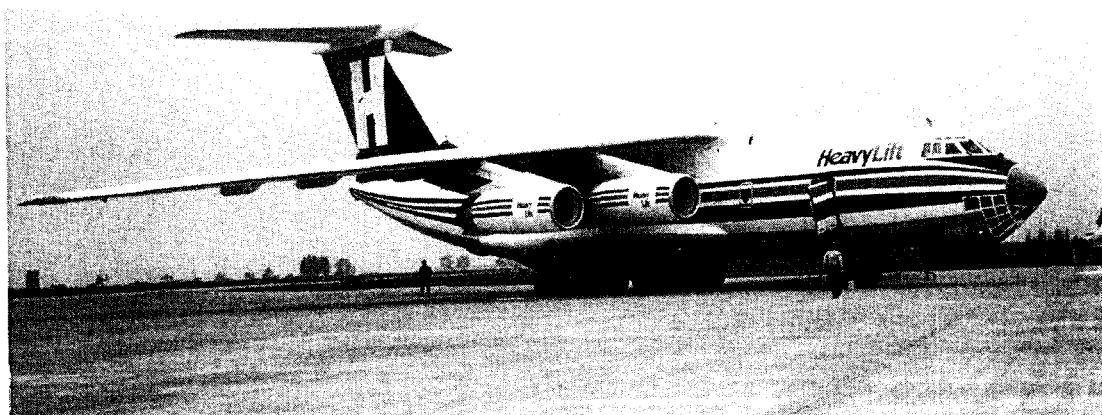


FIG.7—THE ILLYUSHIN 76 DELIVERING THE 'B' QUALITY STEEL

The first day of October brought arguably the best news so far in the negotiations with ASMAR; *Brazen* could remain in dock until the repairs were complete. This crucial decision was the result of ASMAR's successful bargaining with the trawler owners to delay their vessels' docking and was only achieved after some tough negotiations on Contract penalty clauses and liability involving the three interested parties. At last, a work schedule leading to undocking could be prepared and the ultimate goal, a sailing date, programmed in for the ship to work to.

It was in everyone's interest that the programme should be as tight as possible. Shift and weekend working with maximum manning was planned. The estimate for fabrication and reconstruction of the hull was ten days and for subsequent preservation and painting a further five days. This resulted in a

forecast undocking date of 17 October. *Brazen* would, by then, have been in dock for only 19 days if this was achieved. The ship estimated that they needed a further three days recovery period to embark weapons, fuel, store ship and run a mini Basin Trial before sailing on 20th.

By Monday 3rd, the removal of damaged structure from the ship was complete and fabrication was under way and as they had promised, ASMAR produced their detailed analysis of the total work content and a draft contract. Negotiations over contractual detail followed and took into account rates for wages, overtime, services and overheads, materials (allowing for the UK supply of 'B' quality plate), consequential additional work (e.g. undocking and redocking the three trawlers) and penalty payments. These all came to a satisfactory conclusion within the budget and a relieved DA signed the contract on 4th October.

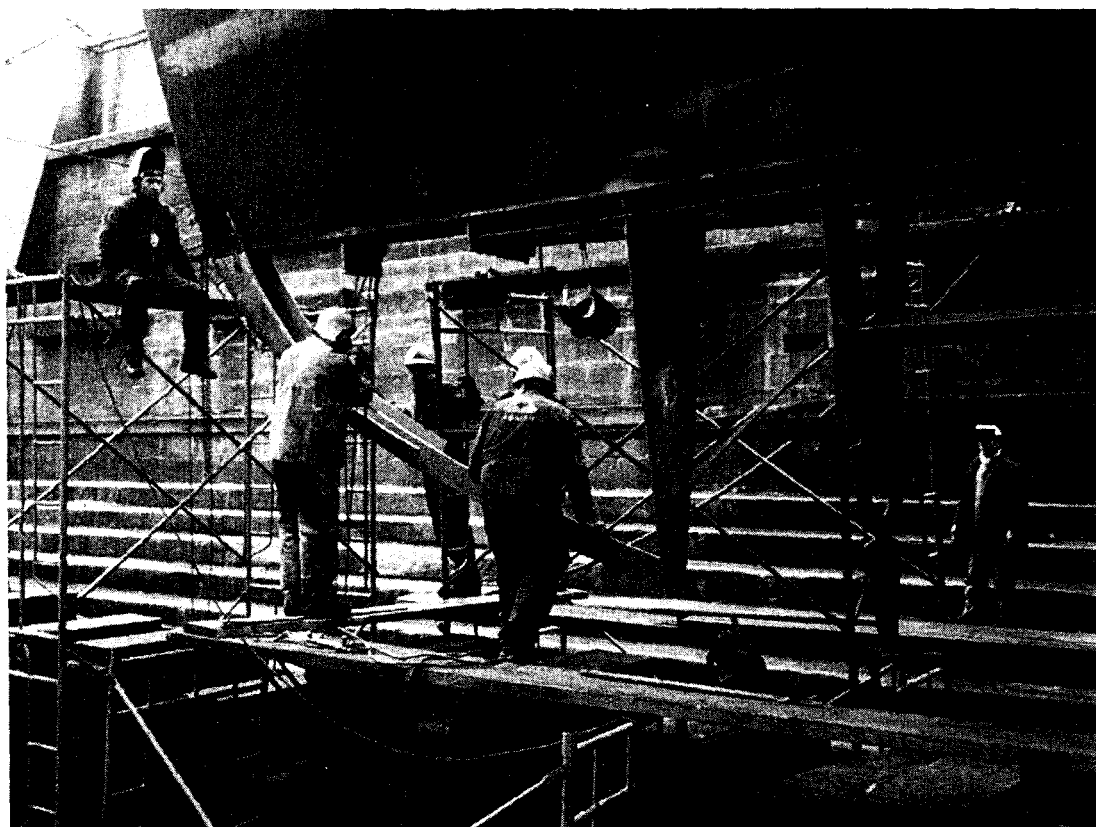


FIG. 8—REPAIRS UNDER WAY

The next ten days saw the long awaited transformation to *Brazen's* fore end. A new accurately moulded forefoot and stem bar was positioned, (FIG.8), frames were erected and plated in and the prefabricated unit to be fitted in place of HO30 appeared. The welders ASMAR deployed were taken from their submarine squad and the quality of their work was not only clearly visible but was validated by the standard of the radiographs—only one small possible fault in nineteen shots. Progressive air testing was carried out on water tight compartments as they were closed up and the standard of presentation was equally high with very few defects emerging. Repairs to the Forward Sewage Treatment Plant went ahead as soon as the compartment became available but in the end, manual operation was the best that could be achieved in the absence of correct control panel parts. Meanwhile, the port, aft stabilizer was removed and secured onboard and the bearing blanked. Reinstatement was to wait until *Brazen* was back in the UK.



As the structural work drew towards a close, life became more difficult. Progress was slower due to the complexity of the structure and the poor access this left for welders and the limitation it imposed on the number able to work at any one time. The programme became tighter but not impossible and undocking on 17th still looked viable. Painting started on Friday 14th and minimum curing times were just achievable. We had been blessed with almost ideal weather throughout our stay in Talcahuano, warm, dry and everything one expects in spring but, on Saturday when outer bottom paint was to be applied, it poured all day and nothing could be progressed on the critical path. Fortunately the climatic change was short lived and we were back to normal the next day and painting resumed but with an inevitable one day slippage to undocking—there was just no fat left in the programme!. Some rapid rescheduling by the ship indicated, however, that the additional day in dock could be accommodated by paralleling up some of their activities. It should be noted that somewhere along the line *Brazen's* sailing date had already been brought forward to Wednesday the 19th, so this was to give them little more than twenty four hours between undocking and leaving.

The full external paint scheme was achieved by late on Monday. Fortunately the variations in weather conditions had not affected work inboard and compartment preservation went smoothly. One added hazard amidst the mass of activity at the fore end was the requirement to refill the fore peak with several tonnes of hot bitumen, (FIG.9). The raw material was heated on the dockside and carried in buckets by 'runners' up the brow and down through the line of hatches at the fore end. This process took about three days and was achieved without accident or serious spillage.

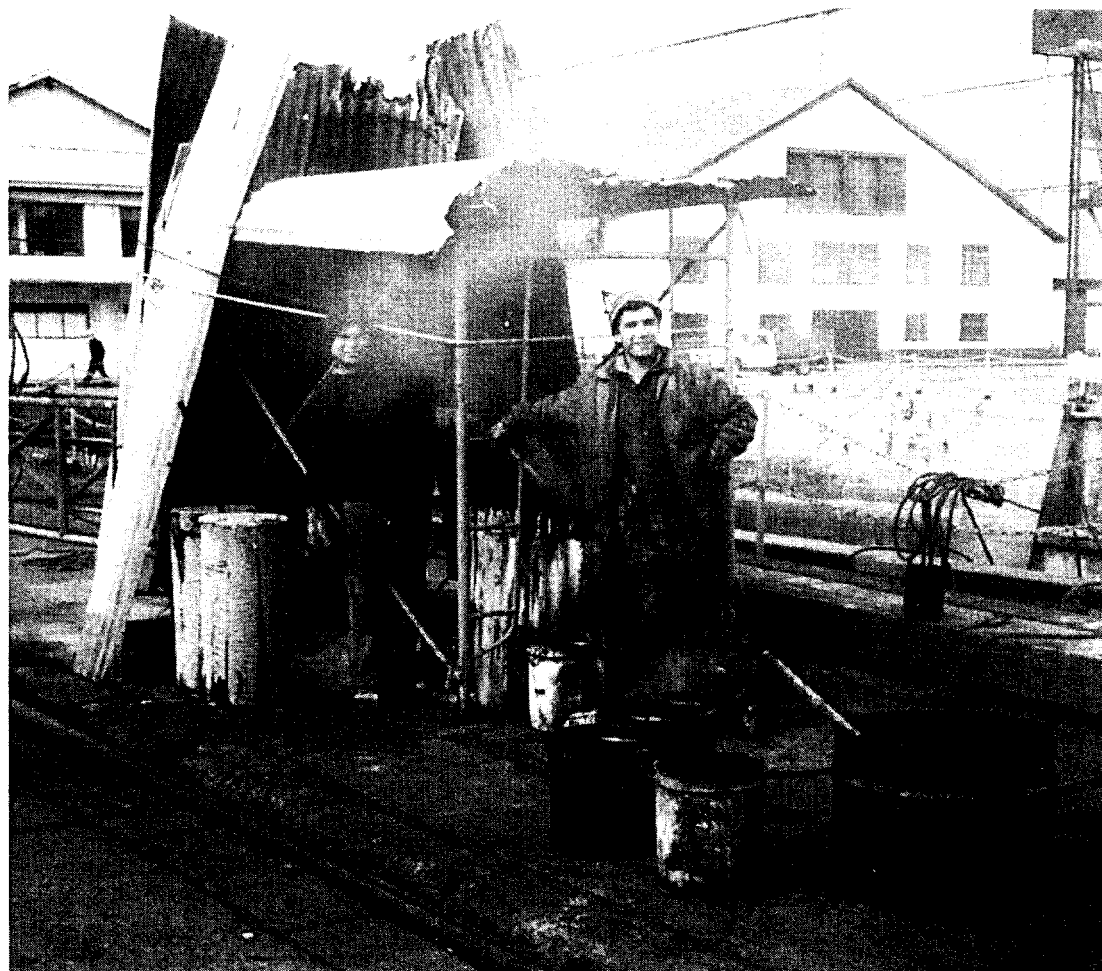


FIG. 9—BITUMEN FOR THE FORE PEAK

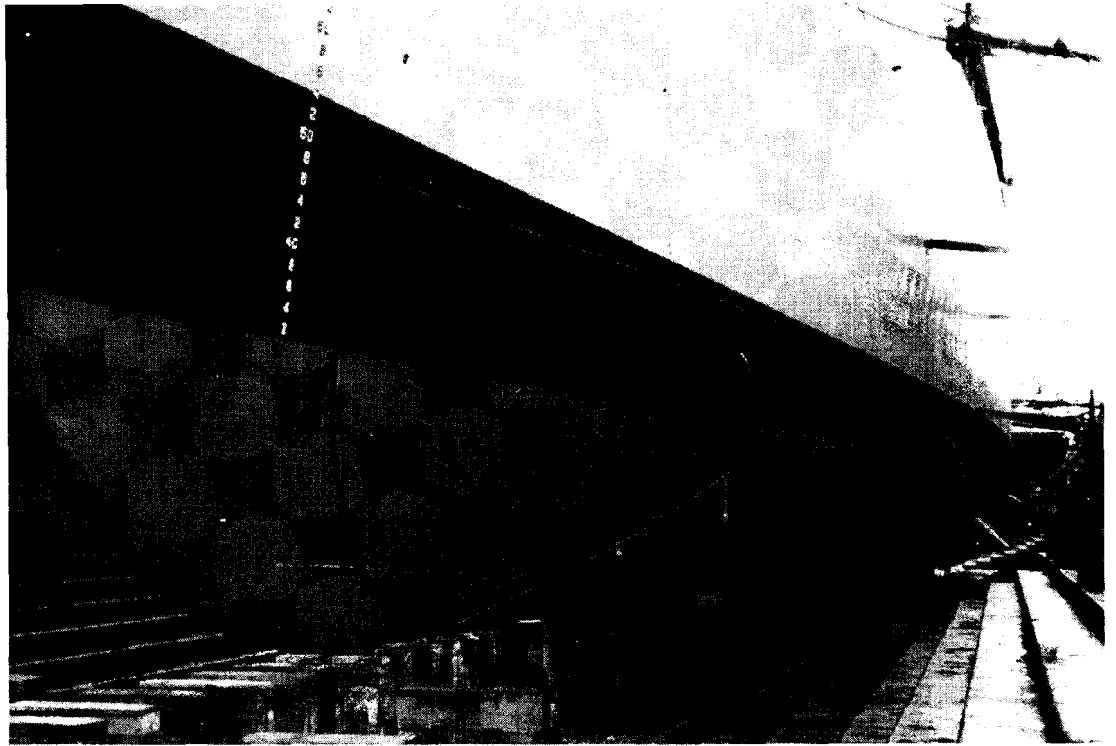


FIG. 10—WORK COMPLETE AND READY TO UNDOCK

And thus the day for undocking had arrived, the hull structure was back to build standard, (FIG.10). Final calculations of the ships condition were made; in this case there were significant changes to weight and buoyancy to take into account! and therefore trim would be significantly affected. All necessary checks were made and by 1245 on Tuesday the 18th, *Brazen* was safely tied up at her original berth, (FIG.11).



FIG. 11—AFLOAT AND READY TO GO HOME

The ship, however, still had her hull damage recorded as an outstanding OPDEF. This had to be cleared and it was via this route that NA/W2 was able to confirm that the ship's structure had been restored to 'Build Standard' and that the CSSS was once again valid. This information was signalled to the WPM who, in turn, advised CINCFLEET that *Brazen* was clear to go to sea from the structural viewpoint.

Twenty four hours of hyper-activity were to follow. Storing, fuelling, (Dieso had to be brought in by road, around 400 tonnes!) and all the essential preparations for sea were made. There was even time for a small farewell party! And at 1600 on Wednesday 19 October *Brazen* sailed for home; only thirtyseven days after her near disaster a thousand miles south.

In Chile there only remained the paperwork to be cleared up and the bill to be collected. By the time we (the DA and NSC team) had done this the docks were, once again, all filled with fishing vessels and normal patterns of life were resumed.

### **Return to the UK and sonar reinstatement.**

*Brazen* got back to Devonport on 18 November 1994 and was docked on 1 December to have her underwater sensors restored and her port aft stabilizer replaced. This work took another four months and at the beginning of April 1995, with only sonar trials outstanding, she rejoined the Fleet. It is hoped that an account of the last phase of the repairs will be told in a later issue of *Journal*.

### **Lessons learnt.**

The overall conclusion was that the whole mission had been successfully achieved. However, as with any complex task, much of which can not be planned or legislated in advance, lessons were learnt and those relating to the recovery and repair aspects are listed below:-

- (a) The procedures laid down in the 'Naval Support Command—Operational Procedures' [BR2001(1)] were validated and proven.
- (b) Short notice deployment of NSC personnel generally worked well but a few obstacles were encountered which needed removing, e.g.
  - Difficulty in obtaining hire cars outside normal working hours.
  - Official credit card facilities.
  - Telephone charge cards.
  - Round the clock Fax availability.
- (c) The damage control equipment and stores holding on board needed enhancing. This has already been initiated and an action grid agreed.
- (d) Hydrostatic curves for a RN vessel generally only take account of trim up to 2 metres. The effect of the excessive trim when grounded on the ship's stability characteristics could not, therefore, be quickly assessed. Consideration should be given to the provision of additional data which takes into account excessive trims.
- (e) Non-Datum Pack drawings used in the ship construction process should be kept by the design authority.
- (f) The commercial mobile telephone obtained by the DA permitted real time exchange of information and was invaluable.
- (g) One of the small project team's major problems was briefing the vast MoD infrastructure. Co-operation afforded by DNLSD was invaluable.
- (h) The nomination of a single point of contact within the WPM team is essential to keep fast moving aspects under control.

**Acknowledgement**

The authors would like to thank LIEUTENANT COMMANDER M. LEWIS, MBE, the MEO of HMS *Brazen* at the time of the incident, for his advice and loan of photographs in preparing the article.

*Reference*

1. DAVIES, M. 'Salvage of HMS *Brazen*.' *Journal of Naval Engineering*. Volume 36. No.1. pp 40-55.
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