

DEFENCE COMMITTEE

Ninth Report

**PROCUREMENT OF
UPHOLDER CLASS SUBMARINES**

Report, together with the
Proceedings of
the Committee
relating to the Report,
Minutes of Evidence and
Memoranda

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NINTH REPORT

The Defence Committee has agreed to the following Report:

PROCUREMENT OF UPHOLDER CLASS SUBMARINES

I. INTRODUCTION

1. In our Sixth Report of this Session, *Royal Navy Submarines*, we reported the results of our general examination of Royal Navy Submarines. We covered submarine roles and numbers; the vessels; their weapons and sensors; personnel; research; and operation of submarines in fishing areas.¹ Alongside our general examination of submarines, we have also undertaken a review of the procurement of four Type 2400 Upholder class diesel-electric powered patrol submarines (SSKs 01-04).²

2. The Upholder class boats, which replace the Oberon class submarines dating from the 1960s, are the first new design conventional submarines to be built in the UK for some thirty years.³ Their primary role is to detect, classify and track other submarines but, in addition, they can undertake anti-surface ship warfare, mine laying, surveillance, training of other RN forces and other duties.⁴ We have already reported in some depth on the role of the diesel-electric powered submarine in our Report on Royal Navy Submarines.⁵

3. The first of class UPHOLDER (SSK01) was designed and built at VSEL Barrow-in-Furness at a cost of around £405 million (at 1990/91 outturn prices). This cost includes certain equipment provided to VSEL by the Ministry of Defence (MoD), but not the weapons fit. UPHOLDER was accepted into the fleet in December 1990, some three years late, but will be taken out of service later this year for rectification of faults in the Weapons Handling and Discharge System (see paragraphs 38-44 below). The contract for construction of SSKs 02-04 (UNSEEN, URSULA, UNICORN) was placed with Cammell Laird at Birkenhead (a wholly owned subsidiary of VSEL) in 1986. UNSEEN was launched in November 1989, URSULA in February 1991 and UNICORN will be next year. The estimated in-service dates of SSKs 02-04 are currently delayed by 17, 8 and 3 months respectively. Like UPHOLDER, UNSEEN and URSULA will have to dock for repairs to the Weapons Handling and Discharge System. UNICORN will be modified during the build period.⁶ The total cost for all three submarines is expected to be around £390 million. MoD expects the Upholder class submarines to be in service for around 25 years.⁷

4. It is unclear exactly how many Type 2400 boats MoD originally intended to procure; an eventual class of between ten and twelve was probably envisaged. VSEL has told us that the price it quoted for SSKs 02-04 was based on the expectation that invitations to tender for the next batch would be issued during 1992. The company had made investments in specialised plant which would not have been considered cost-effective if it had known there would be no further

¹ Sixth Report from the Defence Committee, *Royal Navy Submarines*, HC 369 of Session 1990-91.

² UPHOLDER, UNSEEN, URSULA and UNICORN.

³ Q27.

⁴ Evidence, p 15, Answer 1(c); Eleventh Report from the Committee of Public Accounts, *The 1989 Statement on Major Defence Projects*, HC 373 of Session 1990-91, p 30.

⁵ HC 369 of Session 1990-91, paras 12-35.

⁶ Evidence, p 24, A25.

⁷ Q179.

orders. However, the July 1990 Options for Change announcement made it clear that the Upholder class would consist only of four boats.

5. Prior to the Options for Change announcement, MoD had placed long lead contracts for equipments to a value of £20 million for the next batch of Type 2400 submarines. The largest contract, worth £12 million, for the Sonar 2075 has since been cancelled (see paragraphs 10-12). MoD has not made final decisions on whether to complete the other contracts.¹

6. We examined the implications of MoD's plans to operate a fleet of just four Upholder class submarines in our Sixth Report. We noted that MoD expects three Upholder boats to be in service at any one time.² Our conclusion was —

“From our review of the evidence, and of the wartime and peacetime tasks of SSKs, we consider that there should be a minimum of 6 SSKs, and we recommend that HMG urgently reconsider its proposal to retain only 4”.³

7. We envisaged MoD maintaining a fleet of six SSKs by retaining the two most effective Oberon class boats after the four Upholder class submarines entered service. However, this would inevitably be only a short term solution. It might be more cost effective for MoD to place a follow-on order for two Upholder class boats. It is worth noting that the cost of purchasing UNSEEN, URSULA and UNICORN was in total rather less than that for developing and building the first of class UPHOLDER alone. VSEL told us that it would expect to reduce further the cost of building Upholder class submarines should MoD place another build order with them; no doubt other warship building yards would also compete keenly for such an order.

II. REQUIREMENT

Background

8. MoD identified in the late 1970s a requirement for a new class of diesel-electric submarines to replace the Oberon class boats. Feasibility and other studies were undertaken by MoD, Vickers (now VSEL), the Admiralty Research Establishment and the Defence Operational Analysis Establishment. The Naval Staff Requirement for the Type 2400 Upholder class submarine was agreed in January 1980. **The Type 2400 submarine represents a very significant increase in capability over the Oberon class. Alongside the submarine itself some 23 new equipments were also developed.**⁴ **The result is a submarine which has a much more up to date weapon fit and greater endurance, is quieter,**⁵ **and requires a crew of only 47 compared with 69 in an Oberon class boat.** It has a displacement of around 2400 tons dived, is reported to be capable of 20 knots dived and 12 knots surfaced, and has a range of some 8,000 miles.⁶

9. The weapons fit comprises six bow torpedo tubes from which Tigerfish wire guided anti-submarine and anti-ship torpedoes can be fired. These tubes also have a launch capability for Sub-Harpoon underwater-to-surface missiles, Mk 5 ground mines and the soon to be introduced Spearfish torpedo. The torpedo tubes can be loaded before sailing and it is reported that twelve reloads are carried.⁷

Sonars

10. The Type 2400 submarine sonar fit consists of:

- 2040 bow array providing medium range passive surveillance, short range active and intercept capabilities;

¹ Evidence, p 24, A2.

² HC 369 of Session 1990-91, para 38.

³ *ibid*, para 35.

⁴ Evidence, p 15, Answer 1(a) and (b).

⁵ Q1.

⁶ *Jane's Fighting Ships 1991-92*, p 678.

⁷ *ibid* and HC 369 of Session 1990-91, paras 51 & 52.

Costs

56. The current estimated cost of £390 million (at 1990/91 prices) for SSKs 02-04 is within the original estimate (at the same price basis). The price for UNSEEN has been increased by the inclusion of MoD Change Notices (£1.5 million) and Ministry caused Delay and Dislocation (£2.7 million). The prices for URSULA and UNICORN have been increased by some £1.1 million each to allow for Change Notices, but no Delay and Dislocation costs have been agreed for either. The inflation adjustment clause is linked to the Programme agreed under the original contract but may be extended to encompass MoD caused delays and other Force Majeure events. **These relatively small cost increases in the light of the extensive delays emphasise the value of agreeing a fixed price contract at the outset.**¹

V. CONCLUSION

57. Although UPHOLDER will not formally complete her Fleet Weapons Acceptance Trials until late 1992, after the fault with the WHDS has been rectified, it seems likely that she and the other Type 2400 boats will prove to be excellent submarines. We have already expressed in our Sixth Report of this Session our concern as to whether four Upholder class boats will be sufficient to meet all the Royal Navy's requirements. In the short term, MoD could retain two recently refitted Oberon class boats in service at relatively low cost. But now that the initial investment in development and tooling up has been made, together with that for basing and training facilities, MoD may find that it would be economic to procure two further follow-on Upholder submarines. Whatever the size of Upholder class that MoD decides is appropriate, the Ministry must ensure that proper arrangements are made for keeping the boats operationally up to date. With a class of just four boats, this is likely to be expensive in unit cost terms.

58. As we observed in paragraph 28 above, the arrangements for designing the Upholder class submarines contained the classic contractual and project management arrangements which have led to problems on so many of MoD's procurement projects. At the time the design contract was let in 1980, VSEL was not prepared to take on prime contractorship and the requirement was insufficiently defined to allow risk pricing. We were pleased to note that industry now has the necessary capability to tackle prime contracting, and the recent experience on the EH101 Merlin prime contract tendering exercise suggests that even the most complex project is now susceptible to fixed price contracting. **Many of the lessons from the Upholder class submarine project appear already to have been learned. We trust that these lessons will be fully applied in the recently announced uprated Trafalgar class submarine programme.**

59. No doubt the introduction of prime contracting into future warship building projects will cause industry and MoD to undertake a full review of the current approach to first of class design and construction. The Upholder class experience shows that where money was invested in a limited shore development facility, problems were overcome early and in an effective way. **MoD and industry should consider extending the scope and scale of shore development facilities in future projects.**

60. The Upholder class design was influenced, at least in part, by the requirements of potential export customers. Although no sales have yet been achieved, neither VSEL nor MoD have yet given up hope. The Director General Submarines told us —

"The opportunities [for sales to approved countries] will be few and far between. It is up to United Kingdom industry to grab them and win".

We entirely agree.

¹ Evidence, p 23, A35.

MINUTES OF EVIDENCE

TAKEN BEFORE THE DEFENCE COMMITTEE

WEDNESDAY 15 MAY 1991

Members present:

Mr Michael Mates, in the Chair
Mr John Cartwright
Mr Churchill
Mr Bruce George
Mr John Home Robertson
Mr John Lee
Mr John McWilliam

Examination of Witnesses

MR BRIAN HAWTIN, Assistant Under Secretary of State (Material Naval), MR BILL SANDERS Director General Submarines, MR MALCOLM EDWARDS, Director of Contracts/Submarines, CAPT. JOHN CHADWICK, RN, Assistant Director Submarines & Underwater Warfare, and MR. PETER DAVIES, Director Naval Architecture Submarines, Ministry of Defence, examined.

Chairman

1. Mr Hawtin and gentlemen, thank you for coming to help us with our inquiry into procurement of the UPHOLDER class submarines. From looking at their styles and titles you have brought a galaxy of experts. Can we encourage you to let the experts answer some of the technical questions we shall have and then we will be able to proceed as quickly as possible. Can we start off with some general questions about the requirement. What are the main improvements in the UPHOLDER class design over the OBERON?

(Mr Hawtin) There are a range of refinements. It has much more up to date weapon fit than the OBERON class. It is a quieter submarine. It has greater endurance and it has a smaller crew. In fact, there is overall a very significant capability update.

2. The first answer you gave us in the memorandum you sent said that smaller designs were actively considered. Leaving aside the export potential aspects (which we shall come to shortly), what advantages in the end have accrued to you from opting for the bigger 2400 design?

(Mr Hawtin) I think basically, Mr Chairman, there is more scope for weapon systems into the larger hull. Perhaps I could invite Captain Chadwick to come in.

(Captain Chadwick) I think the main difference is that the weapon load on the larger submarine is clearly more than you can get into a smaller submarine, so you provide the submarine with greater flexibility and greater endurance in its weapon system as opposed to the platform. The platform itself has clearly got a better submerged endurance than smaller submarines, and you can, generally speaking, in a larger submarine carry more food, which enables the patrols to go on for that much longer.

3. Had you gone, say, for the 1400 size, what would have been the weapon load there?

(Captain Chadwick) I think it would have been of the order of two thirds of the UPHOLDER.

4. That was the key decision that made you go for the larger, more complex expensive build?

(Captain Chadwick) No. I do not believe it was the key decision. I think it was one of the issues taken into account. I am sure the DGSM could probably add to that. It was the potential for export of conventional submarines.

5. We are coming to that. Why then was it considered that the larger 2400 design would have greater export potential than the smaller one?

(Mr Hawtin) That was the advice at the time, Chairman, from British Shipbuilders and Vickers. They were of the view that a larger submarine, taking account of the other submarines from our competitors which were on offer and taking account of the potential market that they saw, was likely to have rather better export potential. There was, therefore, I think, an increase in the final size of the hull of some 150 tonnes to reflect that view.

6. Therefore, that consideration caused it to be larger than it would have been had it only been for your own needs, is that what you are saying?

(Mr Hawtin) There was an increase in the hull which took account of the export view, but, as Captain Chadwick has already indicated, Chairman, the larger hull was one the Royal Navy were very happy to have and one which enabled them to put more weapons into the submarine.

7. When was that view given to you?

(Mr Hawtin) That I think was in the run-up to the staff target and staff requirement which was the period 1979-80, Chairman.

8. At any stage since then was that view revised or are you saying by then it was too late?

(Mr Hawtin) I think by then, Chairman, it would have been too late, after the requirement had been settled, but I do not think there has been any fundamental change of view.

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[Continued

[Chairman Contd]

No, the staff requirement has not been substantially amended since it was originally endorsed.

Mr Lee

9. Could I ask, did DESO, or whatever was its equivalent then, support the contention of British Shipbuilders about export potential?

(Mr Hawtin) I am pretty sure they would have done.

Chairman: The answer is, he thinks so.

Mr McWilliam

10. Could we have it confirmed in writing?

(Mr Hawtin) Let me simplify it. I can give a categorical yes.

Chairman

11. Thank you. Apart from size, what changes to the other design, the weapon fit, were made to enhance export potential?

(Mr Hawtin) I believe size was the only important consideration, Chairman, but I look to my colleagues to correct me if I am wrong.

(Captain Chadwick) I think that, if you had looked at that time at the range of conventional submarines that were available for sale throughout the world, you would have found a range predominantly based on the German 205 and 206 classes which were quite a bit smaller. Since then they have produced an export version which I think is around 2000 tonnes which has been sold to Argentina, I believe, and I think Turkey. I think the view would have been taken that the Australians and Canadians, who would be looking to replace the OBERON class in the middle 1990s, would be looking for something which had a longer endurance than would be offered by the 2000 tonne submarine. I think that would probably lead to something larger than was currently available on the export market.

12. So it was the extra endurance and extra weapons capacity?

(Captain Chadwick) Yes.

13. How was that offset by what inevitably was going to be a very large extra cost and therefore a disincentive?

(Mr Hawtin) You mean in terms of the Ministry or in exports?

14. Exports?

(Mr Hawtin) I think that is for the company to judge. They clearly were of the view that a larger submarine with the additional scope that offered and the extra price that would have gone with that in terms of export price was worth adopting for the export potential as they saw it.

15. Is it fair to summarise it in this way, that you were happy to go along with their wishes in the export field because, in fact, coincidentally it suited the Royal Navy as well?

(Mr Hawtin) Yes. Our main concern obviously was the Naval Staff Requirement, what the Navy

wished to have in the submarine; coincidentally increasing the size which we did to meet what were seen as export opportunities was something we were happy to go along with.

16. Are you satisfied that DESO and VSEL are doing all they can to market it?

(Mr Hawtin) I am certainly happy that there is very close contact between DESO and VSEL and I am sure the company you have recently seen as a Committee, Chairman, are doing their best to market the submarine.

17. Why do you think you have all had so little success?

(Mr Hawtin) I think it is probably due to a range of factors. The only complete answer, as it were, can be given by the customer who has bought foreign rather than British, but I think there is a range of factors. The UPHOLDER class is a relatively sophisticated submarine, it is a relatively expensive one, and I think since the 1970s period when the staff requirement was determined there has been an expansion in the number of other countries offering submarines on the market.

18. Since it is really a vital part of our ability to get our own equipment at a reasonable cost, is this not a repeat of so many previous stories—too expensive, too sophisticated, too complex, and all the foreign buyers have gone for something more cheap and cheerful? Is there not still a lesson for us to be learned as to over complicating things?

(Mr Hawtin) I would take issue with "over complicating", Chairman. As I said, the basic drive as far as we were concerned was to meet the Navy's requirements. We did in this particular instance go a long way towards heeding the views of the industry at the time and adapting the submarine in a way which they judged would make it more attractive as an export sale. In the event it has not happened that way, but I would not like to attribute blame or come to the judgement that you have reached. I think the situation for the variety of reasons I have outlined has not panned out as was expected, but there are still export hopes. It is still being marketed and the company have certainly not written off the prospect of overseas sales.

Mr Lee

19. When did we last sell a new submarine abroad?

(Mr Sanders) The last time was in the 1970s when we sold the OBERONS to Canada and Australia and, of course, that was what I think was primarily behind the British Shipbuilders' view when the judgement was made that the marketing of the UPHOLDER class would be with those sorts of countries who had that sort of capability, that sort of endurance and that sort of weapon fit. Of course, the only opportunity that has actually presented itself has been Australia and the United Kingdom

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lost. What is interesting is that the size of the Australian submarine is now larger than the 2400, so it is wrong to think the 2400 is too large to be marketable. The opportunities will be few and far between. It is up to United Kingdom industry to grab these and to win. It is a rather different scenario, and always has been, compared with the German small submarines that are marketed in relatively large numbers for totally different operational purposes.

Mr Churchill

20. Can you give some indication of the additional endurance of the 2400 compared to the German submarine, and are we talking about an improvement of 25 percent, 50 percent, 100 percent?

(*Captain Chadwick*) I think I would prefer to take that away. I think that certainly the German 205 and 206 tend to operate for relatively short patrols in the North Sea and in the Baltic, maybe of the order of two to three weeks. They have relatively limited food supplies on board. I would expect that something like a COLLINS or UPHOLDER's endurance would be somewhere in the region of 75 days.*

21. It is a question of stores, not primarily of fuel. One is not talking about the time of dive and the time on patrol?

(*Captain Chadwick*) One is talking about the submerged endurance as well.

22. Greater submerged endurance as well?

(*Captain Chadwick*) Yes.

(*Mr Sanders*) The endurance difference is really an order of magnitude and we are talking about factors here of 2 or 3 etc. between those submarines.

Chairman

23. Prior to the Options for Change announcement, how many UPHOLDER class boats did you envisage buying?

(*Mr Hawtin*) No final decisions on numbers have been taken, Chairman.

24. How many did you envisage buying?

(*Mr Hawtin*) As I think our evidence has indicated to you, some long lead items for boats SSK's 05-07 had been purchased but beyond that no firm plans had been made and no firm decisions had been taken on those boats.

25. The Satellite Inertial Navigational System, if I have SINS right, you have ordered for nine boats?

(*Mr Hawtin*) We have ordered 20 sets of SINS.

26. So we were talking about nine or ten boats?

(*Mr Hawtin*) We were talking about boats in that order, but as I say decisions have not been taken.

*Note by witness: The expected endurance of a Collins or Upholder class submarine is of the order of 65 days. That for a German 205 or 206 submarine would be of the order of 30 days.

27. It was the order of nine or ten. Let us turn to the delays in the UPHOLDER and start, if I may, with the weapon handling and discharge system. Can you tell us, in layman's terms, what that system is and what was wrong with it and how you are going to solve it?

(*Mr Hawtin*) May I just emphasise at the outset that the UPHOLDER was the first new diesel submarine design since the O-class of the 1950s. It does, as I have already mentioned, represent a very significant capability up-date, and first of class problems are something, I am afraid, we have to expect with submarines and surface ships as there are no prototypes. There have been the inevitable first of class teething problems with UPHOLDER and we have overcome these one by one, and we are confident we will solve the remaining weapon handling and discharge systems. However, I think it is important to point out that there have been very important first achievements with UPHOLDER, which was the first submarine where a substantial degree of design responsibility was placed on the contractor, its build contract was the first, First of Class contract to be placed on a risk basis, and it was the first time we have gone to competition for follow-on building of submarines.

28. You make it sound as if you were expecting that order of delay and really all was perfectly well and you have done quite well. Three years—is that what you were expecting? Three years after it should have come into service, December 1987 and it came into service last December, are you really saying that was normal?

(*Mr Hawtin*) No, the picture I have painted is one where it is far from unusual for the teething problems to take place, but with hindsight we would certainly acknowledge both the Ministry and the shipbuilder underestimated the time needed to design and build a Class. As I said, it was the first since the 50s. We were not expecting a three year delay.

29. You were not?

(*Mr Hawtin*) We were not.

30. You sounded as if the achievement was really rather good. The achievement is rather bad, to have a delayed in-service date, for a very important part of the fleet, of three years.

(*Mr Hawtin*) The delay was certainly very unwelcome and a bad feature, Chairman. The point I was making was that there are also a number of very positive achievements associated with this particular class of vessel, and I gave you some examples.

Chairman: Indeed you did.

Mr Churchill

31. I am glad to hear you say it is unwelcome, but is it not surprising that you should regard it as not unusual? Are we to expect this when Trident is due to enter service? Delays of three years? Would that be regarded as quite normal for first of type?

(*Mr Hawtin*) No, I did not say delays of three years were normal, I said one of the features which

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distinguishes the naval procurement programme from those of the other two services is that we do not have prototypes, and therefore the first of class of any particular category of vessel is one in which you can, and frequently do, get teething problems.

32. That is the reason for my question. Are you likely to be faced with similar problems with Trident?

(Mr Hawtin) I would certainly hope not. We have done a considerable amount of testing of Trident on the shore development facility, and techniques of that kind have moved on since the days of UPHOLDER.

Chairman

33. Could you kindly answer the first question I asked which was, what the weapons handling and discharge system is about, what the fault was and how you put it right?

(Mr Hawtin) The weapon handling and discharge system had a design fault in it which under certain circumstances led to the inadvertent admission of water into the torpedo tubes, but may I invite Mr Sanders to give you the complete picture?

(Mr Sanders) That system performs several functions. It starts with the function of controlling the weapon into the submarine from the dock side into the stowages. It controls the selection of the weapons in the stowages, in other words the moving around of them in the submarine for maintenance and testing and selection for the tubes. It controls the weapon into the tubes, it gives the weapon firing information, it controls the flooding and opening of the torpedo tubes, and eventually of course it performs the act of discharge. It is a very complicated system and it is new for UPHOLDER. It is new because the staff requirement could not be met by the weapon handling and discharge system which we had in the Oberon class, and you will recall the Oberon class was designed back in the 50s against a staff requirement applicable at that time.

34. Why did we have to change the Staff Requirement?

(Mr Sanders) The Staff Requirement called for operational factors such as quietness, the speed of discharge, the ability to handle the latest and future weapons. In other words, it was a staff requirement that had to be matched to the operational scenario of today rather than one which was generated in the 50s, and although of course we have been able to improve the Oberon over the thirty years or so they have been in service, clearly it could not match the requirement which was foreseen in the future.

35. What about the T-class?

(Mr Sanders) We considered of course adapting the Trafalgar class, but the submarine is very much smaller and we could not get the nuclear submarine type discharge system into the 2400—its weight was too large and it required too much space—so we had to design one where we could match the available space and weight in the front end of the 2400. That system, which as I say was new, up to the point we

discovered this particular problem had performed extremely well. It had been tested against the introduction of the weapon into the submarine, it had performed well in terms of its ability to handle the weapon on board, it had performed well in the sense of putting it in the tube, and it had actually discharged torpedoes. The problem we encountered was during the later stages of the testing, and really a failure occurred on the support system in the submarine. You will understand this handling system, which had been tested ashore, had to be supplied by power, et cetera from the submarine, and a condition was reached in which, due to a fault on the submarine system, the interface with the weapon handling and discharge gave it a signal, an influence, which it had not met before. As a result, there was a loss of the watertight integrity of the tube, not in a catastrophic sense but in the sense we lost the ability to hold the bow door shut and it cracked open slightly and water started to come into the tube. That clearly was a phenomenon which we could not live with, and we then went into the redesign, et cetera of the total system in the sense of a total system matching the interface with the submarine.

36. What stage had the design work reached when you transferred the job to outside consultants?

(Mr Sanders) The outside consultants or outside contractor—in this case, Strachan & Henshaw—were involved from the outset. They were involved in the initial stage of that weapon handling system right through and had actually been responsible for the detailed design of the various parts of that equipment and testing of it ashore before it went to the submarine. They were also responsible for the purchase of the equipment.

37. I asked the question because the answer you gave when you answered the Committee was that the system was originally based on in-house design in association with the Admiralty research establishment. Is that where the fault initiated itself?

(Mr Sanders) I do not think you could say that the fault that occurred was a phenomenon of the concept of the system itself. As you say, Mr Chairman, if you go back far enough undoubtedly work was done in-house which gave rise to original concepts.

38. Was it that that caused you to put the thing out to consultants?

(Mr Sanders) No, it was our policy at that time to put it out to industry for the detailed design of this, and that contractor would have been involved from the very early stages.

39. Is this an example of over-complex engineering, designers having ideas ahead of the ability of contractors to make?

(Mr Sanders) I do not think it is, Mr Chairman. We are always aware that we ought to be trying to choose something which is as simple as possible for the function.

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[Continued

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40. You are always aware of it but almost never do you do it.

(*Mr Sanders*) This is an extremely complicated function and, in terms of the way the equipment as a whole has performed, it has lived up very well to what it has to do. I have tried to explain really the failure was the interface with the submarine.

41. It was not that it was a revolutionary concept?

(*Mr Sanders*) No, it was not. It used state of the art technology but it was not revolutionary and it was not pushing technology to the future. It was using good state of the art technology to provide us with a sensible answer to the problem we had to face.

42. Is this the system when you have the Trident submarines?

(*Mr Sanders*) No, it is not. The Trident submarine very much generates out of the nuclear submarine system, out of the T class.

Mr Churchill

43. Does it really make sense for the Ministry of Defence to continue to insist on designing these vessels and parts of them in-house? Is it not rather like a customer going off to buy a Rolls Royce and saying "But you have to do it to my design" and telling the manufacturers how to do it? Would it not be best left to industry in the first place after giving a broad remit of what you want?

(*Mr Hawtin*) I think the broad answer to that, Mr Churchill and I would like Mr Sanders to comment further, is that it depends on the capacity of industry to undertake that work. Where possible, we do contract out work but in many areas—and the design of the submarine was one of them at that time—British industry did not have the capacity.

Mr McWilliam

44. Mr Sanders, would you like to say a word more about the interface? This is not one of your software problems again, is it?

(*Mr Sanders*) No, it was a hardware interface, a mechanical system, the system providing the power, the oil. What happened was that there was under a fault condition an over-pressurisation of the hydraulic return line and, therefore, the weapon handling system saw a pressure coming back on the system which it was not used to. With hindsight, if we had built the submarine earlier, or built a prototype which was the same as the submarine earlier, had we been able to put the thing together as a total submarine earlier, we would have found it. It was essentially the putting together of the total submarine which presented us with the first opportunity to match that and to understand all the conditions that would apply.

45. You are confident that can now be solved?

(*Mr Sanders*) Yes, we are confident it can be solved in the sense that it just so happened by the time we had the problem in the submarine we had also built a very comprehensive training rig at HMS

DOLPHIN on which we would train our people. Of course, we were only able to build that rig once we had done the designs and development, building it in parallel with the submarine; we therefore had good facilities we could get into and look at, and we have been able replicate the fault and have been able to use that rig now to give us the solution. So we are confident now that we can handle it.

Chairman

46. The Comptroller and Auditor General's memorandum to the PAC said that you accept responsibility for—to use his words—"inadequate design specifications" of the system. Who prepared those, yourselves or Strachan & Henshaw?

(*Mr Sanders*) The preparation of those specifications across the interface would have been done in industry by VSEL on the submarine and by Strachan & Henshaw on the weapon handling and discharge side, Chairman. The Ministry held the responsibility for the accuracy of those across the interface.

47. So where was the Ministry's inadequacy?

(*Mr Sanders*) I think it was in our inadequacy to see all the implications of that complicated interface ahead of a prototype and the ability to test in a prototype.

48. With hindsight would you have benefited from a technology demonstrator phase?

(*Mr Sanders*) It is easy for us to come to the conclusion that we could have found it, and I suppose it must be right that, had we been able to design that system much earlier relative to the submarine, had we been able to put the system together much earlier than the submarine, we could perhaps have found that. I have some slight doubts that we would have done it just by putting together a more comprehensive handling and discharge system because, without the submarine attached to it, it is always possible we would never have got far enough back into the submarine in order to have found it.

Mr Lee

49. So what were the extra costs incurred in broad terms as a result of these delays? Bluntly, who picks up the tab?

(*Mr Hawtin*) The design and hardware changes cost of the order of £8 million, Mr Lee, and it is the MoD's liability.

50. So there is no financial liability on VSEL or Strachan & Henshaw?

(*Mr Hawtin*) No.

Chairman

51. Was that wise, with hindsight?

(*Mr Hawtin*) I am talking about the nature of the design fault for which the Ministry accepts liability.

52. Was it wise to put them in a situation where, if the thing that you ordered did not work, you paid for putting it right?

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(*Mr Hawtin*) The problem we face, Mr Chairman, is that the fault was inherent in the design when passed to Strachan & Henshaw.

Mr Home Robertson

53. Has it been put right? What additional cost has been incurred as a consequence of this mistake?

(*Mr Hawtin*) Mr Sanders has explained that we are currently working on it and are confident it can be solved. The cost of the design work and hardware so far is £8 million. There is the work on the individual boats on top of that.

Chairman

54. So far—so there will be more extra cost?

(*Mr Hawtin*) No, I think we are fairly confident, Chairman, that is the cost we are talking about in terms of the design work. What we still have to meet are the costs of the work on the four boats.

55. What are they likely to be?

(*Mr Hawtin*) At the moment, Chairman, I think we are in the process of getting tenders from industry and I would prefer not to give you a figure in open session, but we can give it to you privately or in writing.

Chairman: Thank you very much.

Mr Home Robertson

56. When do you expect the modification to be complete on UPHOLDER?

(*Mr Sanders*) Our intention is to bring UPHOLDER in towards the end of this year and complete it. We will complete boats numbers 2 and 3 in succession after they have been built and accepted. We will do the work on the fourth boat during the construction.

57. Can you confirm in open session whether or not UPHOLDER can fire torpedoes at present?

(*Mr Sanders*) It can fire torpedoes and has fired torpedoes. If the Royal Navy really required them to fire torpedoes they could do it. We would have to cover this with delicate drills on board; that is not a position we would accept for normal use.

Chairman

58. For peacetime training is it the case that she cannot fire torpedoes?

(*Mr Sanders*) She could, but the ———

59. With peacetime safety regulations and for training, she cannot yet fire torpedoes?

(*Mr Sanders*) She will not be used for that purpose.

60. What I think you were saying was, if it came to a war or something, different standards would apply?

(*Mr Sanders*) The capability is there.

61. How much of the three-year delay to UPHOLDER is caused by this discharge system

problem?

(*Mr Hawtin*) The delay arising from prototype problems, Mr Chairman, which included the weapon handling discharge system and the main propulsion system amounted to 15 months.

62. Let us turn to the main propulsion system. What were the problems on the main propulsion system? How are they solved?

(*Mr Sanders*) In a way, Mr Chairman, it is a rather similar story. The main propulsion system clearly was new; this was the first new conventional submarine for 30/40 years. The system had been tested ashore in terms of the performance of the main motor, switchboard etc., and the electrical power supply. The first time the systems came together was in the submarine. The system had been tested and had performed at sea over the full range of performance up to an extreme trial. That was being conducted submerged, which was to simulate an emergency recovery condition. The worst——

63. Of what?

(*Mr Sanders*) The submarine. To recover from a major incident submerged, like, for example, a flooding. If there was a break on the sea water system and it was flooding, the submerged submarine would have to recover, get to the surface.

64. Sorry, I did not understand the naval term.

(*Mr Sanders*) I apologise for the terminology, Chairman. The worst condition is one in which the submarine is proceeding at maximum speed ahead and the condition in which the trial was done was one in which you reverse the main motor and the shaft from ahead to astern to try and take the speed off. It was when it got to that extreme manoeuvre that there were large currents induced in the field of the motor. These currents were larger than were predicted. The safety devices etc started to work in order to control the amount of current and the power was lost. The submarine actually surfaced under a normal surfacing mode and came back to port. It took us some time to discover why the system would not hold itself under control on this extreme end of its performance, but we did discover in the end that the main reason was our prediction of the interaction of the propeller with the hull under this extreme condition was outside the range that we had assumed and, as a result, the control system on the main motor was unable to cope. Once we had discovered—and it took us some time—what it was, it was a relatively small change to the control system to give it the right inputs and we then took the system right back through its performance and trials again and that has now been proved and demonstrated, and the system is now complete and working.

65. It was a design problem?

(*Mr Sanders*) It was a design problem in the sense that the system failed to cope with the total range of performance.

66. Who was held responsible for that?

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(Mr Sanders) Well, the design was done by GEC and we are considering at the moment the liability which we might place on that company.

67. So, unlike the discharge system, you think the responsibility might be the contractor's this time and not yours?

(Mr Hawtin) I think it was in fact Marconi rather than GEC, and we are currently undertaking legal action with them. We believe there is a case for disputing the liability.

Mr McWilliam

68. This is a conventional diesel electric submarine, it does not have any exotics in the power supply?

(Mr Sanders) It is the first diesel electric submarine which is a single screw and a rather similar shape to a nuclear, unlike any diesel electric submarine which we have had before.

69. It is powered by a diesel engine under surface which charges batteries and which runs off its batteries connected to a conventional electric motor, is it not?

(Mr Sanders) Its concept is very similar to that power system, that is correct.

70. And if you stop spinning the electric motor and spin the power take-off, that motor turns into a generator, does it not?

(Mr Sanders) That would apply.

71. That is what the problem was. Nobody calculated the hysteresis current which would be induced by that happening?

(Mr Sanders) That is correct. What I have tried to explain of course—

72. I have been an electrical engineer for over 30 years and I can tell you this is very simple. Why did it go wrong?

(Mr Sanders) I think you will accept what actually happens is a function of the propeller, et cetera, and the characteristics at the back end and, as I have tried to explain, under the extreme conditions of reversing, our prediction of the performance was inaccurate.

73. Is the propeller fixed pitch or variable pitch?
(Mr Sanders) Fixed pitch.

74. So it is a straight forward calculation, is it not?

(Mr Sanders) It is not a straight forward calculation or prediction under that extreme condition.

75. Apart from cavitation.

(Mr Sanders) But when you say "apart from cavitation", that is what this is all about, and that as a prediction is extremely difficult.

76. So it is a more efficient propeller than you thought you had?

(Mr Sanders) I would not like to be drawn into that. When you are reversing a propeller like that, efficiency is not a factor.

Mr Cartwright

77. Can you tell us what it has cost to put right this problem in the propulsion system?

(Mr Hawtin) £8 million.

78. Another £8 million?

(Mr Hawtin) Yes.

79. Is this the basis of your claim against Marconi?

(Mr Hawtin) Yes. We are disputing the liability.

80. You are hoping to recover the full £8 million?

(Mr Hawtin) I would not like to speculate about how much.

81. That is your aim?

(Mr Hawtin) We are disputing an element of the additional cost.

82. Only an element? Can you tell us what element?

(Mr Edwards) The fault on the main propulsion system is in two parts. I do not understand the technical jargon of it but on one part we are not disputing that the company performed as it ought to have done under contract, on the other part we are. We have taken legal advice and we are continuing to take legal advice, and based on that advice we will take whatever action is necessary to pursue a claim with the company. So whilst the total cost to the Ministry may be £8 million, it will be somewhat less than that we will pursue.

83. Can you give us a feel for how much—if it is only part of the problem - you are laying at the company's door?

(Mr Edwards) I would not wish to guess because the debate with the lawyers is still going on intensely, and the figure has varied markedly.

Chairman

84. Let us put it the other way: how much of the cost are you satisfied you should bear yourself?

(Mr Hawtin) Since we are about to engage in litigation with the company I think it would not help us if we gave you a figure in open session.

85. You told us this thing is about £8 million, you told us you hold the contractor responsible for some of that, and that is fair enough, and that may be in dispute, but if it is half you can tell us. It is not going to help or damage any litigation if you say that the design part is your fault and whether that is 3 million or 6 million, is it?

(Mr Hawtin) Again, as Mr Edwards has explained, the precise figure we shall be going for—

86. I was not asking for a precise figure, only the

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order of a half or three-quarters which the Ministry will accept as design problems and therefore MOD liability.

(Mr Hawtin) I think we would expect, Mr Chairman, of the order of a quarter of that.

87. So roughly 2 million. We are not trying to pin you down, or we would have asked you to spell out the £8 million. You shell out £8 million on the propulsion system, another £8 million on the weapon handling and discharge system, and I am wondering whether there is another £8 million on the next page — I do not know, I have not got there yet.

(Mr Hawtin) We are endeavouring to recover as much as we can.

88. Absolutely right. I am sure you are giving us a ballpark figure, and I am sure your lawyers will not be nervous about that, indeed you may have one of them sitting behind you — we do not know who you bring along. Have you drawn any lessons on the adequacy of the shore testing of the propulsion system which did not reveal the problem in advance of sea trials?

(Mr Sanders) Here again we must draw the conclusion that had it been possible to test more of the system ashore, we might have found this fault. Even if we had gone to the expense of trying to test the whole of the system, and we did not have the facilities available which could have done that so we would have had to build a new facility, I think there is some doubt as to whether or not we would have been able to simulate this; and I think there must still be some doubt. It is possible, however, if we had done that, and assuming the cost of that facility is less than the cost which is accruing to us now, then it might have been in our favour.

89. But it did not occur to you at the time this might be a better way to proceed?

(Mr Sanders) It certainly occurred to us, Mr Chairman, and the conscious decision was made not to go to the expense of a full system.

90. And what roughly would the expense have been of a full system, on which you took the decision not to proceed?

(Mr Sanders) I am not sure I am aware that I have ever seen a figure given to that, but we would have been talking about several million pounds. This would not have been cheap.

91. Whoever took the decision not to do it, must have known what it was going to cost to do it and said, "No, it is not worth it".

(Mr Sanders) The judgment was made at that time.

92. But you do not know on what basis that judgment was made, although presumably the person who took the decision knew.

(Mr Hawtin) I think the position is, we do not have that information with us today.

93. We might ask you to let us have that. What

was the length of the delay caused by this problem?

(Mr Hawtin) The delay on UPHOLDER, Mr Chairman, was about seven months.

94. That is over and above the 15 months you told us about on the weapon handling and discharge system? None of these were concurrent?

(Mr Hawtin) The seven months is subsumed in the 15 months. The 15 months was the problem arising from the prototype difficulties we had and, as I said, that covered the weapon handling and discharge system, the propulsion and other prototype problems.

95. Right. We have another 21 months to find.

(Mr Hawtin) We do not have another 21 months to find.

96. We are three years behind, 15 months of which was the weapons, so we have another 21 months. I was wondering whether this seven months was part of that.

(Mr Hawtin) It is part of the 15 months.

97. Can we turn to the changes to the naval staff requirement. Your answer 6 told us about the delay caused by material changes by you to the naval staff requirement. What were they?

(Mr Hawtin) The changes, Mr Chairman, were the decision to go for a full set of anechoic tiling for UPHOLDER rather than a partial, half set.

98. That is only one.

(Mr Hawtin) That is the main change to the requirement, there have been changes to her accommodation fit.

99. Frequently, VSEL told us. Changes to the accommodation layout.

(Mr Hawtin) I cannot comment on the frequency.

(Mr Sanders) It would be wrong in the context of UPHOLDER to say there has been frequent change. The accommodation in UPHOLDER satisfies the staff requirement; it satisfies the staff requirement in terms of the size, shape and the provision of facilities for the crew. What happened in UPHOLDER was, when the crew was embarked and the submarine was at sea, they came up with views on the improvements needed. These were detailed improvements that come from the experience of actually living on board and some of those changes have been made in Upholders but I would not say it was frequent.

100. How much delay was caused by this anechoic tiling? Why did you contemplate only having partial tiling?

(Captain Chadwick) The original staff requirement called for a full acoustic tiling fit for all the Upholder class. At the time the contracts were made for UPHOLDER, we did not have a sufficiently refined design for a full fit but nevertheless the partial tiling fit can achieve a significant reduction in the acoustic signatures of that

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particular submarine. You will understand the tiling fit is not all one type of tile. A range of 3 or 4 types of tiles were used and some of those tiles were still under development. When trials on some of the SSNs had been completed it became apparent we could reduce the acoustic signature of the Upholder further by going for a full fit. We put in a change notice for putting in the full fit. The judgment was clearly made at that time that it was possible to undertake it on build and it was a sensible thing to do.

101. You were always going to have a full fit but did not have the technological capability to complete the design at the time?

(*Captain Chadwick*) The original staff requirement called for a full tiling fit.

102. How much delay did that cause?

(*Mr Hawtin*) Two months, Chairman

103. Is that part of the 15?

(*Mr Hawtin*) No.

104. We have got to 17 now.

(*Mr Hawtin*) Yes.

(*Captain Chadwick*) That of course only affected UPHOLDER. That was the only major change of design that affected UPHOLDER as far as the weapons systems were concerned.

105. Now your answer 5b said that you were not aware of any clashes of priority between VANGUARD and UPHOLDER design work. Does that mean you are fully satisfied that UPHOLDER always received the quality and quantity of design team effort which it required?

(*Mr Hawtin*) I think we would like to amplify that answer a little, Mr Chairman. Perhaps I can ask Mr Sanders to comment.

(*Mr Sanders*) Certainly at the time the contract for UPHOLDER was placed, Mr Chairman, our aim was to get the design of the UPHOLDER out of the way before VANGUARD came on and the relative timescales still meant that we achieved a substantial part of that. I think the answer we gave perhaps was a little bit stark. I would have to accept that there were some areas where VSEL found it difficult to provide the two design teams with the sort of levels of expertise and the capability that was needed and so there were some areas in which priority was given to the VANGUARD class.

106. How well did VSEL cope with the re-design work stemming from the problems in the later stages of UPHOLDER's construction?

(*Mr Sanders*) I think they dealt very well with the work that was needed to find the solutions, Chairman. It required a concerted effort from them, the putting together of expert teams in order to find these solutions. We had no reason to believe that they had done anything other than perform in an admirable fashion at the end of the contract.

107. Of course it was crucial, was it not, with a

completely new design and class with many different inputs that you did get the integration right. Your answer, when we asked you about this, said you were responsible for integration with VSEL acting as your agent. How did this work in practice? Would it perhaps have been better if you made them act totally as a private contractor?

(*Mr Sanders*) Your first question, Mr Chairman, is how did it work in practice. They acted as our agent in the sense they performed the tasks that are necessary in order to hold together the integration. What they were not prepared to do at the time we placed this contract was to take on the risk and the responsibility for that integration. It was their judgment at that time that they did not have the knowledge and the expertise sufficient to do that. It has always been the Ministry's intention, and even at the time these contracts were placed it would be the Ministry's intention, to try and transfer that responsibility if industry was prepared to take it on and if we felt it was in our interests to do so. At the time of placing these contracts the judgment was that that was not the best way to proceed and so the Ministry withheld that responsibility.

108. Do you think it might have been better to have made them a private contractor, with hindsight?

(*Mr Sanders*) It is a hypothetical question.

109. It is not actually because if your answer is yes then that is a lesson for the future. It is a question that I hope you are very much asking yourselves.

(*Mr Hawtin*) The point Mr Sanders is making, Chairman, is industry themselves were not prepared to act as prime contractors at this point and were not prepared to accept the risks involved.

110. They would have done?

(*Mr Hawtin*) No. They were not prepared to do so. So it was not an option we had open to us.

111. They would have done for a price?

(*Mr Sanders*) There was no indication at that stage that they were even prepared to do it for a price.

112. It simply was not an option in any way. Is that what you are telling me?

(*Mr Sanders*) At that stage they were not prepared to take on that responsibility.

113. Did you ask them why? Did you try to press them to if this was your policy? I know that it is easy to be wise with hindsight but this is the way we learn lessons for the future.

(*Mr Hawtin*) I think at that particular point in time, Chairman, prime contractorship was still in its infancy. We were attempting to develop it but industry—the ship builder in this case—was not prepared to accept the risk involved in completing the development of the weapon systems concerned and the integration in the submarine. They considered—and it is for them to expound on their

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commercial judgment—it was not something they were prepared to carry the risk for.

(Mr Sanders) If your question is if we were faced with the situation today, Mr Chairman, would we do it the same way, the answer clearly would be no.

114. You would insist?

(Mr Sanders) We would look to industry today to be able to put that capability together and to be able to take that responsibility and our belief is that over the 10 to 12 years that this transpired industry today would be prepared to do that but they were not at the time of placing these contracts.

(Mr Hawtin) Could I just pick up on one word you used, Chairman—"insist". Again in theory that may be an option open to us but the Ministry also has to balance the risk of forcing or encouraging an unwilling contractor to take on a task and accept risks that he does not feel he is competent or prepared to. So it is not a simple black and white equation.

115. I understand that. Who, though, specifically had overall responsibility for this project?

(Mr Sanders) The overall responsibility rested with the MoD.

116. Yes, but who?

(Mr Sanders) It rested in the hands of the project, if I could describe it like that.

117. There was a project manager?

(Mr Sanders) There was a project manager and a project holding responsibility for the total platform. There were, of course, equipment projects that were dealing with development of some of the individual weapons systems.

118. There was one person who answered for the whole UPHOLDER project was there? Was that the Director General Submarines? Am I getting a little near to home?

(Mr Sanders) It would not have been me at the time.

119. Then that is an easier question for you to answer!

(Mr Sanders) As far as we were able to do at the time we had brought that responsibility together in that project. I have yet again to indicate that in some of these areas such as the weapons handling and discharge there were other projects within the MoD which did not come under the Director General Submarines.

120. It is a perfectly fair point, that this whole new way of doing things was in its infancy but if we do not ask questions we do not learn lessons and we make mistakes again — which has not been unknown in the history of procurement in the Ministry of Defence. Why were there no reliability and maintainability requirements included in the build contract?

(Mr Hawtin) Because at that stage, Chairman, we are talking about the first of class and our know-

ledge of the class was not sufficient to specify reliability and maintainability levels and targets in the way we would now, but requirements were in place for the various components and sub-systems. I do not know if Mr Sanders wishes to amplify.

(Mr Sanders) Yes, the answer was against a measure of total maintainability and reliability for the whole of the submarine fleet, Chairman. As Mr Hawtin says, our knowledge at that stage was not advanced sufficiently for us to take meaningful decisions bearing in mind that this was a first of class and a new type of submarine.

121. Now can we talk in general terms about the delays to UNSEEN, URSULA and UNICORN, the second, third and fourth of class. Can you give us an indication of the in-service dates and how far these have slipped from your originally approved ones?

(Mr Hawtin) Yes. The precise dates are classified and we have given them to you in the answer to question 17 but the slippage, let me give you, is 16 months for UNSEEN and currently we expect 6 months for URSULA and 3 months for UNICORN.

122. I agree with all of that except it looks like rather more for UNSEEN. Did you say 18?

(Mr Hawtin) 16.

123. Then I cannot do my sums. Take a look at your answer again would you.

(Mr Hawtin) I agree, Chairman, the answer certainly looks like 18 months.

124. It looks like 18 months.

(Mr Hawtin) May we check this and come back to you?*

125. Yes, of course. You gave us several reasons for the delays to UNSEEN. What was the cause of the most serious delays?

(Mr Hawtin) The main delays I think were consequential problems arising from the weapon handling systems and the main propulsion system which we have talked about. There were also delays arising from the effects of industrial action and the decision to introduce the sonar 2046 and radar 1007 systems, improved weapon fit for the boat.

126. What are the circumstances in which she was damaged during sea trials?

(Mr Hawtin) She collided with the sea wall, dock wall, I believe, on return from sea trials, Chairman.

127. How much delay did that cause?

(Mr Hawtin) That caused one month's delay.

128. And the answers that you gave us

*Note by The Witness: HMS UNSEEN'S in-service date has slipped by 17 months compared with that originally approved and HMS URSULA has slipped by 8 months.

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about UNSEEN, how do they read across to the URSULA delays?

(*Mr Hawtin*) The 6 months on URSULA again, Chairman, is attributable to the effect of industrial action primarily and to delay and problems with the timing and quality of Ministry of Defence supplied items.

129. Who is bearing the costs of the delay due to industrial action?

(*Mr Hawtin*) I think in the case of URSULA the costs are, I believe, being split between the Ministry and the contractor but Mr Edwards will correct me if I am wrong.

(*Mr Edwards*) There are different types of contract. The contract for HMS UPHOLDER is a fixed price incentive fee contract and in that sense all the costs come into the reckoning at the end when the final price is determined and therefore we shall share the costs of industrial action on that. In the case of the others it was a competitively-won fixed price contract with fixed overheads and so all the costs of strike action will fall to the contractor.

130. Entirely?

(*Mr Edwards*) Entirely, yes.

131. Let us turn now to the contracts. You told us that the design contract for UPHOLDER was cost plus. Is there any mechanism within the contract, such as reducing the profit rate or withholding progress payments, to influence VSEL's performance on the contract?

(*Mr Edwards*) This is a design and development contract. Yes, there is a mechanism and we could withhold payments. I think that the time this was placed there was probably an arrangement to have regard to the efficiency of the contractor under contract, and we had the means of withholding payments or payments for profit on it. But it is a cost plus contract.

132. Have you used that mechanism at all?

(*Mr Davies*) Not on the design contract.

133. Have you on the build?

(*Mr Davies*) Yes, we had one period where on UPHOLDER we stopped giving them instalment payments for six months because the principal naval overseer, our Ministry man resident in the yard, was unhappy with the progress on the boat and the clearance of defects, and with mutual agreement with the company — although that may sound silly — we did in fact stop payments for six months to give them an incentive to complete their work in a more efficient manner.

134. The Public Accounts Committee reported last week your attempts to negotiate a fixed or firm price for individual work packages within the design contract had not been successful. When did they take place?

(*Mr Hawtin*) The negotiations on the design contract were conducted in 1980.

135. How much were the contingencies which VSEL demanded?

(*Mr Hawtin*) I do not have the answer to that.

(*Mr Edwards*) There would be no contingencies, Mr Chairman, because the decision was taken at that time, 11 years ago, to proceed on a cost plus pricing regime.

136. Yes, but the fact you were trying to negotiate a fixed or firm price then apparently failed, and the PAC tell us the sticking point was the contingencies which VSEL were demanding, and I want to know how much they were.

(*Mr Edwards*) I am almost certain there was no quantification of what contingencies may have been suggested. It was just more than likely a feeling that the contingencies would almost certainly be too great to comprehend or accept.

137. But you did not know what they were.

(*Mr Edwards*) No, and I doubt very much whether they were quantified.

138. They must have been quantified in order to have been rejected.

(*Mr Edwards*) In the environment at the time, there was certainly a disposition to resort, and I use that word, to cost plus arrangements, because the scope and scale of the work was of an indeterminate nature. There was a feeling that it was desirable to have flexibility to direct the company to pursue particular avenues, and there is the contingency bit, but the fact you are talking about a contract of tens of millions of pounds perhaps where there is no definition of the work at the outset, then there is a sure expectation that the contingencies would be altogether too much.

139. Do you intend the contract to continue to completion on a cost plus basis?

(*Mr Edwards*) Almost certainly, because we are very much towards the end of it now.

140. Did you try at any stage to alter that?

(*Mr Edwards*) Yes, attempts have been made and they have all foundered. Unless you do it at the front end, you do not get anywhere later on. That is the experience.

141. That is the lesson you have learned?

(*Mr Edwards*) Yes, and we do not operate that way now.

142. How does your current estimate of the cost of completing the design contract under cost plus terms and conditions compare with the fixed price VSEL offered you and which you rejected?

(*Mr Edwards*) I am not aware of a fixed price offer, I must say. I would have to look at that. It is eleven years ago and I am certainly not aware there was any fixed price offer for development. I would be astounded if there was.

143. I think it is something we would like to have

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a note on, so we can be sure that we know the answer to that question. Your answer number 6 tells us that VSEL are overrunning the target cost on the UPHOLDER build contract. By how much?

(Mr Hawtin) I am afraid we do not have the answer to that, Mr Chairman. We will let you have it.

144. This is your answer 6 about the increase in costs—problems and delays to MOD supply items, which we have asked you about, VSEL overrunning the target cost on the build contract, and then contract changes which you have made. Presumably you have quantified these?

(Mr Edwards) May I say it will be certainly several months at least before we will have a clear picture of the outturn on the UPHOLDER contract. It has now reached the stage of final negotiations. What we do know is that there will be an overrun over the target price.

145. You know there is?

(Mr Edwards) We know there is, but we will not be able to quantify that for some months.

146. You have no idea what the overrun is?

(Mr Hawtin) What we can say is that our estimate of how much the platform and design effort required, which was under-estimated, is something like £25 million.

147. But the cost overrun might be a good deal more than that?

(Mr Edwards) Mr Hawtin is drawing in a design and development contract there, not specifically UPHOLDER.

148. But not the build. So you have a cost overrun but you have no idea how much it is?

(Mr Edwards) We know the contract will overrun and indeed might even reach its maximum price, after which the Ministry picks up no further cost.

149. Do you expect it to do that?

(Mr Edwards) There is an expectation it might well do that, but it is a few months off being drawn together.

150. If we hit the maximum price, what profit will VSEL make?

(Mr Edwards) It depends how much over the maximum price they went, because essentially each pound over falls to the company to meet.

151. If it reached the maximum price and did not go over it, how much profit would VSEL make? That is the plus element of the cost, is it not?

(Mr Hawtin) While Mr Edwards is looking that up, may I perhaps help further on the cost increases on UPHOLDER? Our current estimate compared with the original estimate is that there will be an increase of some £40 million, or just under 11 per cent.

152. Is that in build or design and build?

(Mr Hawtin) Of which £10 million is the develop-

ment of the weapon system and £30 million is the design and build of First of Class. What I do not have, I am afraid, is a break-down of that £30 million between design and build.

153. That is just for UPHOLDER?

(Mr Hawtin) For UPHOLDER.

154. If it was that figure, if it was held at that figure, does that take you to the maximum price?

(Mr Hawtin) I think we will have to offer you a note on this, Chairman.

155. Let us turn then to the other three, 02 to 04. Do those contracts contain reliability and maintainability requirements?

(Mr Sanders) Not specific ones relative to the overall submarines, no.

156. Why not?

(Mr Sanders) Because, again, at the time that contract was placed we had not had the feed-back from UPHOLDER. We had insufficient information therefore to judge what might be a reasonable set of reliability data to enter into contract negotiations.

157. This was in 1986, Mr Sanders. We had come to terms with R&M by then, had we not?

(Mr Sanders) Yes but we had not got the feed-back of the at sea performance sufficient for the prototype.

158. That does not stop you building in R&M requirements to a competitive contract, does it?

(Mr Sanders) Again, I am referring to specific R&M requirements applicable to the whole of the platform. Again the contract will require equipment and sub-systems to be tested and demonstrated and proved and there are reliability and maintainability requirements to be shown from the point of view of the submarines but I am referring really to overall R&M factors appropriate to the whole submarine.

159. Does the proposed sale of the Cammell-Laird yard have any effect on SSKs 02-04 construction?

(Mr Hawtin) Not directly, Chairman. Under the terms of the contract VSEL will be responsible for building the boats in time and the costs that arise.

160. Would the long term support they might expect to get from the build yard be affected?

(Mr Hawtin) We would expect VSEL to provide that adequately, Mr Chairman.

161. Are they contracted so to do?

(Mr Hawtin) They are obliged under the terms of the contract, I believe, to meet that requirement as well.

162. That is watertight?

(Mr Sanders) We believe that it is watertight. We have the guarantee from the parent company.

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CAPTAIN JOHN CHADWICK, RN and MR PETER DAVIES

[Continued

[Chairman Contd]

163. Under that guarantee?
(Mr Sanders) Yes.

Mr Lee

164. In broad terms, Mr Hawtin, if we take the UPHOLDER project or saga, taking into account the ability to do the job, the expertise, overall costs, how is the project viewed in the MoD on a scale of 1 to 10? In other words, 1 is a total disaster and 10 is an outstanding success story. Where would you broadly put it?

(Mr Hawtin) That is a very difficult question to answer, Mr Lee. I would certainly not wish to pretend it was a total success story. We are some 3 years late and some 10 or 11 per cent over the original estimate. I think, however, given the problem that this was the first conventional submarine designed for very many years, the state of the art technology put in it and the fact, as I said at the outset, that one has to use the first of class as the prototype for testing, we are satisfied that we will have a submarine which meets the Navy's requirements and which provides an extremely effective addition to the fleet.

165. If I can just come back to my broad scale of 1 to 10. Where would you want to put it at this stage? Where would the MoD put it?

(Mr Hawtin) I do not think that I have sufficient visibility of all the MoD's equipment projects to rank it in that way.

Chairman

166. Is Mr Sanders professionally indifferent to the Cammell-Laird closure?
(Mr Sanders) Pardon?

167. The answers you have given me about the consequences of the closure of Cammell-Laird tend to make me think that you do not think it will make any difference at all. What is your professional assessment of the effects of that closure?

(Mr Sanders) It is difficult to make a judgment without knowing precisely what the terms of the closure are. What we have got from VSEL is an undertaking that they will honour the contract and whatever happens to that yard, whether it is closed or sold, they will make sure that they honour the delivery of these submarines against that. They are undoubtedly themselves, I suspect, thinking about what they might do in any set of circumstances. We have not really speculated at what they might be. We prefer to take the line that this is a company responsibility and we shall have to carry on. At this point in time it is remarkable the way in which the workforce at Birkenhead are carrying on with these submarines with no apparent ease up of the enthusiasm. We prefer not to do anything which might upset that at this point in time.

168. If you assume that no more submarines will be built at Cammell-Laird, does that not narrow your options as the Director General Submarines?

(Mr Sanders) I do not think so, Mr Chairman. I

have had to accept the changes to the defence programme and I have a contract there that has to be supplied. At this point in time I have not got any further requirements for any further submarines at this point. Of course, the company might hope that other things will come along that they might build at Cammell-Laird and indeed if there were further orders it would help my position, but I am in speculation.

(Mr Hawtin) Could I just say in terms of the capacity to build submarines, VSEL have the capacity to build them and so, too, do Yarrows. We expect that . . .

169. Does MoD expect to receive any claims from VSEL as regards the decision not to proceed with further Upholder class orders?

(Mr Hawtin) No, Mr Chairman.

170. You do not?

(Mr Hawtin) No.

171. If you did you would reject them?

(Mr Hawtin) Yes.

172. How long can you defer a further order for Upholders before it becomes an uneconomic proposition because production facilities for equipment would have been closed?

(Mr Hawtin) That is a hypothetical question, Mr Chairman.

173. It is a real one.

(Mr Hawtin) The position is we have no further plans for any further orders. As I said a moment or two ago we are satisfied that VSEL have the capability to build conventional submarines, so do Yarrows, and there is therefore a continuing capacity to build conventional submarines within the United Kingdom.

174. I do not believe that it is a hypothetical question, Mr Hawtin, because when you take the decision to build no more, to stop at four, which is a perfectly legitimate decision — whether it is right or wrong is something that will come out in the wash — you must have said to yourself, "Are we closing the door to any further Upholders whenever and if so when?" That is not a hypothetical question. I would be very surprised if you had not asked yourself that question.

(Mr Hawtin) I have answered it.

175. You have said that there is no further requirement. That is not the question. The question is about further Upholders. When would that not be an economic proposition because the facilities to build various parts of them would have been broken up and closed down.

(Mr Hawtin) I cannot give you a specific timetable for that and, of course, it will depend in considerable measure on what success VSEL have in exporting.

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CAPTAIN JOHN CHADWICK, RN and MR PETER DAVIES

[Continued

[Chairman Contd]

176. Was it not a question that you addressed yourself to when you were taking this decision?

(Mr Hawtin) Not that I am aware of, Mr Chairman, because we decided at that point we did not require further orders of Upholder class submarines.

177. And you gave no thought to a possible change in the situation which would require it?

(Mr Hawtin) I cannot say myself, Mr Chairman, whether we gave no thought at all. I am not in a position to answer that question.

178. Alright. How many refits and dockings do you expect that Upholder class submarines will need during their operational lives?

(Mr Hawtin) I think we are still looking at the refit pattern—and I will invite Captain Chadwick to comment—but I believe that the current thought is 7 or 8 years before refit.

179. How long do you expect them to be in service?

(Captain Chadwick) Twenty-five years.

180. So we are talking about two?

(Captain Chadwick) Yes. The upkeep cycle was for two refits at notional seven and a half year intervals and, generally speaking, there will be two docking periods within each commission in order to make sure that routine maintenance is done on the underwater fitting and also to carry out various safety checks to ensure that the safe-to-dive certificate can be complied with.

181. Will the refits and dockings be cheaper and shorter than they were for the Oberon class?

(Captain Chadwick) I think we would expect the first refit to be of the same order of cost. UPHOLDER was specifically designed with a "Dutch Breach" to allow access for the removal of equipment more easily than was the case in the Oberon class and VSEL paid more attention to the shipping routes when the vessels were put together and major items of equipment could be moved in and out much more quickly. I think it is fair to say we are not entirely sure in the wake of Options for Change what the pattern for refit for UPHOLDER will be in the future. What we have had to do is look at the submarine flotilla as a whole and the programme of improvements over 10 and 15 years.

One of the things we have asked the DGSM's organisation to look at is whether or not it is possible to operate UPHOLDER with one refit at midlife. That would give us more submarine availability and it would also mean we would then look at the weapons system at that mid life point to see whether we needed to upgrade it and whether we needed to make it more in common with the SSN weapons system.

182. When do you expect to decide to put the first UPHOLDER refit out to competitive tender?

(Mr Hawtin) I cannot give you a specific answer.

183. Do you expect to do that in principle?

(Mr Hawtin) I think we are still looking at the whole pattern of refit work, Mr Chairman, and no decisions have been taken. This is part of the overall look which I believe you covered at your session in April.

184. So you have taken no preliminary decisions even about the first docking of UPHOLDER?

(Captain Chadwick) What contractually or in time?

185. Yes, as to whether you are going to put it out to tender. This seems to be the ethos under which you are working. You contractualise dockyards and you get management in. Are you going to use that?

(Mr Hawtin) As you rightly say, Chairman, our ethos these days is to go for competition but we have not decided on the best time for the refit.

(Mr Sanders) No but you asked about the first docking, Mr Chairman. The first docking for UPHOLDER will be the one I referred to — later this year — when amongst other things we will put the weapons handling discharge right and of course that went out to competition.

186. It did?

(Mr Sanders) That did. We are in the assessment phase now so that is indicative of the way that we are progressing.

Chairman: Right, Mr Hawtin and gentlemen, thank you very much for your help. We will no doubt be sending you some additional questions but can you answer the questions in writing that you did not have the facts about? Thank you very much.

WRITTEN EVIDENCE

Asterisks in the Evidence denote that part or all of a question or answer thereto, or a passage of evidence, has not been reported, at the request of the Ministry of Defence and with the agreement of the Committee.

1. Memorandum submitted by the Ministry of Defence (1.5.91)

UPHOLDER

Q1. (a) When were the Naval Staff Target and Requirement issued?

A1. (a) The Naval Staff Target (NST) for the submarine itself was endorsed in January 1979 and the Naval Staff Requirement (NSR) in January 1980. There were 23 other equipment NSRs associated with the UPHOLDER class.

Q1. (b) What studies preceded their issue, and by whom, when, and at what cost were they undertaken?

A1. (b) Following the issue of the Outline Staff Target in November 1977, platform studies were carried out by the Ministry of Defence and Vickers. Operational analysis was carried out by Admiralty Research Establishment and the Defence Operational Analysis Establishment. Costs are unknown. Parallel studies were carried out in relation to the two principal associated NSTs, NST 7550 (Sonar) and NST 7719 (Weapon Handling and Discharge).

A nine month feasibility study, at a cost of £1 million, was conducted before the NSR was endorsed. This work was again undertaken by the Ministry of Defence and Vickers (which has now become VSEL).

A1. (c) What was the role foreseen for SSK 2400 submarines?

A1. (c) The role foreseen for the SSK comprised the following tasks:

War Tasks

- (i) Anti-submarine warfare
- (ii) Anti-surface ship warfare
- (iii) Minelaying
- (iv) Surveillance and intelligence gathering
- (v) Training of own forces

Peacetime Tasks

- (i) Simulated war patrol operations for training purposes
- (ii) Training of own forces
- (iii) Trials in support of new equipment

Q1. (d) To what extent was the Requirement influenced by export considerations?

A1. (d) During the pre-feasibility study period, two main designs were developed, DSRN A1 (1960 tonnes) and the DSRN B1 (2250 tonnes). It was considered that there could be an export potential for 30 to 40 hulls of over 2000 tonnes during the decade 1986/96 and this influenced the selection of DSRN B1 as the candidate design. In conjunction with Vickers, it was agreed that the smaller design was too close to other European competitors and that the larger DSRN B1, extended if necessary to the even larger DSRN D1 design (2650 tonnes), would offer the greatest export potential.

Q1. (e) What other options were considered for meeting the Requirement other than a UK design and build programme?

A1. (e) MoD considered the options for collaboration before the Staff Target was endorsed and concluded that collaboration on the total project would not be appropriate. MoD did, however, endorse the conduct of talks with both the Netherlands and Australia, but, when the NSR was endorsed, it was accepted that these talks had confirmed that neither country was suitable for full collaboration.

Q2. How was the design work on Upholder split between MoD and VSEL?

A2. MoD is the design authority for UPHOLDER, taking overall responsibility for all aspects of the design of the submarine and its systems and equipments. VSEL acted as the design contractor, developing the detailed design under MoD direction.

Q3. (a) When was the contract for design and build of UPHOLDER awarded to VSEL?

A3. (a) The design contract for the T2400 submarine was placed in May 1980. The build contract for UPHOLDER was placed in November 1983.

Q3. (b) What were the terms of the contract as regards price, profit rate, progress payments and completion milestones?

A3. (b) The design contract was let on a cost-plus basis, with progress payments covering costs incurred and the agreed rate of profit.

The build contract was let on a target cost basis, bound by a maximum price. Payments were linked to satisfactory achievement of agreed programme milestones.

Q3. (c) Have these terms been changed subsequently?

A3. (c) No.

Q4. To what extent did the price for UPHOLDER reflect anticipated gains in VSEL's efficiency stemming from the Submarines Facilities Project at VSEL? (Paragraphs 25–28 of the C&AG's Memorandum "The Torpedo Programme and Design and Procurement of Warships" refer—see PAC 31st Report, 1987–88).

A4. The facility was not available for use in the construction of this vessel; the price for UPHOLDER was not therefore affected.

Q5. (a) In view of the reference in Paragraph 3.23 of the C&AG's Report, HC 423 of 1984/85, to insufficient design resources at VSEL, what action did MoD take to ensure that VSEL allocated to Upholder design resources of a proper quantity and quality?

A5. (a) It is VSEL's responsibility to provide adequate design resources to meet their contractual commitments. The MoD project team monitored the position throughout the duration of the contract, and pressed the company to dedicate more resources to the programme when appropriate. As a result, the company subcontracted some design work.

Q5. (b) Were there any clashes of priority between Upholder and Trident submarine design work? If so, how were these overcome?

A5. (b) MoD is not aware of any clashes of priority between VANGUARD and UPHOLDER design work.

Q6. What are the reasons for the delay to the in-service date and the increase in costs of UPHOLDER recorded in the 1990 Major Projects Statement? Does MoD envisage any further cost increase?

A6. A number of factors contributed to the delay to HMS UPHOLDER's in-service date. These included industrial action at VSEL, faults in the design of the Weapon Handling and Discharge System (WHDS), MoD material changes to meet the approved NSR, problems with the main generator cooling fans, problems with electrical power conversion equipment and various shortcomings in the design and construction process.

The cost increases result from problems and delays to MoD supplied items, such as the WHDS, from VSEL overrunning the target cost on the build contract, and to contract changes made at MoD's request. Costs are not expected to exceed the estimates recorded in the Major Projects Statement 1990.

Q7. (a) What were the arrangements for integrating UPHOLDER with equipments supplied to VSEL by MoD and with its weapons?

A7. (a) Extensive use was made of a Shore Development Facility (SDF) established at VSEL Barrow to prove equipment integration before installation in the actual boat. Overall responsibility for the integration rests with the MoD, with VSEL acting as MoD's agent.

Q7. (b) Were any problems encountered and, if so, how were they handled?

A7. (b) As in any project of this scale, integration problems have been encountered. These have mainly been in areas where complex data exchange is required between different pieces of equipment. The SDF, which was designed specifically for this task, has been the main tool used in solving these difficulties.

Q8. (a) What were the principal problems identified during "UPHOLDER's sea trials, in particular the bow doors and motor drive, showing in each case the nature of the problem and the way in which it has been rectified?"

A8. (a) The problem was not in the "bow doors" as such, but with the WHDS. The difficulties, which were caused by a design fault, were identified in mid-1988 before the start of Contractor Sea Trials. The watertight integrity of the hull was assured for these trials by locking the torpedo tubes shut. A modification to correct the fault has been developed and is now undergoing trials on a special WHDS shore test facility.

Problems with the motor drive, or main propulsion system, concerned the automated control equipment and the propulsion switchboard. These were also due to design faults and have now been corrected.

Q8. (b) What shore tests were carried out on the motor drive prior to mounting it?

A8. (b) Separate shore testing was carried out on both the main motor and the propulsion switchboard. Testing was conducted to prove the equipment under conditions which were expected to be representative of the "worst case" in-service conditions.

Q9. Does the contract for Upholder require the submarine to achieve specified levels of performance, reliability and maintainability? If so, have these been met by UPHOLDER?

A9. Performance requirements were included in the development contract. These have been satisfied in the evaluations carried out to date. No specific reliability and maintainability requirements were included in the build contract. However, quality assurance requirements were stringently enforced and we expect the UPHOLDER class to have a high degree of reliability.

Q10. It would be helpful to the Committee to have a background note on the Weapon Handling and Discharge System, described in the Major Projects Statement 1990 as an "associated project".

A10. The WHDS has been developed and procured through a separate NSR. The NST was endorsed in June 1979 and the NSR in March 1980. The equipment was procured by the Ministry of Defence under a separate contract for supply to VSEL. The WHDS was originally based on an In-house design in association with the Admiralty Research Establishment. Design responsibility was transferred to Strachan and Henshaw in February 1986 for Full Development and build, in accordance with MoD policy to contract out to the maximum extent possible.

Q11. (a) Para 3.19 of the C&AG's Report, HC 423 of 1984/5, refers to the setting up by MoD of a joint ships weapons management team to provide a "cradle to grave" project management for the Upholder class. Does this team still exist? What advantages and disadvantages does MoD believe will accrue from this project management approach?

A11. (a) The joint ship/weapon management team will remain in existence throughout the life of the class. This integrated approach has enabled a small team to effect taut management. The continuity between procurement and support has been a significant factor in resolving the problems that inevitably arise on a programme of this complexity when introducing new equipment into service.

Q11. (b) If other project management arrangements currently prevail, it would be helpful to have a background note on these.

A11. (b) No alternative project management arrangements currently prevail.

Q12. Why was UPHOLDER fitted with the older 2026 towed array, when 2046 was already the standard in Swiftsure and Trafalgar class boats? When will 2046 be fitted in UPHOLDER?

A12. Sonar 2026 was originally specified as the towed array sonar in the NSR. In the original Schedule for the construction of the submarine, Sonar 2046 would not have been available for supply to the shipbuilder in time. With the improved performance and reduced cost of 2046, it was specified for the later boats of the class. Consideration is being given to providing UPHOLDER with 2046 at the earliest practicable opportunity.

Q13. (a) Does Upholder fully meet the Naval Staff Requirement? If not, what are the deficiencies and how are these to be rectified?

A13. (a) At this early stage of UPHOLDER's operational life, it is not possible to answer this question. Her Fleet Weapons Acceptance, currently scheduled for late 1992, is the point where she must formally demonstrate the design acceptance against the criteria of the NSR. The only known shortfall is the problem of the WHDS, for which remedial plans are in hand.

Q13. (b) In what respects is her performance markedly above Requirement?

A13. (b) Again, it is too early to answer this question.

Unseen, Ursula and Unicorn

Q14. (a) Over what period did the tender exercise for UNSEEN, URSULA and UNICORN (SSK02-04) take place?

A14. (a) December 1984 – December 1985

Q14. (b) Which companies were (i) invited to and (ii) did submit tenders?

A14. (b) VSEL, Cammell Laird (CL), Scott Lithgow and Yarrows were invited to tender and all submitted bids. CL and VSEL subsequently merged and submitted a joint bid in the name of CL.

Q14. (c) On what basis did MoD decide to award the contract to Cammell Laird?

A14. (c) On the basis of price and compliance with the terms and conditions of the tender request.

Q14. (d) How did MoD calculate the £20 million saving from the competition, which the C&AG reported in para 19 of his memorandum appearing in PAC 31st Report 1987-88?

A14. (d) This sum, which is an estimate of the savings from both competition and batch ordering, was calculated by comparing the estimated prices for the three single boats with the best competitive batch price for all three.

Q14. (e) What indications, formal or informal, did MoD give to tenderers as regards MoD's intentions for further Upholder class orders, specifically on numbers and timescale?

A14. (e) No formal or informal indications of MoD's intentions for further Upholder class orders were given to any of the tenderers, either on numbers or timescale.

Q15. What arrangements did MoD make for long lead items for SSKs 02-04?

A15. Long lead items for SSKs 02 and 03 were procured through the lead yard (VSEL) under a contract placed in October 1983. When the build contract for SSKs 02-04 was awarded to CL in January 1986, they assumed responsibility for the long lead contract, and procured the material for SSK04.

Q16. (a) What are the terms of the SSK 02-04 contract as regards price, progress payments and completion milestones?

A16. (a) The contract for SSKs 02-04 was placed on a fixed price basis with payments linked to the satisfactory completion of agreed programme milestones.

Q16. (b) Have these terms been changed since the contract was let?

A16. (b) No

Q17. (a) What are the expected in-service dates and costs for SSK 02-04 and how do these compare with MoD's original estimates?

A17. (a) The in-service dates currently estimated compared with those originally approved are:

	ORIGINAL APPROVAL	CURRENT ESTIMATE
SSK02	*	*
SSK03	*	*
SSK04	*	*

The current estimated cost at 1990/91 prices is £390 million compared with an originally approved cost of £411 million at the same price base.

17. (b) What are the reasons for any delays, or changes in costs?

17. (b) Delays have been caused by a combination of factors. In the case of SSK02, the main causes are changes to the planned sonar and radar fits, modifications to the WHDS following the faults discovered in UPHOLDER, late delivery of some MoD-supplied items, the consequential effects on Cammell Laird of VSEL'S industrial dispute, and the need to rectify damage sustained on return from Contractor's Sea Trials. The delay to SSK03 has resulted from the industrial dispute, the late delivery of some MoD supplied items and to delay by the shipbuilder. SSK04's delay is attributable to the shipbuilder.

Q17. (c) What is the current expenditure, or to a recent date for which information is conveniently available, on Unseen, Ursula and Unicorn?

A17. (c) As at February this year, expenditure on the platforms in cash terms has been as follows:

SSK02	£77 million
SSK03	£58 million
SSK04	£39 million

Q18. (a) Are there any significant differences between the design of SSK 02-04 and UPHOLDER?

A18. (a) There have been only minimal changes to the design of SSK02-04. These are Sonar 2046 instead on Sonar 2026, Radar 1007 instead of Radar 1006 and some alterations to the layout of accommodation reflecting lessons learnt during UPHOLDER's sea trials.

Q18. (b) Have there been alterations in the accommodation arrangements?

A18. (b) Yes. SSK02-04 are benefiting from SSK01's experience and will receive a number of accommodation modifications during build. SSK01 will be modified to this standard at the earliest opportunity.

Further Upholder Class Batch

Q19. MoD has told the Committee about the long lead items originally purchased for the anticipated next batch of Upholder class SSKs (Answer Gc of MoD's memorandum dated 22/2/91). a. Why were the sonar suites and ATP equipments, which may be retrofitted, not part of the original outfit of Upholder boats?

A19. (a) Technology has progressed rapidly since the order for the first of class was placed. Cheaper and more capable sensor systems have become available through associated SSN development programmes. They were not options that were available when the order for SSKO1 was placed.

Q19. (b) How many (i) sonar suites (ii) ATPs and (iii) SINS equipments were ordered, and on what expected future number of Upholder submarines?

A19. (b) The equipment ordered was as follows:

EQUIPMENT	NUMBER ORDERED	FOR SUBMARINES
Sonar suites	5	05-07, SDF and trainer
ATPs	5	05-07, and spares
SINS	20	01-09, and spares

Q20. (a) What is the total estimated cost to MoD of work undertaken by MoD and contractors in connection with the anticipated next batch of Upholder class submarines?

A20. (a) The cost of the work done by MoD is not available. There are no costs to the MoD for the work done by contractors beyond those detailed in answer A2 of our memorandum of 22 February (Evidence page 24).

Q20. (b) Has MoD incurred any cancellation charges in connection with the decision not to proceed with the order for the anticipated next batch?

A20. (b) Not at this time.

Exports

Q21. (a) What role is MoD taking as regards encouraging exports of Upholder class submarines?

A21. (a) The MoD, through the Defence Export Services Organisation (DESO), continues to be actively involved in supporting VSEL in the promotion of submarines to overseas customers. To date this support has included a joint MoD/VSEL visit to one potential customer country and joint promotional activity in another.

Q21. (b) What is MoD's assessment of the export prospects?

A21. (b) There is currently the prospect of a sale of T2400 to one overseas customer. DESO continue to monitor the market jointly with VSEL to identify other opportunities to promote the submarine.

2. Further memorandum submitted by the Ministry of Defence (20.6.91)

Q22. It would be helpful to the Committee to have a note on the additional endurance—submerged and total length of patrol—of the 2400 Upholder Class compared with (a) Oberon class submarines and (b) its main competitors in the export market, showing the key factors affecting endurance? (Q20-22) refers).

A22. The endurance of the Upholder Class (whether submerged or surfaced) is approximately 65 days, which is the same as the Oberon Class. The key factors are the capacity for carrying stores and provisions which is dictated by hull size, fuel capacity and efficiency, and (in operational terms) weapon carrying capability. Each of these can become the limiting factor depending on the scenario. Competitors such as the Dutch Walrus Class, which is of similar size to Upholder, will have a similar endurance. The German Type 205 or 206 on the other hand are, at 400–500 tons, much smaller and have a correspondingly shorter endurance estimated at some 30 days. However, provision limited endurance can in all types be extended by carrying extra rations in irregular stowage spaces.

Q23. (a) What were the main terms of the contract with Strachan and Henshaw as regards work to be undertaken, price, satisfactory performance and payment terms? What procurement responsibilities did Strachan and Henshaw have and what was their relationship, with MoD and VSEL procurement functions? (Q36).

A23. (a) There have been a number of development contracts placed with Strachan & Henshaw (S&H) including feasibility studies in 1978, the main design and development contract in 1980 and the modification programme in 1989 and 1990. With the exception of the modification work these were cost plus contracts with regular interim payments subject to satisfactory progress. The modification contracts were firm price. The currently estimated cost of the development contracts is £43m (at 1990/1 prices). Formal responsibility for the design work rested with MoD until 1986 when S&H assumed the role of Design Authority.

The production and supply to the shipbuilder of Weapon Handling and Discharge Systems (WHDS), to the approved design, for SSK 01 and SSKs 02-04 were placed under two contracts in 1983 and 1985 respectively. The current estimated production cost is £75M (at 1990/91 prices). The contract for SSK 01 was priced on a cost plus basis whilst the contract for SSKs 02-04 was firm price.

Q23. (b) Did Strachan and Henshaw have any involvement in Upholder design work before February 1986?

A23. (b) Yes. S&H were contracted to carry out all Upholder Class WHDS design work from the outset in March, 1978.

Q23. (c) What is MoD's current policy on contracting out of detailed submarine and ship design work, and what is their assessment of industry's capacity? (Q43).

A23. (c) MoD's policy is to contract out as much responsibility as industry is willing and competent to accept. Industry's capability has improved over the last 10 years and today we would expect much greater responsibility to be taken by industry than was the case when UPHOLDER was ordered. Nevertheless, whatever role is undertaken by industry, the ultimate responsibility would remain the MoD's.

Q24. (a) How much would it have cost to produce a more comprehensive shore development facility or prototype submarine capable of identifying the WHDS and Main Propulsion System faults before UPHOLDER was built? (Q44 and 92).

A24. (a) To produce a comprehensive shore prototype of the WHDS would have entailed duplication of a significant proportion of the fore end of the submarine complete with interfacing systems in their correct geometry. Even then it would not have been possible to represent fully "at sea" conditions, nor would there have been the capability to test all aspects of the system. Exhaustive testing could therefore only have been carried out in a prototype submarine. The same considerations apply to the shore testing of the Main Propulsion System (MPS). Such facilities have not been costed but would undoubtedly be very expensive in that they would be reproductions of a major portion of the submarine.

Q24. (b) How successful has the shore development facility (Answer 7 of MoD's memorandum dated 1 May 1991) been in identifying and clearing integration problems? Was MoD surprised that the SDF apparently failed to give warning of the difficulties which arose shortly before or during contractors' sea trials?

A24. (b) The Shore Development Facility used on the UPHOLDER project represents the core of the Tactical Weapon System only and was never intended to embrace the Weapon Handling and Discharge System (WHDS) and Main Propulsion System (MPS). It has been particularly successful in the role for which it was designed. Separate shore testing of individual equipments such as the WHDS and MPS was carried out at the sub-system level prior to installation and integration in the submarine.

Q25. It would be helpful to have a note on the proposed dates and estimated cost of work on the 4 Upholder class submarines for rectification of the WHDS fault, and showing which companies have been invited to tender, and on what contractual terms. (Q55).

A25. Three companies have been invited to tender for the WHDS modifications: Babcock Thorn Ltd, Devonport Management Limited and Cammell Laird Shipbuilders. The terms and conditions are those normally associated with a competitive tender of this nature, that is, they are firm priced and include Liquidated Damages Clauses against late completion of the work. The estimated cost of the work is * SSK 01-03 will be modified by mid 1993 and 04 will be modified during build.

Q26. *It would be helpful to have a note on the proposed claim made by the MoD or the contractor in respect of the main propulsion system fault. (Qs 67 and 83).*

A26. The fault in the Main Propulsion System was highlighted as a result of Contractor's Sea Trials. Events leading to and following the incident are complex but the facts have been presented to our Solicitors who believe we have a strong case based upon Marconi's contractual obligation to provide a product fit for purpose. Marconi's Solicitors have acknowledged the Notice of Arbitration served upon them. Our aim is to recover as much of the £8m as possible.

Q27. *It would be helpful to have a note on the delays to the in-service date of UPHOLDER caused by each of the various problems which were encountered during construction (Qs 61, 93, 102); and on the delay to UNSEEN. (Q124).*

A27. The main reasons for delay and their approximate effects, rounded to the nearest working month, are as follows:

HMS UPHOLDER:

Main Propulsion system problem	7 months
WHDS problem	2 months
Other prototype problems	6 months
Total delay for prototype problems	15 months
Change to requirement—mainly to fit full anechoic tiling	2 months
Miscellaneous minor design problems attributable to MoD, eg filters on High Pressure air bottles, Electronic Warfare mast access panel	4 months
Weather disruption of Sea Trials	1 month
Industrial disputes at VSEL and shipbuilder performance shortfalls.	14 months
TOTAL DELAY	36 months
UNSEEN:	
Change to requirement—fit of Sonar 2046 & Radar 1007	4 months
WHDS problem	1 month
Main Propulsion System problem	3 months
Collision damage	1 month
Industrial disputes (inc VSEL)	4 months
Miscellaneous minor design problems attributable to MoD	2 months
Other minor problems (eg contaminated cable, gale damage)	2 months
TOTAL DELAY	17 months

Q28. *What were the arrangements within the Development and Build contracts for UPHOLDER intended to influence VSEL's performance? What consideration was given to applying the arrangements on the Development contract? What were the circumstances surrounding the six month payment stoppage on the Build contract? Was consideration given to payment stoppage on other occasions during the build contract? (Qs 131-134).*

A28. The design and development contract was placed on an ascertained cost basis under which the MoD agreed to pay VSEL their "reasonably incurred costs". Until 1984, the contractor's efficiency was a factor in the assessment of the agreed non-risk rate of profit. Subsequently, in accordance with the Government Profit formula, average efficiency was an assumed factor. Additionally, the contract enabled the Ministry to withhold interim profit or progress payments were satisfactory performance not achieved.

The build contract was placed on a Target Cost Incentive Fee basis whereby VSEL would only recover 80% of any costs over the target up to a maximum of 14.3% overrun, and nothing beyond that. VSEL would receive 50% of any underrun. These factors, together with the instalment scheme of payment for

achievement of precisely defined milestones, were the main features intended to influence VSEL's performance against the contract. In addition the contract contained provision for liquidated damages in the event of late completion.

To encourage VSEL to correct outstanding defects on SSK01 and to improve their Quality Control Procedures, in early 1989 MoD withheld payments against agreed milestones for 6 months. This had the desired effect. Stoppage was not considered on any other occasion.

Q29. It would be helpful to have a note on the attempts to negotiate a fixed or firm price on Upholder design and build contracts referred to by the Public Accounts Committee. (Qs 134-143; Eleventh report from the PAC "The 1989 Statement on Major Defence Projects", Para 24 and Qs 4596-8); specifically:

- (1) When did these negotiations take place?*
- (2) How large were the contingencies demanded by VSEL?*
- (3) Does MoD now intend the contract to continue to completion on a cost plus basis?*
- (4) How does MoD's current estimate of the cost of completing the design contract under cost plus terms and conditions compare with the fixed price offered by VSEL which MoD rejected?*

A29. At the outset of the contract no part was sufficiently defined to allow risk pricing. As work progressed some attempts were made to establish Firm Prices for individual Project Orders but never for the contract as a whole because the problems of defining the work content remained. In 1985, for example, VSEL were asked to provide a firm price quotation to complete the preparation and production of the T2400 submarine build drawings. Their quotation, which included a 13% contingency, effectively accepted no risk and we were unable to negotiate a satisfactory arrangement. As the contract is now substantially complete, it is our intention to continue on the basis of "reasonable costs incurred". VSEL have never offered a fixed price to complete the totality of the contract.

Q30. It would be helpful to have a note on the expected cost outturn on the "development of the weapon system" (Q152) and the UPHOLDER design and build contracts (Qs 143-154). Specifically, of the build contract:

- (1) By how much are VSEL overrunning the target cost?*
- (2) Does MoD expect VSEL's costs to reach the maximum price? What profit would VSEL make at maximum price, if any?*
- (3) By how much has the target cost been increased to take account of the material changes required by MoD? Or in relation to the industrial dispute?*

It would also be helpful to have further details on the "development of the weapon system" contract (Q152).

A30. The weapon system referred to in Q152 was the WHDS and details of the contracts for this are given in the answer to Q23. A final price has still to be agreed for the UPHOLDER platform design and development contract but is estimated at around * (90/91 prices). On the UPHOLDER build contract, although precise details are not yet available, VSEL are known to be overrunning the target cost and are expected to run close to, but not exceed, the Maximum Price. If the cost were to reach the Maximum Price, VSEL would be entitled to * profit. The expected cost outturn is about £143m (90/91 prices).

The Target Cost on the Upholder build contract has been increased by an estimated £4.2m to account for MoD approved changes to the build requirements. Cost arising from the strike from June to August 1988 will be shared between the contractor and MoD against the shareline arrangement. The actual costs of industrial action which will fall to MoD are estimated to be £1M.

Q31. When did the industrial action take place at VSEL, did it also cover Cammell Laird: and how much delay did it cause?

A31. The all-out strike at VSEL lasted for 3 months from June to August 1988, but the period from March 1984 up to June 1988 saw a variety of other industrial disputes causing a further 5 months delay to programme.

Cammell Laird were not involved in the 3 month strike although they did suffer from consequential delays in the supply of information under the Design Agency Services contract which when added to other industrial action at their own yard added 4 months to the build programme of UNSEEN, the programme for URSULA was similarly delayed by 4 months as a consequence of the VSEL strike. No such consequential delay has been claimed for UNICORN.

Q32. (a) What were the shortcomings in the design and construction process of UPHOLDER referred to in Answer 6 of MoD's memorandum dated 1 May 1991?

A32. (a) This referred to the underestimation by both the MoD and the contractor of the problems likely to be met in the development and construction of a First of Class submarine. For example, as development progressed additional updating design work on the specification proved necessary; space constraints led to greater design effort than originally anticipated, and Setting to Work of systems for the first time revealed prototype problems when tested at their performance extremes.

Q32. (b) In June 1985 the Chief of Defence Procurement (Sir Peter Levene) told the Public accounts Committee that during the negotiations leading to the Upholder build contract MoD had been "successful in fixing manpower targets reflecting substantial reductions for future improvements in productivity". Did these reductions come about? (35th Report from the PAC, Design and Procurement of Warships", HC 452 of Session 1984-85 refers).

A32. (b) Yes. Before placing the contract the VSEL tendered manhours were reduced by 5.5% to allow for future productivity. This was built into the contract target cost and had the effect of reducing the contracted costs by some £1.25m (90/91 prices).

Q33. How did MoD enforce the quality assurance requirements on the UPHOLDER build contract? On what grounds does MoD expect high degrees of reliability to be achieved by UPHOLDER? (Answer 9 of MoD's memorandum dated 1 May 1991 refers).

A33. The contract placed responsibility for Quality Assurance (QA) with VSEL who maintained control through audits carried out by their QA department. In addition, MoD conducted its own audits of VSEL's QA system and of a range of construction activities, and performance was monitored through a joint VSEL/MoD Quality Assurance Management Group. MoD accepted and paid for work done only when Quality standards had been met.

To ensure equipment reliability the MoD supported a programme of extensive testing of major equipments at subsystem level. In addition VSEL supported extensive production testing of subcontracted Shipbuilders Supply Items. The submarine was then thoroughly tested during construction and on Contractor's Sea Trials. We are satisfied that this process will generate high standards of reliability.

Q34. Which of the MoD supplied items were delivered late for UNSEEN and URSULA? How late? Why? Were liquidated damages payable on these items? (Answer 17 of MoD's memorandum dated May 1991 refers).

A34. The equipment problems related to the quality rather than the late delivery of MoD supplied items. All defects were made good by the original contractors at no cost to MoD. Liquidated Damages were not payable for these delays because sub-contractors were not prepared to accept the risks given the uncertainty and size of the task.

Q35. Has the fixed price for construction of SSKs 02-04 been changed for reasons other than inflation (eg for MoD changed requirements)? Is the inflation adjustment clause linked to the original timetable for completing the contract?

A35. The price for SSK 02 has been increased by the inclusion of MoD Change Notices (£1.5m) and Ministry caused Delay and Dislocation (£2.7m). The prices for SSK 03 and SSK 04 have been increased by some £1.1m each to allow for Change Notices, but no Delay and Dislocation costs have been agreed for either. The inflation adjustment clause (Variation of Price or VOP) is linked to the Programme agreed under the original contract but may be extended to encompass MoD caused delays and other Force Majeure events.

3. Part of a memorandum submitted by the Ministry of Defence¹ (22.2.91)

WEAPONS

Q1. The Committee would be assisted by a declassified brief on current SSN and SSK weapons systems, including sonars and decoys, and minelaying capability. It would also be helpful to have an indication of the implications, if any, of proposed reductions for future construction and weapons outfits.

A1. SSN—HMS VALIANT and HMS COURAGEOUS

These submarines have the following fit/capability:

- a. Sonar
 - 2001—first generation, medium range, passive and active SSN bow array
 - 2019—sonar intercept array
 - 2046—long range, passive narrow band towed array
- b. Weapons

These submarines have six bow torpedo tubes from which TIGERFISH wire-guided, anti-submarine and anti-ship torpedoes, as well as RN Sub-Harpoon (RNSH) underwater to surface missiles, may be launched. Additionally, these tubes may be used for the deployment of MMk 5 ground mines. The weapon outload that any submarine carries is determined and directed as appropriate to its operational tasking.
- c. Countermeasures

Countermeasures stores can be launched from two Submerged Signal Ejectors (SSE) to confuse and distract enemy sonars and weapons.

SSN—Swiftsure and Trafalgar Class

The Existing weapon system of these platforms is essentially the same as that of VALIANT and COURAGEOUS. The main differences are that the S & T Class have five torpedo tubes instead of six, and a flank array Sonar 2007. Some equipment is more modern in design, giving improved performance, a reduced acoustic signature and a superior overall capability.

SSK—Upholder Class

The equipment fit of this class is:

- a. Sonar
 - 2040—bow array providing medium range passive surveillance, short range active and intercept capabilities
 - 2041—passive ranging sonar
 - 2046—long range, passive narrowband towed array (UPHOLDER herself is fitted with Sonar 2026 which will be replaced by 2046 at refit)
- b. Weapons

Upholder SSKs have six bow torpedo tubes from which Tigerfish wire guided anti-submarine and anti-ship torpedoes can be fired. These tubes also have a launch capability for RNSH underwater to surface missiles and M MK 5 ground mines.

Q2. The Committee was informed that around £15 million had been committed on Upholder long-lead items [Q402] It would be helpful to have details of this expenditure and of the retrofitting plans referred to.

A2. Because of time and cost considerations a number of long lead items were ordered in 1988 and 1989 against a then expected future buy of Upholder Class submarines. Such action was kept to the essential minimum. The major items involved and the sums on contract are:

EQUIPMENT	CONTRACT VALUE
New sonar suites	£12.0m
UK Air Turbine Pumps (ATP)	£3.0m
NATO Shipboard Inertial Navigation Systems (SINS)	£4.0m
Miscellaneous studies	£1.0m

We are considering whether it would be cost-effective to retro-fit the Sonar and ATP equipments on contract into the four Upholder Class boats and the SINS equipment into Swiftsure and Trafalgar Class submarines. Decisions have not yet been taken.

¹ See HC 369 of Session 1990–91 for complete memorandum.

