

MR D J PEPPER, Vice Chairman, Rolls-Royce Limited, and MR P GOODWIN, former Managing Director, Rolls-Royce and Associates, called in and examined.

Dr Gilbert

1073. First of all, I must apologise to you both for having kept you waiting so long but the evidence of the previous witness was so fascinating, I am afraid, that he kept us going far longer than we had expected.

(Mr Pepper.) Not at all.

1074. You have been good enough to let us have a memorandum already in written evidence. Is there anything you would like to add to that by way of emphasis or clarification before we put the questions to you?

(Mr Pepper.) Yes, Chairman, perhaps I should add a point to it. In the context of this major equipment purchase I would like to emphasise the value of having an organisation such as we set up with RR&A in the past to handle the transfer of technology. The UK naval nuclear propulsion programme has been a considerable success, and the major reason for that was the good advice given to the UK by Admiral Rickover. He maintained that it was necessary to set up an unambiguous channel of communication and technology transfer using nominated commercial organisations on each side of the Atlantic. These were the Westinghouse Corporation of the United States and Rolls-Royce, which began RR&A here in the United Kingdom. As far as the Trident programme is concerned the nuclear propulsion system, whilst having its origins in the United States of America, has been so developed that what is needed for the new submarine can be designed and produced in the UK with no technology transfer from the US. However, there are parallels to be drawn between the present situation and the technology transfer associated with the missiles and what has already been achieved with the nuclear propulsion system, and we therefore commend to you the advantage of having an RR&A type of organisation handling the UK end of the exercise.

1075. I am much obliged. You are saying we are now wholly independent of the United States as far as the next generation of nuclear steam-raising plant is concerned? (Mr Pepper.) That is right, yes. The important point really was using that

method of absorbing the technology so that one could service the original nuclear plant bought from the Americans companies. As I say, on the organisation of companies with a lead contractor it does seem to us that perhaps a parallel could be drawn for the technology transfer implicit in the new Trident system; in other words, to make the most use of the information and to improve the ability to maintain it and support it.

1076. You say, Mr Pepper, in subparagraph (d) of your memorandum: "Because of the size of the equipment, and also as a result of the method chosen to build submarines, the major items of reactor plant need to be ordered before the submarine hull". Are we to infer from that that there is more than one method available for building a submarine and that some other methods might produce a reduction in this lead-time?

(Mr Pepper.) Could I ask my colleague to answer that? He has been for the last four years Managing Director of the RR&A company.

(Mr Goodwin.) If I can answer the question by explaining what I mean by this particular method chosen to build the submarines: submarines, as you know, are basically cylindrical in section and the way that the Vickers yard at Barrow, which is probably the shipbuilder, builds them is that they roll complete hoops of steel which they then build up from the aft end of the submarine forward and this allows an end-loading technique to be used for the leading in of major items of machinery. The way this method of building has been derived over the years is one which optimises the period of time for building submarines as a whole, but it does mean that large items of equipment that are too large to go in through the hatches have to be installed or fitted into the submarine with that hoop of the submarine at that stage. Some of the components are very large, as you can imagine, and they have to have a long lead-time. So, there are alternative methods available to shipbuilders well set out but this is the best way of building a submarine as a whole.

1077. Is the equipment you are putting

into the submarine of itself a determinant of the size of the submarine? (Mr Goodwin.) No, the size of the submarine — and we are particularly talking about the Polaris replacement submarine —

1078. We are talking at the moment of the Trident programme.

(Mr Goodwin.) Yes, the size of the submarine will be determined by the size of the weapon system itself, and then the nuclear steam-raising plant obviously takes the best advantage of that size, of the hull diameter in particular.

1079. I think it is fair to say that the evidence we have had so far leads us to believe that the Ministry of Defence has yet finally to make its mind up as to the actual size of the new hulls. Can we take it that if a decision were to be made at some time in the future not to proceed to the full Trident programme but to go for an updated Polaris, your steam-raising plant could fit in a hull of a size adequate for a missile of that size?

(Mr Goodwin.) Yes. We have reached agreement with the Ministry of Defence on the basis that our design will fit into either type of boat.

1080. You have had discussions with them?

(Mr Goodwin.) We have had discussions. We have had, because of the long lead-times involved, to agree with the Ministry of Defence the space envelope in which we can work.

1081. So, there would be no modifications necessary from your point of view if a decision were taken to change the programme?

(Mr Goodwin.) No. That is based on my understanding of the submarine envelope that the Ministry of Defence would aim at for a Polaris replacement as opposed to the Trident submarine.

1082. How long would it take you to build the first of these plants and when would you expect to be able to start production?

(Mr Goodwin.) Can I perhaps add a little bit of detail at this stage that may help the understanding of the situation? It has been our practice, and the practice of this programme, to have a prototype operating at a place called HMS Vulcan, at Downreay

in the North of Scotland, and this new plant will be no different in that respect. Now, that prototype is currently being built. The major machinery for it, the long lead items, etc., are being made in the manufacturers at the moment and, therefore, we are in a situation where we are going through the preliminary stages of proving out this new reactor plant. Provided that we can comply with the requirement I have put on there of receiving long lead orders two and a half years before the submarine needs to be ordered, then we could start the procurement of the reactor plant for the submarine proper at very short notice indeed.

1083. Will these steam plants be suitable for use both in SSNs and SSBNs?

(Mr Goodwin.) Yes. I am hesitating slightly there only in as much as we have reached a space envelope agreement with the Ministry of Defence which is aimed at the Polaris replacement or Trident type submarine. So if you then require to put that into an SSN type of submarine the Ministry would require the space envelope to be identical, so that is something I am not competent to comment on.

1084. What is the life of one of these plants?

(Mr Goodwin.) The life of the plant is the same as the life of the submarine. The design of the plant itself is designed to be the same as the life of the submarine. Individual components may need to be replaced during the submarine's life on a planned basis, and in particular the reactor core obviously will need to be replaced during the life of the submarine. The frequency with which it is replaced is normally a matter of design and testing, but also has to be combined with the operating profile that the Navy want to impose on the use of the submarine. So it is part of the design exercise to make sure that major components, reactor fuels etc., can be replaced during the lifetime of the submarine at a time which is convenient to the operating profile of the submarine itself.

Mr McKay

1085. Do you expect the new plants to be easier to maintain than the old plants? Do you expect the time to be longer in between maintenance periods?

(Mr Goodwin.) The periods between major refits of the submarine will be longer and the ease with which that refit is done from the point of view of the reactor plant

be easier to maintain the plant. That is one of the design criteria we have put into the initial stages of design of this plant.

1086. Have there been any major defects reported in the old plant?

(Mr Goodwin.) It would be quite wrong of me to say there were no defects. Obviously any engineering plant has defects. But we have not had major defects.

1087. Will you be prepared to enter into a fixed contract?

(Mr Goodwin.) That is a difficult question to answer because, if I can speak about our experience in the past, experience in the past has been that, having taken the original Dreadnought plant, we developed it through several different generations of major modifications and also several minor modifications to improve the plant. Therefore, we have never had the opportunity of a long run of repeat orders which would allow us to go into a fixed price in the terms that you mean. But, on the other hand, Rolls Royce & Associates is not a manufacturing organisation, it is a design and supply organisation. It designs the plant, then it buys the plant from a variety of manufacturers. Whenever it has been possible for us to fix on the design of a component, we have entered into firm price contracts with those manufacturers on individual items — major items in some cases — which we then supplied to the Ministry of Defence for building into the submarine. So it is a compromise.

1088. You just mentioned Rolls Royce & Associates being designers. How important was this to Polaris?

(Mr Goodwin.) I think, as Mr Pepper said in his original statement, the Lynch-pin of the success of this overall programme was the fact that this entirely new company, Rolls Royce & Associates, was set up solely for the purpose of handling the information that came in from the Americans on the Dreadnought plant and then developing that plant. We believe it has been a key feature in the success of the Polaris programme that Rolls Royce & Associates was set up and has been a successful operation.

Mr Conlan

1089. You say that you are now completely independent of the United States as far as technology transfer is concerned. Does that then presuppose that the plant

for the new Trident submarines will be in some ways different from the plant used in the American submarines?

(Mr Goodwin.) We do not know what plant is used in the American submarines at the moment. We know what plant was used in the American submarines in 1959 when we took the Dreadnought plant from the Americans, and that plant has been developed and improved over 20 years. We now have a new plant which makes use of the same essential feature, the pressurised water reactor, but it is a development based on all the experience we have picked up over the years, so we really do not know how it compares with the American.

1090. Would it be reasonable to assume that international technology will progress at about the same rate anyhow?

(Mr Goodwin.) We have no reason to believe they have made any massive steps that we have not made.

1091. If they had, would you expect to see some technology transfer?

(Mr Goodwin.) I do not think we would expect it as of right. If we believed that the Americans had made some massive steps that we had not made, then I think we would press the Ministry of Defence to seek some kind of relationship with the Americans.

1092. Would you necessarily know about it?

(Mr Goodwin.) No.

1093. Then how could you make your request?

(Mr Goodwin.) You ask me if we would necessarily know about it. We would know from the information that we pick up from the newspapers, perhaps intelligence sources and so on — you know. Information does come to us from a variety of sources and from the Navy itself. The Navy would probably know about it if they received information which indicated the American submarines were outperforming our own.

1094. How would the new plant differ from the plant in existence?

(Mr Goodwin.) Higher power, a longer lifetime between refits; it had designed into it right from the start all our experience on maintenance and reliability and so on, so that it will be easier to maintain and — an important feature — it will take notice of current thinking on nuclear safety. The

nuclear safety scene has changed over the years, and this new plant will put in all those features which are now regarded as essential.

1095. Presumably that will be much more costly?

(Mr Goodwin.) It will be very significantly more costly. It is very difficult to relate the cost now to costs in 1959 because of the aspects of inflation and so on, but if you relate the value of the pound to the power of the plant and the period between refits, I think you can draw a comparison which shows that pound for pound it is not that much more costly, but it is more sophisticated plant.

1096. I think we have been told that of the total Trident programme the manufacture of submarines will absorb 30 per cent of the total cost. That is a submarine, the weapons platform. What proportion of that cost will be absorbed by the power pack?

(Mr Goodwin.) In my memorandum I said that it was something like 10 per cent of the total submarine cost. I have no reason to believe it will be very different from that, so I guess that means 3 per cent of the total cost.

Dr Gilbert

1097. You said there would be no massive steps of which you thought you would be unaware and Mr Conlan pressed you on that. I rather infer from what you say that there is no regular exchange or discussion of information between you and the American manufacturers in this field. Why is that?

(Mr Goodwin.) * * *
(Mr Pepper.) If I could add to that, Chairman, part of the original philosophy was by buying a plant from America for the submarine Dreadnought made here we would buy that hardware plus the design information connected with it and limited to it and specifically stand on our own feet and through RR&A build up a capability here for moving from that platform on to more advanced plants. For example, the life of the nuclear reactor core has considerably increased with the modifications we have made, and so on. I think it was basic to the original philosophy that, to build up a capability here, it was best not to continue the drip-feed but to force the issue and set up this capability. That was one element. I think the major element though was national security, that the submarine plants

to the Americans — and still to this day — assumed such strategic significance that they felt they had to have a very firm control of the information.

1098. * * * Would you not see advantage in regular exchange of information with the Americans? After all, what we are talking about here, as I understand it, all the time are only minor increments in technology. These minor increments are, however, very significant, particularly when we are talking about noise suppression. Would you care to comment on that?

(Mr Goodwin.) * * * At this stage if we were offered that kind of relationship we would welcome it because we now feel that we have gone through the development phase ourselves and we are competent to stand up in front of them as technical equals, if not equals in terms of quantity.

1099. I do not doubt your analysis of the benefits to Rolls-Royce & Associates over the past several years, but the situation has now changed. Now that you have established an independent capability, would it not be both in your interests and in the interests of the Alliance to go to the Americans and say "Look, we don't need you but we have some things that we think you could benefit from and there may well be things you have got we could benefit from"? (Mr Goodwin.) From our point of view I am sure we agree.

1100. Why have you not done it? (Mr Goodwin.) You are speaking to Rolls-Royce & Associates. We are subject to contracts from the Ministry of Defence and the Ministry of Defence themselves are the custodians of the relationship between UK and US.

1101. Have you put it to the Ministry of Defence that they should do this? (Mr Goodwin.) We have suggested from time to time there are particular issues we would like to talk to the Americans about, but they themselves have never felt that it was appropriate to press the issue to the point of crisis. I think that any questions on that relationship you ought to direct to the Ministry because we are not aware of the politics at the back of this.

1102. To your knowledge have they, in fact, without pressing things to the point of crisis, taken up any of the matters you have raised?

(*Mr Goodwin.*) On certain specific questions — most of these relate, of course, to problems on existing plant — where we had requested the Ministry to seek information from the United States, and here I should explain that the only contractual relationship that exists between the United Kingdom and the United States on the nuclear submarine plant is that relating to Dreadnought and there is an agreement within that contract which says that, if during the lifetime of the Dreadnought plant (and we are still within that lifetime) the Americans found anything which affected nuclear safety and hazarded the safety of the submarine, they would let us know what that problem was. We have had no positive communications in that respect. On occasion we have asked the Ministry of Defence to question certain features that we have found and the reply has always been one which said, "Yes, we know about that but we do not consider it a safety hazard". That is not very much help.

1103. At the moment what is the planned time between changing the cores of nuclear reactors?
(*Mr Goodwin.*) I find that difficult to answer — something like three years. It is a question of the way the boat is used and the Polaris boat is used differently.

1104. In what sense? Speed on patrol?
(*Mr Goodwin.*) The amount of energy that is used up by the patrol pattern. Again I think that is a question the Ministry of Defence will answer better than I can.

1105. Are these planned times related to the refit cycles of the boat?
(*Mr Goodwin.*) Yes.

1106. You are content, that does not produce any great problems?
(*Mr Goodwin.*) No. We can design the plant so that it fits into the refit cycle developed.

1107. Going to this new steam raising plant, is that going to involve much additional capital investment on the part of manufacturers?
(*Mr Goodwin.*) No. The new equipment that is needed because of the change in design has already been supplied by the manufacturers in order to produce this prototype which is going to be built in Downreay. The only additional capital require-

ments would arise from a very different boat-build rate.

Mr McKay
1108. While you are dealing with the building of it, will your labour force increase because of the programme?
(*Mr Goodwin.*) No. Again let me explain that most of the labour force that we generate is in our own sub-contractors who make the hardware for the plant. Provided that the boat-build rate does not change significantly, there is no reason for significant changes in the labour force.

1109. There is no significant change for the sub-contractors?
(*Mr Goodwin.*) Not significant.

Dr Gilbert
1110. How far are you down the line with the first of these? Have you had an order yet from the Ministry of Defence for the first one?
(*Mr Goodwin.*) No. We had the order for the prototype and we do not yet have the order for the first of the boats.

1111. When would you expect to see that?
(*Mr Goodwin.*) I think that again is a difficult question to answer because there have been a number of programmes which have been discussed where there are possible options, and I think the earliest option required long lead orders in 1981, but we do not know at the moment which particular programme the Ministry is intending, or hoping, to follow. So again I come back to my 2½ year lead time on the boat programme.

1112. They have not discussed this with you?
(*Mr Goodwin.*) We have had endless discussions about the options but not about the chosen option.

Mr Cartwright
1113. You said the prototype was produced as a sort of proving operation for the whole of the new plan. How long does that process take?
(*Mr Goodwin.*) It takes a tremendously long time. The design process for this plant started in 1976 and we were talking about a replacement plant with a given specification, without talking about Trident or anything. The prototype build started — the earthworks started — about a year ago,

the plant will be operational in late 1984-early 1985, but it will then operate for, we hope, 20 years and during the whole of that period you are building up knowledge about the plant. The idea of the prototype is you are in advance of the boat at sea, so you meet problems there first and have a chance to modify the production programme.

1114. As far as the actual production programme itself is concerned, is there any critical point at which you have to have a minimum amount of knowledge of practical experience of the prototype before you can actually start work on the production models?
(*Mr Goodwin.*) There are a series of critical points, depending on which particular component you are talking about. So in parallel with the prototype itself, which is the total plant, there are a fairly large number of individual development programmes which are looking at particular components and so on. So it is not possible to identify a single critical point in the build-up of knowledge, and you go to the whole programme again. That programme has been planned on the basis of 20 years' experience. We know where the major areas of uncertainty are and they are being tackled early and eliminated one at a time.

Dr Gilbert
1115. The plant, I take it, will be transported complete from the manufacturers to Barrow. It will not be assembled at Barrow, will it?
(*Mr Goodwin.*) The plant as a whole is assembled at Barrow. There are major sub-assemblies that are made in the manufacturers, then transported to Barrow.

1116. In what ways are your new plants going to be superior to existing ones?
(*Mr Goodwin.*) Higher power, longer period between refuelling.

1117. Does higher power mean higher speed?
(*Mr Goodwin.*) This is a function of the submarine design, so I am afraid I cannot answer that question.

1118. If you put the new plant into another version of Polaris or something similar?
(*Mr Goodwin.*) That would mean higher speed because you would be putting the higher power in the existing hull size, but,

depending on the size of the submarine, then the constructors will require a given horsepower and we design to a horsepower. So higher power, longer period between refuelling — that is aimed to fit in with the planned refits; higher reliability which means that we will have fewer unscheduled halts; easier maintainability, which is the point this gentleman was asking about. You mentioned the question of noise. Obviously noise reduction is one of the things which is a design criterion. I am trying to choose my words carefully here — a higher demonstrable nuclear safety, if that is a satisfactory way of putting it: the question of nuclear safety is one which is always emotive and difficult to argue. We have not got a safety problem with the existing plants but the safety criteria have changed over the 20 years and therefore we need to demonstrate safety to a different level. This design intends to do that.

1119. Are these all criteria you are asked for by the Ministry of Defence?
(*Mr Goodwin.*) Yes. It was a debating process between ourselves. We established the design objectives in terms of what they would like, what we felt we could achieve, and put them all together into a package which became the contractual package.

1120. At what sort of cost?
(*Mr Goodwin.*) Can I have a more specific question please? The cost of the programme includes the design, development, building prototype and so on. Do you mean the total package cost?

1121. Let us start with that.
(*Mr Goodwin.*) If I gave an order of magnitude cost of the order of * * * I think that is the total programme cost.

1122. That would be including the plants for four or five boats?
(*Mr Goodwin.*) No. That includes the design, the development and the supply of the prototype plant at Downreay — one plant only — and all the safety work and design proving that goes with that.

1123. What will the unit costs thereafter be?
(*Mr Goodwin.*) I am afraid I do not have that figure in my mind at the moment.

1124. Could you give an order of magnitude?
(*Mr Goodwin.*) I think it will be of the

order of * * * * * unit cost, but that is —

1125. How does that compare again by order of magnitude in current prices with the existing equipment?
(*Mr Goodwin.*) I think the comparable figure is about * * * * * for the existing plant.

1126. * * * * * we are talking about an increase of * * * * *
(*Mr Goodwin.*) Thereabouts, but I would ask you not to take those figures too seriously. They are very much orders of magnitude.

Mr Cartwright
1127. On the question of availability of the necessary labour, is there any particular problem as far as Rolls-Royce is concerned, or any of the sub-contractors, with regard to the availability of the skills that are necessary for this programme?

(*Mr Goodwin.*) Provided there is no massive change to the boat programme, there are no major problems.

Dr Gilbert
1128. Thank you both very much. I hope you consider your visit worthwhile. Is there anything you would like to add to what you have said to us today?

(*Mr Pepper.*) Perhaps, Chairman, only to go back to the original point and say we would feel, although it is not in our parish, that the technology transfer associated with such an important purchase needs careful thought and perhaps lessons could be drawn from RR&A 20 years ago when it received the technical information on nuclear propulsion. But we only offer that as a suggestion.

(*Dr Gilbert.*) Thank you very much. We are obliged to you both very much indeed.