THIS WEEK - POLARIS

ROLL 28

INTERVIEW WITH REG FARMER

DAVID: Can you tell me about the Nuclear Warships Safety Commitee and how independent it is.

REG FARMER: I'm not sure what in fact you wish me to tell you. There are at least half a dozen people who are not directly employed by the Ministry of Defence. They're either professors or have recently retired from jobs such as atomic energy, and like myself.

DAVID: And what is your role? What is your safety role?

INSTRUCTION

DAVID: Broadly speaking, what is the job you are supposed to do?

REG FARMER: My expertise for the last thirty years or so, has been concerned

REG FARMER: (Continued) with developing safety techniques...

INSTRUCTION

DAVID: What is the job that the committee is supposed to do?

REG FARMER: To bring together advice that they would seek from different orders in relation to the safety of the operation of the fleet.

DAVID: And who are you responsible to?

REG FARMER: I am there at the request and on behalf of the Ministry of Defence. But I am otherwise lately from the Atomic Engineering Authority, but now retired.

DAVID: Who is the committee as a whole responsible to on its safety recommendations?

REG FARMER: The Secretary for State.

DAVID: That would be Tom King?

REG FARMER: Yes.

DAVID: Do you have a veto over what happens?

REG FARMER: No. The ultimate responsibility for any action is that of the senior operators who will take advice in relation to the circumstances that existed at that time.

DAVID: So you're essentially there to advise the Navy?

REG FARMER: Indeed. Yes.

DAVID: And is it possible for them to go against your advice?

REG FARMER: It would require a discussion which they would probably present to the Secretary for State, where differences of opinion due to different circumstances might apply.

DAVID: Now how do you go about your

DAVID: (Continued) work? Do you all meet at the Ministry of Defence, or do you go and visit Navy bases, or what?

REG FARMER: Both. We would have regular meetings, perhaps four, six, per year, normally at the Ministry of Defence. We would almost every year visit at least one site, where some exercise would be carried out to show the (word) of that site, to face consequences that may be unusual.

DAVID: Now on the question of decommissioned submarines, nuclear submarines and what to do with them, has the committee given any thought to this matter or been asked for a safety opinion?

REG FARMER: To my knowledge, no.

DAVID: Would you expect the Committee to be consulted before a decision is taken?

REG FARMER: Yes.

DAVID: So we can assume if you haven't been consulted a decision hasn't been taken yet.

REG FARMER: I believe that is so. Certainly we have not been consulted.

DAVID: Has the committee itself had any discussions among its members about what might be the best route to get rid of old nuclear submarines?

REG FARMER: Not on the basis of a committee discussion or part committee discussion, but between experts concerned with safety technology, we would from time to time discuss the matter.

DAVID: And have you as an individual, as a scientist who's close to this, for example, got an individual view about what might be the best route?

REG FARMER: I am aware of the difficulties of choosing any route. The route I would prefer would be to sink in the deepest ocean. But that seems to me totally impratical, because other nations are also concerned. So it would be my opinion that they could be safely stored for some time in a fairly quiet piece of coast. I see no harm to man or beast for many many many years.

DAVID: Why do you say they could be sunk at sea if other nations are opposed to this?

REG FARMER: I didn't say they could be. I say other nations would be concerned. Whereas I think it is the best technical solution, I do not believe it is a practical one.

DAVID: Do you then reject the concerns of other nations about sea dumping?

REG FARMER: No, indeed not. I would be

REG FARMER: (Continued) concerned with what they say, and whether the situation is known to them as it is known to us, in that we would have different situations as a sea lock nation and a large land based nation might have. The subject would be up for discussion.

DAVID: But your view as a scientist is that it would be perfectly safe for us to dump at sea?

REG FARMER: You're talking about submarines, aren't you?

DAVID: Yes.

REG FARMER: Yes. My answer is yes. I believe it's absolutely safe.

DAVID: But you accept that it's impractical because of the opposition...

REG FARMER: I do. Yes. Yes.

DAVID: Now the second alternative which

DAVID: (Continued) you would prefer, how would that be safe?

REG FARMER: The fuel is removed from the reactor. You would then have a steel shell for the submarine, and inside that other steel structures, which have been partly irradiated, but would remain stable, and I see no environmental attack on that vessel, for in my view hundreds of years.

DAVID: So you would be content to leave them stored above ground indefinitely?

REG FARMER: I'd be content to leave them while still further knowledge is gained. I do not believe we can always solve problems which have some commitment over hundreds of years, at the present time. Time is required for more information and for history to build up.

DAVID: Why don't we bury them as the

DAVID: (Continued) Americans are doing?

REG FARMER: I think that is adding to the problems, because I would rather have them available on - tied alongside, than in a hole where we wouldn't know what is happening to them.

DAVID: And why don't we cut them up, as has been suggested, and put them in a deep repositary at Sellafield?

REG FARMER: This involves additional work with radioactive - enduced radioactive material on the steel, bringing it out into the open. I believe it is much safer left inside the vessel tied alongside.

DAVID: Because people would incur radiation exposure cutting them up?

REG FARMER: In doing it. Yes. Yes.

DAVID: If I can turn now to the technical defect which has led to the retirement of some of the submarines, and may lead to the retirement of more, what part has the committee played in assessing the safety of the submarine since these defects were discovered?

REG FARMER: It has had reports from the staff who have been working on the problem, mainly from Rolls Royce Associates, but with a sympathetic understanding from the rest of the Ministry of Defence staff, appropriate to the job. We have listened to the evidence as it's been forthcoming over the last six to eight months at least, and I've been reassured by the progress that has been made in this rather complicated but important research effort. And I believe extremely good results are coming forward which will help us to resolve this problem.

DAVID: When the problem was first discovered the defence committee and the public were told that it had safety implications. Now what this means when we're talking about cracks in the pipework which has been published as the cause, is an accident to the reactor circuit. Could you tell me why that is a cause of safety concern, what might happen if the very worst went wrong.

REG FARMER: It leads to the discharge of the cooling water from the reactor, through any broken part of the pipe system. This would require the reactor to be reduced in power, this is difficult operationally, of course. And in the long run, to run at lower power and until it could be brought back to base, and then the long term repair would be undertaken.

DAVID: If this repair work wasn't done, how great would the risk have

DAVID: (Continued) been that a fracture to the pipework might take place in port or while proceeding into port or out of port?

REG FARMER: It would be difficult to say that one situation is worse or better than another. Certainly entering port she's usually running at fairly low power, and that is a safer state to be in than high power. Otherwise if I continue your last question, quite often the piping system is split into at least two parts to the left and to the right. Usually faults of the type that we have been discussing would occur on one side or the other side, and the affected side would be isolated. But this does lead, as I say, the reactor to run then at lower power. But it could be run safely under these conditions until further work has been done.

DAVID: It's been said to us that the

DAVID: (Continued) risk is ultimately what's called a maximum design accident, that there could be a wholesale structural failure of the pipework and this could lead to a series of explosions and ultimately to melt down. Now how probable is that scenario?

REG FARMER: So low, in my opinion, as to be near absolute zero, lower than any number I could put my confidence on. Extremely low indeed.

DAVID: Does that mean that such a maximum design accident can't happen?

REG FARMER: Can't is an impossible word to use. I say it is lower in risk than anything that I can reasonably calculate.

DAVID: Why is it then that the safety committee's imposed restrictions on the use of these submarines, for example that they've been

DAVID: (Continued) given short term safety certificates voyage by voyage? Is this to monitor the cracks?

REG FARMER: Partly to monitor, but whereas you just led me into discuss maximum credible accidents, previously what we talked about was a small credible accident. And the small credible accident which is a limited crack or pipe split is one which can be dealt with and isolated until further work is done.

DAVID: So what you're saying is that the most credible danger of an accident is a relatively small split..

REG FARMER: Yes.

DAVID: ... of the kind you've described, and what you're saying is that the maximum design accident is only a theoretical possibility.

REG FARMER: I have never had very much faith in the maximum design, because the maximum changes from time to time. And it's usually not a very useful concept to have. I'd much rather work in the credible, even if it is highly unlikely, but express views to that unlikeliness.

DAVID: It's been said to us that if you have a failure in the pipework of the kind we're talking about, the water which is under intense pressure flashes to steam instantly, and causes what is in effect an explosion which may rupture the reactor compartment. Is this accurate?

REG FARMER: Not an explosion, no. A depressurisation is the sort of thing that has happened when relief valves blow. And you know on boilers many years ago, from time to time you'd hear the hiss as the relief valve blew. Well, that is high pressure water escaping through a

REG FARMER: (Continued) restricted opening, which is precisely the effect we're talking about in this limited accident.

DAVID: There's no danger then of the entire pipe fracturing at one of these wells and releasing the steam in an explosive form?

REG FARMER: In my view, no. It is lower than any probability that I would care to assess.

DAVID: Why then has the safety committee banned nuclear submarines from visiting foreign ports until these cracks have been repaired.

REG FARMER: We would not like any size of accident to happen at all, particularly in a foreign port. And we're talking about the possibility of a crack which has penetrated more deeply than suspected, and starts leading to this depressurisation and isolation of the affected part

REG FARMER: (Continued) that I had described. We would not - we would not like that to happen in some foreign port. If at sea then the captain would slowly bring the vessel back to berth.

DAVID: Aren't people likely to say we wouldn't like it to happen in a British port either.

REG FARMER: Once we've arrived at a British port the reactor is either shut down or reduced to very low power level. So the crack is very much less likely to occur once she's come home.

DAVID: But when you visit a foreign port surely you - the reactor is reduced in power as well.

REG FARMER: Not necessarily. It may be kept at power ready to move out again. When she comes to a British port quite often she is laid up for some time for .... or for other activities, research, inspection and the

REG FARMER: (Continued) like.

DAVID: If I could just pursue this for a moment. When a submarine visits its home port, such as (Fass Lane?) on the Clyde, surely it comes up the Clyde under full reactor power until it gets to the port.

REG FARMER: No, reduce the power.

DAVID: And it comes...

REG FARMER: It is running at reduced speed and can run at reduced power from the reactor.

DAVID: Have you ruled that the submarine should approach (Fass Lane?) or British ports under reduced power in order to reduce the risk of such an accident?

REG FARMER: The final decision will be made by the captain at the time depending on circumstances, but it is generally understood that

REG FARMER: (Continued) in normal circumstances it would be cutting down in power to run when tied up to run at quite a low power level, just to keep steam alive.

DAVID: People are bound to say though that there's not that much difference between visiting a foreign port and visiting a British port, and that while reactor power levels may vary, the risk of an accident is still there. Would you reject that point of view?

REG FARMER: I reject the point of view that they are both comparable situtions. In the British port there was always work to be done. There's staff available on the site. At a foreign port you're in to welcome the mayor and the town council if you like, but be ready to move in one day or two days, or as necessary. It's to show goodwill.

DAVID: How confident are you that the repairs which are now being undertaken on those cracked pipework are going to be successful?

REG FARMER: I'm extremely encouraged by the way in which this research work has gone on at Rolls Royce, and the work which is now planned to bring it into effect on the submarines, piece by piece, one by one. I beileve that this is - will make it almost certain that the cracks can continue to be monitored and we've found to be under reasonable control.

DAVID: And can you guarantee that the repaired boats will be operational for the rest of their planned life, in the case of the Polaris boats, for example, until Trident comes in.

REG FARMER: I would expect that to be so, but I cannot guarantee. The operation of any submarine is

REG FARMER: (Continued) still dependent on inspection from time to time to get the latest knowledge on the health of that submarine.

DAVID: It's true, isn't it, that two of the submarines that have had these cracks, Warspite and Churchill, have now been withdrawn, scrapped. It's been said to us that there's a double standard operating, that the hunter killer submarines which have these cracks are being withdrawn, whereas the Polaris boats are not being withdrawn, because it's necessary to keep them on station, to keep the deterrent going. Would you accept that there's a difference in standard there?

REG FARMER: I am not sufficiently familiar with the operational requirements of the Navy to be able to answer the question.

DAVID: Let me put it this way then. As a distinquished scientist who's

DAVID: (Continued) a member of this committee, are you satisfied that the Polaris submarines are entirely safe to operate with these cracks being present or potentially present?

REG FARMER: I am absolutely confident that with the inspection procedures which have been followed, and will continue to be followed, that when any one of these is released from operational duty, with a particular programme in mind, then that is fully up to the safety standards that we would expect.

DAVID: There have been occasions though when the Safety Committee's been unwilling to grant safety certificates to some of the submarines when the Navy would have preferred them to be declared operational.

REG FARMER: I'm not certain that I could go along with the second part about whether the Navy preferred it or

REG FARMER: (Continued) not. Certainly it is true the Committee has from time to time recommended that a particular operation should not be carried out.

DAVID: And it is true that at the moment not all the Polaris boats have safety certificates?

REG FARMER: That is true, yes.

DAVID: Is it possible for you to say how many of them do have safety certificates?

REG FARMER: No, it's not that I'm hiding anything, I'm not, so I don't know what the number would be.

DAVID: But you would accept that they all only have short term safety certificates and that they're being carefully monitored from voyage to voyage.

REG FARMER: That is true, certainly. Yes.

DAVID: This is a defect which was

DAVID: (Continued) discovered very late in the life of these submarines, and was quite unexpected. I think you and your committee would accept that. Under those circumstances how can you guarantee the repair, how can you guarantee the future of the boat?

REG FARMER: I would be more positive in my reply here, in that the programme of inspection which had been in operation for many years did in fact find the crack. I think that was wonderful news that it found it. And so we have confidence that continued inspection to a specific programme will still keep us in touch with these events. It is not unusual for high pressure steel circuits to be inspected, and sometimes under special conditions to find that there is a crack. There are then procedures for following up the crack growth, linking those with the

REG FARMER: (Continued) operational history of the vessel, temperatures, pressures, frequency of movement and so on, and then coming to conclusions as to what to do in the future, either changing the material or progressively changing the environment. These are lessons to be learnt and are being learnt.

DAVID: But it is a fact that no-one had any knowledge the cracks were developing in these welds until new inspection techniques discovered them.

REG FARMER: But that is generally to in the inspection of steel vessels. You don't say there is a crack line behind here until you find it. But you always believe there is some chance that highly stressed steel vessels might show cracks in areas by stress intensity. It is unlikely, but we look for them.

DAVID: I'd like to pursue one technical point there. It is a fact that the prototype reactor at Dounraey was built with one pipework assembly of low alloy steel, while the Valiant class submarines, and the Polaris submarines were built of stainless steel on the American pattern. Now it's been said to us that one result of that was, however much you round the test reactor, you are never going to find out what happened to the welds between stainless steel and mild steel, because your prototype is made of a different material for various reasons. Doesn't that mean that you were, as technicians, running in the dark?

REG FARMER: To be fair, I don't think that I am fully able in confidence to answer the question. Not that I am ducking it, but you are asking a question which could be directed to somebody concerned with stress analysis and steel

REG FARMER: (Continued) alloys. My job is often to ask the question because I can't always give you the answers.

DAVID: Let me put it this way then, if I can. What explanations have been given to you and the committee as to how this design defect, for that's what it is, arose in the first place? Was it bad engineering, poor technology, or an inability to predict what was going to happen to stainless steel welded to another metal in this way.

REG FARMER: It moves towards the latter, not only in regard to the choice of metals and metal alloys, but also in relation to the environment in which they're operating.

DAVID: Could you expand on that a little?

REG FARMER: Well, the environment consists of water being circulated with

REG FARMER: (Continued) variational pressure and temperature. Also from time to time shutting down and emptying the system ready for maintenance or inspection, then refilling it. And at different time rates and under slightly different conditions. So these often influence the fact of whether cracks will come or not come. So we learn more not only about alloys, but also about the environment.

DAVID: It's been said to us, and the facts would seem to bear it out, that one of the reasons these cracks may have developed is that all these boats have been run on beyond their original design life. I mean that does happen with machinery often, but it is a fact that they were designed to last twenty years, and they're now being made to last longer. How much do you think that's a factor in this problem coming up?

REG FARMER: Not in isolation an important factor. I say we are finding out that it's not only the lifetime, but what is squeezed into that lifetime. And sometimes you might have a system which over ten years has had more adverse situations arising, which might affect the crack growth, than another vessel which has operated for twenty years. And this is part of our desire to understand more about the phenomina with the inspection and tests going on, in order that we can resolve this.

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INTERVIEW WITH REG FARMER CONTINUED

DAVID: What then do you feel has been the main cause of these cracks suddenly appearing?

REG FARMER: If I just consider the question one moment. They haven't suddenly appeared. It is in recent times that they have been found. Some of them have, we believe, progressed slowly, and this is not unusual in a highly stressed situation. What I think is extremely encouraging is the fact that we have found these, and have now had many months following in under research conditions what can of affect the crack and the crack growth.

DAVID: Let me put it this way then, having discovered the existence of the cracks, what do you think is the main cause of them having occured in the first place?

REG FARMER: There's no simple answer, because it isn't a simple problem. One could have avoided that with slightly different alloy conditions. One might have reduced it considerably under slightly different running conditions, that is the ways in which maintenance is carried out when it's carried out. So there's a combination of circumstances, it's not a single one.

DAVID: However long they'd been there, when the cracks were discovered it led to urgent action. How prominant a role did the safety committee play in ordering that the boats be inspected, and a pretty elaborate programme of research and repair put in hand, which did disrupt the Navy quite a bit.

REG FARMER: I think it has been good that there is a format which these things can be discussed, and at which are present people who are

REG FARMER: (Continued) independent in their lifestyle, and their finances from the operators. We have put in very strong recommendations, and have listened on many occasions to the nature of the work carried out and the progress being made. So I think it has been at least encouraging for the people to decide what to do, and how best to do it. We have learned a lot from this association.

DAVID: Why do workers have to be exposed to extra radiation by trying to repair these welds inside the reactor compartments?

REG FARMER: It is important to get - for part of the work to get fairly close to the system which is slightly radioactive. As soon as possible, when the instruments are applied, the people are allowed to retire and take further action by remote control. And a lot now is being done by remote control to reduce

REG FARMER: (Continued) the radiation dose to the people concerned. But there are times when they do need to approach with a time limit, and put instruments in the system or carry out more close examination than can be done remotely. But this is still under control as to the limit to which they are exposed, following national recommendations.

DAVID: It's been said to us that one of the problem welds is at the junction of the primary circuit pipe with the pressure vessel itself. Now surely that's a very radioactive spot.

REG FARMER: Not very. You can still get close to it, but not for a long time.

DAVID: You would accept though that if it's necessary to have people to have people to go into the reactor compartment and work on it at all, they are getting

DAVID: (Continued) extra radiation doses.

REG FARMER: Yes. But within the limits for - which would be normally given to an operator in many other circumstances. They're employed at jobs at which radiation may be present, but under strict control.

DAVID: Why isn't it possible to remove these parts and repair them outside the reactor compartment?

REG FARMER: This would take a very large effort of people getting even closer to the reactor in order to do it.

DAVID: So there'd be even more radiation exposure if she...

REG FARMER: Certainly. Yeah.

DAVID: And it would be physically difficult to get them out?

REG FARMER: It is difficult, but possible.

REG FARMER: (Continued) But the simple steps to be taken at present are to try to ensure that crack growth is as much under control as we can get it, and suitable for the vessel to continue operation. That is what we're still trying to establish with a high degree of confidence, under what conditions can they continue to operate with a very slow controlled crack growth.

DAVID: But how do you control the growth of a crack?

REG FARMER: By controlling the conditions under which the vessel operates.

DAVID: Does that mean you limit its speed or... Does that mean you limit its speed or limit the stress that's put on the reactor, or what?

REG FARMER: No. It's maintaining the proper chemistry of the water system. What does have a PH, and it needs to be kept under control,

REG FARMER: (Continued) both during normal operation and during maintenance. These are one of the factors involved in the future operations.

DAVID: But the water you used in the coolant circuit is demineralised normally, isn't it? I'm just trying to establish what special measures are being taken.

REG FARMER: I could not tell you, in that I'm not a chemist. But all I'm saying is chemical control of the system is an important part.

DAVID: We understood that you were seeking to have a physical control as well, that sleeves or glands are being - collars are being welded on to the suspect areas, like a sort of patch. Is that going to protect the pipe against...

REG FARMER: It would be difficult if you were leading me through a number of sequences of things which might be done. There's a number

REG FARMER: (Continued) of possibilities that might be done. One of the possibilities is to ensure that even the crack propogates. It will not suddenly lead to a very high stress level in that part of the pressure system. That's limiting the break. There are many - well, there are at least a number of things which have been under consideration, some of which will be tried. But the whole subject is still under close review, and still research is being carried out.

DAVID: So there hasn't - there isn't a final solution yet?

REG FARMER: Any solution will always be progressive. In other words I'm questioning your use of the word final. You continue to operate under conditions which at that time seem right for that vessel. And it may not be the same solution. It will be following the same trend, but the solution may differ.

DAVID: The reason I'm pressing this is that some people have said to us that if you discover a design defect in a car, for example, the manufacturers will recall all those cars, and that considering we've discovered a design defect in the submarines, the zero risk option, if you like, would be to recall all the submarines, to ground them. Why don't we do that?

REG FARMER: I do not regard this as a design defect. As I mentioned earlier, there are a number of factors which lead to cracking under high pressure stress steel. We are learning about these in the particular combination that apply for this operation for these submarines. And so it's not a design defect in an absolute sense.

DAVID: It's a design defect in that sense that all the submarines with that design of reactor, which is quite a large group,

DAVID: (Continued) have either got that defect, or may get it.

REG FARMER: Because they're operating under similar conditions.

DAVID: And they're of a similar design of reactor.

REG FARMER: That's right, yes. It's a combination, I repeat, of the circumstances, that it could have been possible that under different conditions this design would have been entirely successful, and worked for twenty to thirty years without a crack. So it's not simply a design...

DAVID: I understand that. But you would accept that all the submarines of that design have either got that defect, or are prone to that defect.

REG FARMER: There's a probability that this could occur, but there are many systems which have not yet shown

REG FARMER: (Continued) a crack. Many of these fleets - many of the fleets you're talking about. So your generalisation may not be right.

DAVID: But your concern is that they may show cracks in the future.

REG FARMER: They continue to be watched, yes.

DAVID: Wouldn't the course that was absolutely free of risk then be - ground the whole fleet of that type, permanently.

REG FARMER: I believe the risk is so low that that is not a necessary requirement, otherwise we might have said so. Additionally quite a lot of things are done because of the benefit either singly or collectively to the nation in so doing. I do not believe that we can live to a zero risk where zero is nothing at all.

DAVID: Would you accept that there's any possible substance to the charge that you're under pressure to allow the Polaris fleet to operate under whatever restrictions, because we need it.

REG FARMER: I don't feel - I've never felt under pressure as a member of the committee. I've always wished to be reassured that the balance of risk, as I now assess it, is consistent with the oeprational duties or the limit there of, which are currently proposed.

DAVID: Why hasn't the committee, or its members, given evidence to the defence committee to reassure them about this matter, and why don't they make public statements about this matter? Because people have said to us this committee's not accountable to the public.

REG FARMER: We are responsible, as I said,

REG FARMER: (Continued) to the Secretary of State, and it would be up to him and the staff of that department to decide where to go and how much to do. It would not be for the committee alone. We are responsible to the minister.

DAVID: I'd just like to clarify one point about the accident scenario, if I may. It's been said to us that the contents of a submarine, PWR reactor, consists of quite a sizeable amount of radiation, and the figures which the Navy itself uses for the likely amount that would escape in a maximum design accident are quite large. I think it's ten to the sixth iodine 131 and ten to the seventh other fission products. Now people have said to us, if that inventory did escape, if the submarine hull was breached, and it went into a plume in the air, and there was an exposion, there'd be a big burst of energy

DAVID: (Continued) behind it, and it could spread all over the Clyde, say almost as far as Glasgow, perhaps, for all we know, and that more should be done to alert people to those dangers. Now what's your view of that?

REG FARMER: I believe the risk is so low it is almost imaginary. But people in assessing what would happen after accidents do put in figures which may be a thousand, ten thousand or million. Without any assessment at that time of whether it could happen or not happen. That part of the exercise is purely a theoretical exercise, in my view it's not very helpful.

DAVID: What would you say to the sailors, and the families of those sailors who have to sail in the nuclear submarines that are subject to these defects. Could you assure them that they're completely safe at all times, despite the existence of

DAVID: (Continued) these cracks?

REG FARMER: Yes. As I said earlier, I think in our discussion, my assessment of the risk is that it's lower than anything I could reasonably calculate. It is never zero, but people do not - most people do not work in a zero risk environment any how.

DAVID: But if the risk is so trivial, why are we going to so much trouble? Why are we spending so much money? We've scrapped two submarines after spending a hundred and sixty million on it, they've been banned from foreign ports. There's a really very expensive and innovative programme of research going on to try and find a way of mending these things. Why go to so much trouble if there's no risk?

REG FARMER: You have put together, I think, at this stage, both the frightening risk of ten to the sixth... which I say is so

REG FARMER: (Continued) incredible as not to worry me, alongside the small accident in which there's a crack in a pipe, which does not lead to exposure to people of radiation, but does lead temporarily to the loss of the submarine in service. It has to be withdrawn and repaired. And if we want to keep a fleet active, then we have to reach the stage where these cracks are both identified and dealt with in such a way that they will not grow, as a rate which is of any concern to us.

DAVID: But you've come to the point of saying to me, this defect has no safety implications. The only implication is that there might be a little hiss of steam out of a valve, and it would put the submarine out of service, but there's no danger at all.

REG FARMER: That is our belief in the way in which this accident - this crack could develop, develops to a

REG FARMER: (Continued) stage where a limited loss of high pressure water, shutting down the once part of the system, operating with the other half of the system until the vessel is brought back and repaired.

DAVID: Yet the Ministry of Defence itself says this fault has safety implications. They're the MoD's words.

REG FARMER: Well, that is a safety implication, that unless action is taken to do this, and to be ready even if the crack occurs and develops, and the steps are then taken as already discussed and agreed with the Navy. It's limiting the effect of the accident.

DAVID: So the theory that these cracks could spread catastropically, there could be a catastropic failure of the pipes, there could be a major accident, this is all fanciful?

REG FARMER: It is the extreme edge of my belief of the - of what would happen if it developed.

DAVID: Can you give us an indication of what sort of expenditure you've demanded, in effect, to rectify these faults. What's it all going to cost us?

REG FARMER: I couldn't - simply that I don't know.

DAVID: But it is going to be expensive?

REG FARMER: Oh, indeed, yes. Yes, indeed.

DAVID: And from what you say we're not completely certain of a technical solution yet?

REG FARMER: We're not confident of which of the various routes to follow, which will be successful in the long term. We're keeping some options open with the ability both of living in the extent to the break of its isolation, and

REG FARMER: (Continued) the ability now to reduce the rate of crack growth or crack damage in all the surviving vessels.

DAVID: Final question. Is there a possibility that it'll just prove technically impossible to keep these submarines on the road, that eventually in the next few years, they really will have to be withdrawn.

REG FARMER: I do not believe that is so.

DAVID: Can you guarantee that it's so?

REG FARMER: As far as my words - if you mean a guarantee if they have any value, I'm sufficiently confident, and I fully believe that to be true.

DAVID: Thank you.

INSTRUCTION

DAVID: Can you just explain to me, in your own words, the nature of

DAVID: (Continued) the problem, where it is, and what the options are for fixing it?

REG FARMER: I find it difficult to answer this as a sort of local question, because we've been discussing it round in various ways. As you yourself have put in the form of a question, there is a mismatch between two alloys which are part of the high pressure, ... system. Cracks begin to grow. This is not surprising under some circumstances. We have been trying to find the circumstances which lead to growth or accelerated growth. We believe that we are finding answers to that, but meanwhile we have to have further work done on finding which of the submarines are affected. And at what time do they need to be removed from the service for local treatment, and ultimately a decision will be made, both about the operating conditions, which I

REG FARMER: (Continued) say are environmental, due to PH control and many other factors, and the length of time that service compared with the length of time in maintenance. There are many factors there to be considered.

DAVID: Why was it necessary to take two submarines out of service after a hundred and sixty million had been spent on refitting them?

REG FARMER: That I can't answer. Sorry.

DAVID: Wasn't it a recommendation of your committee that something would have to be done about the cracks in those submarines?

REG FARMER: It could well have been, and I am only giving an impression of what I believe was the current thought at that time. But the cost and the effort employed in correcting the fault that was then found was hardly justified in doing it, although, as I said, there had been.. But the

REG FARMER: (Continued) servicing had already gone on, and they were being well serviced when the assessment was made as to what to do about the crack. I do not think there's anything particularly logical, it was a question of timing.

DAVID: Have you, or members of your committee ever discussed with the Secretary of State whether it might be necessary to take the Polaris fleet out of service?

REG FARMER: Again, I can't answer. That would be the privilege of the Chairman of our Committee who does discuss... And I would not otherwise be able to answer it, I don't know.

DAVID: Are you aware of any discussions that have taken place about it?

REG FARMER: Oh, I am certainly aware of the discussion. But after some serious discussions at our

REG FARMER: (Continued) meeting, our Chairman does report to the Secretary of State, and has done so over the last few months.

DAVID: And have you ever discussed between yourselves whether it might be necessary to take Polaris out of service?

REG FARMER: Not as a bulk decision as that type, only with respect to specific boats. Knowing what their history is, and what we know about them at the current time.

DAVID: Do you feel still any of those boats might have to be taken out of service?

REG FARMER: I think it unlikely.

DAVID: But not impossible?

REG FARMER: Not impossible, no. Oh, no. No.

DAVID: Thank you.

INSTRUCTION

REG FARMER: We're confident as to the factors which made contribution to it...

INSTRUCTION

REG FARMER: Because the length of time in service, the length of time at which the waters... The condition of the water, when refilling, the PH of it.. These - because they vary with the history of each of the submarines, when a submarine is taken in and examined, it is then weighed up against these factors of what was the history over the last two or three years or... And then the information of this is then put together and we are trying to decide the best way in which to have chemical control of the water and good operating conditions.

DAVID: You're talking about water

DAVID: (Continued) corrosion, in fact?

REG FARMER: Corrosion as a result of - that is an oxygen - corrosion due to oxygen liberated in the system, yes, which people then try to clean up by having it absorbed - chemically attached otherwise.

DAVID: Have I understood this right then? I mean there's really sort of two tracks. There's one - you're trying to work out the chain of events which is causing the cracks to grow so you can prevent it by treating the water.

REG FARMER: That's right.

DAVID: And at the same time you have to patch up, as it were, the existing tracks, mechanically, just...

REG FARMER: A few cracks might be treated in such a way, as I think you mentioned, to prevent the pipe,

REG FARMER: (Continued) if the crack continued to event the split of the pipe then damaging the adjacent equipment, which is putting collars around...

DAVID: Right.

REG FARMER: The other one which might have very limited application, as I said, cutting out. Extremely difficult, requiring quite a lot of man hours and time to do it. And I think we shall find different solutions, or different vessels,and there might only be three to five vessels which currently are thought to need any repair, or any work done on it. For those that have small crack growth at the present time, we might believe that in the future the crack growth would only be one quarter or one third of what it has been in the past. We say we will now live with this for another five years and then re-examine.

DAVID: Right. You've got slightly ahead of me. I don't understand how you can cut out the stainless steel pipe where it's at the reactor pressure vessel junction.

REG FARMER: It isn't reactor pressure vessel.

DAVID: Well, it is what, the steam generator?

REG FARMER: It is a heater exchanger with a pipe that runs from it. One from the top - one to the top.. And we're dealing with the heat exchanger which is remote from that, which is not attached to a remote from the reactor vessel.

DAVID: Well, perhaps I misunderstood you, but I thought that you actually said that they were at the - at the junction at the pressure vessel end, as well.

REG FARMER: No, I didn't say that.

DAVID: You were saying these are just at the steam generator end.

REG FARMER: That's right, yes. Oh, sure, yes. Yes.

DAVID: Yeah. Well, perhaps you'd make that clear...

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INTERVIEW WITH REG FARMER CONTINUED

DAVID: Can you tell me exactly where this cracking is occuring.

REG FARMER: It's not so easy to do it by words instead of by drawings, but it is in the heat exchanges, towards the bottom of one of the heat exchanges, and it is, as already mentioned, a point at which the alloy system changes from the inside, going towards the outside of the heat exchanger.

DAVID: And it's not happening anywhere else?

REG FARMER: No.

DAVID: Can you tell me what you're trying to do to stop this problem getting worse, what you're trying to do about the courses of this cracking.

REG FARMER: As you know, and as I have

REG FARMER: (continued) mentioned, many of these reactors have - many of these submarines have been inspected over the last year, to find out both the extent of crack growth, and under what conditions have they been operated over the last few years. All this information is being put together. There are few cases in which the crack growth has been of such a size that we feel that something should be done about it. And possibilities have been discussed as to whether to cut out, or whether to just reinforce the immediate surroundings of the crack. This would be required only for a very limited application, but when and where is not yet decided. The other important aspect, which applies to any other vessels, is to have an adequate study of the lifetime history of the system, in order that in the future we might have better or more effective control

REG FARMER: (Continued) of the conditions under which they operate. That we believe could apply to ninety per cent of the vessels now operating, and in my view lead to a very much reduced crack growth rate, possibility to a crack growth rate which could be tolerated under inspections for the next five to ten years, and we should learn even more about it.

DAVID: So what you're saying is that the worst effected boats you're trying to patch up, and for the rest you're hoping to find out what's gone wrong with the water supply that's causing it.

REG FARMER: As one of the vectors, yes. yeah.

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