SENATE

A DISSENT FROM THE REPORT OF THE STANDING COMMITTEE ON FOREIGN AFFAIRS, DEFENCE AND TRADE

Reference: The adequacy of current contingency planning by Federal and State authorities to deal with the accidental release of ionizing radiation from visiting nuclear powered or armed vessels in Australian waters and ports.

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CONTENTS

PAGE

Preface

In dissenting from the conclusions and recommendations of the majority report I have not attempted to include all of the issues raised by the large number of submissions with concerns about the safety of visiting nuclear-powered and nuclear-armed warships. Beside many well-developed arguments there is much disputed material in these submissions, including matter that is anecdotal, officially denied, or differentially interpreted by official sources. I have chosen to concentrate upon the evidence - largely from official sources - that was accepted by the Committee in the preparation of the majority report and have confined my discussion - as far as possible - within the ambit of the terms of reference.

Furthermore, I have not sought to identify every point of disagreement with the majority report; this could have produced a dissenting report as bulky and impenetrable as the majority report itself. It has been my intention to concentrate on the evidence and arguments that I consider basic to the Committee's enquiry and to make this dissenting report as brief and accessible as possible.

For the sake of economy I shall refer to the majority report as "the Report" and the remaining members of the committees of the thirty-fourth and thirty-fifth Parliaments as "the Committee".

I have appended three extracts from the Hansard evidence to this dissent. The first (Appendix 1) is part of the submission of the Australian Atomic Energy Commission, now the Australian Nuclear Science and Technology Organisation (ANSTO), dealing with "mean annual severity" calculations which I have included for the convenience of readers following my argument on these calculations.

The extracts in Appendix 2 are two samples of evidence under cross-examination by the Committee - in both cases the Committee of the thirty-fourth Parliament. I have included Dr Speed's evidence because I feel many of his pertinent comments and observations have been ignored by the Report and also because he is an expert witness with an obvious ability to translate technical concepts into a form that lay readers can understand. The second extract in Appendix 2 is the cross-examination of Professor Jackson Davis which refers to some basic issues not often mentioned in the Report. Readers of this part of the evidence may notice that the discussion is - at the beginning - quite spirited and I should explain that Professor Davis' appearance was preceded by extensive media reports forecasting his evidence, which may have coloured the attitude of Committee members towards him.

Both of these extracts, especially the latter, have theatrical qualities that may give readers some insight into how a Committee works. I should also add that questions to witnesses are prepared for Senators by the staff and technical advisers to the Committee, although obviously members sometimes made up their own.

I have chosen not to quote from the <u>in camera</u> evidence, primarily because I find most of the content unremarkable, not very secret and not very reassuring on safety issues. The exceptions to this are two points of evidence where a Department of Defence expert appears to be evasive - although confusion and a poor memory is a possible alternative explanation. One of these instances relates to Tomahawk cruise missiles, the other to the terms of a United States assurance to Australia that is still classified. This assurance was the subject of a question without notice that I asked Senator Robert Ray (representing the Minister for Defence) on the 29th of September 1988. Senator Ray's answer stated that Australia did not have a confidential U.S. assurance on nuclear weapons accident liability. Senator Ray corrected his answer on the 12th of October by stating that Australia did have such an assurance, dating from 1976.

During the in camera evidence taken on the 16th of December 1986 some of the text of this assurance was read into the transcript by the Department of Defence witness (pp.1-2), but when the same man was asked a direct question relating to "agreements" on nuclear weapons safety on the 17th of June 1988 the answer was "No" (we have no agreements) (p.29). This was later qualified when the witness "remembered" the only assurance Australia has on nuclear weapons, but he then referred to it in very general and dismissive terms without reading any of the text of the assurance (pp.37-38). I suspect that the sensitive material in the assurance is contained in the first sentence of the second quotation on page one of the 1986 transcript. I include this reference and the page numbers for the convenience of Senators with access to the documents. I should also point out that only Senators belonging to the major parties were present at the 1988 hearing.

If the Department of Defence witness was evasive then this evidence supports my argument in the Introduction on secrecy in the context of the alliance with the United States.

1. Introduction

The Report of the Senate Standing Committee has implications that extend beyond the accident hazards presented by nuclear-powered and nuclear-armed warships visiting Australian ports; it reflects badly upon the ability of our parliamentary institutions to protect the best interests of the Australian people. Even Australian citizens who are not immediately affected by warship visits, or those who willingly accept them whatever risks they present, should be concerned about the nature of this report.

I believe that the basic problem is not the competence of the Senate Committee, but rather its lack of the political will to properly address a contentious issue upon which the major parties have considerable agreement.

The first symptom of this deficiency in the Committee was its determinedly narrow interpretation of the terms of reference to exclude any substantial treatment of the cost-benefit argument that underlies warship visits, despite the fact that the majority of the submissions clearly assumed a cost-benefit value quite at variance with the assessment of the Government and the Opposition.[1] This gives parts of the debate presented in the Report a shadow-boxing character, where differing technical propositions compete in place of the fundamental disagreements.

The second symptom is an unwillingness to come to terms with the apparently paradoxical Australian position on nuclear arms. Australia is a nation that is not nuclear armed and has a strong - if mostly rhetorical - posture on nuclear disarmament. At the same time, it has a close military

1 See Ch.3 para.15, where the Report states that the Committee is "prepared to accept some degree of risk"; how much and why is not made entirely clear.

alliance with a nuclear-armed superpower which deploys its nuclear war-fighting machines in Australian harbours.

I believe the Committee is concerned about safety because it would be absurd for a country basically opposed to nuclear arms - and the machines that deliver them - to suffer damage and casualties from a nuclear-powered warship or nuclear weapons accident. But Australia also has a traditional commitment to the U.S that verges on bondage. Even Australians who doubt the usefulness of our alliance with the U.S fear the consequences of any retreat from this commitment and so the Committee was strongly motivated to find a safety formula that did not compromise the access of the U.S. Navy to our ports.

(a) Nuclear-powered warships

It is important to note at the beginning that all the nuclear-powered ships that have visited Australian ports have been warships of the U.S. Navy and they were all almost certainly nuclear-armed.[2] Both the power systems and the armament are the subjects of military secrecy.[3]

The Committee has inherited the contingency planning policy that currently applies to nuclear-powered warship visits and the Report shows no serious consideration of the option to abandon all safety planning. Yet this is the official advice that Australia receives from its trusted and close ally, the United States. The former Ambassador, Mr L.W. Lane (jr.), at the U.S. Embassy in Canberra, answered the first letter from the Committee (13 October 1986) by directing them to the Australian Government for information,

2 But see below (Introduction (d)) on the nuclear weapons that will be retired.

3 Although submarines of the Royal Navy use similar power plants - under licence from the U.S. - they have not visited Australia and there is no reason to expect them in the future.

did not answer another letter seeking information on U.S. port safety plans (17 February 1987), and did not answer another letter (18 February 1988) repeating the request and reminding him that no answer had been received.[4]

Eventually (20 October 1988), the U.S. Navy attache at the Embassy informed the Department of Defence that the U.S. Navy policy was that no special safety plans were necessary.[5] Furthermore, the U.S. Navy will not assist in the preparation of safety plans, nor even comment on such plans.[6] This is a remarkably hostile policy position for an ally in an "equal" alliance.

The Committee has been denied information by the U.S. authorities and by Australian institutions such as the Department of Defence and ANSTO that have access to privileged information from the U.S. and the U.K. The enquiry has been conducted without the co-operation of the U.S., the nation which operates the reactor systems that enter Australian ports, and without the wholehearted assistance of the Australian bodies that are best informed - if only partially - on the technical facts about naval nuclear reactors. For instance, if through possession of classified documents, ANSTO and/or the Department of Defence were aware of some military feature that could seriously compromise reactor safety, they could not tell the Committee about it unless the U.S. authorities agreed. Long-serving parliamentarians may have become blase about this state of affairs, but to me it represents a serious affront to parliamentary democracy and Australian sovereignty.

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4 Ch.6 para.23; see also Ch.6 n.23 and n.24.

5 Ch.6 para.24; a similar advice is apparently offered by the U.K. to the Australian Department of Defence (Ch.6 para.4).

6 ibid.

Most of the information that the Committee has used in its naval reactor assessment is of three types:[7] firstly, information about civil reactors with similar principles of operation but many practical differences; secondly, information about the reactor systems used on nuclear-powered civil vessels - an almost defunct breed;[8] thirdly, and most importantly, information about military reactors discovered largely by civil overview of the U.S. military, including information inadvertently released or reluctantly released to allay public alarm.

In its effort to discover and collate this information, there is a sense in which the Committee is allied with civil institutions within the United States and opposed both by the U.S. Navy and by Australia's own defence establishment - which has a closer alliance with the military forces of the U.S. than does the rest of Australia. Military institutions of most nations seem to have in common a contempt for the civilians they are charged to protect, especially civilians who question military priorities.[9] And while I commend the Committee's effort at civil overview, in practical terms any attempt by an Australian Senate Committee to penetrate the military secrecy of a foreign superpower is hopeless.

(b) Civil reactors and the Committee

I find that the Committee's reference to civil nuclear reactors does little to convince me of the safety of naval reactors, but it does highlight the extraordinary rigour

7 Ch.3 para.39; the text mentions 5 categories, but all the useful material in the last two (safety plans and assurances) comes from military sources.

8 Note that nuclear-powered merchant ships, like the NS Savannah, were powered by reactors using low-enriched uranium fuel (4.4%), not highly enriched fuel like the U.S. warships.

9 George Bernard Shaw's adage that "all professions are conspiracies against the laity" is just as true for the profession of arms.

required to conduct even the imperfect probabilistic risk assessments used for civil reactors.[10]

A necessary part of this rigour is possession of every structural and operating detail of the relevant reactor; fragments of information and inferences are not an adequate substitute.[11] Readers of the Report will notice that many discussions peter out with a statement to the effect that there is insufficient evidence to determine a particular point. This is also true of arguments central to the case that the Committee presents and I shall deal with some of these in section 2 of this dissent.

Another aspect of the rigour required for a thorough reactor analysis is an informed scientific objectivity. This is essential for the control of dangerous technology like nuclear power systems. The British National Radiological Protection Board is currently proposing that the existing safety standard of one significant civil nuclear accident every 10,000 reactor years should be tightened to a "tolerable" one accident every 100,000 reactor years.[12] Discriminations of this order are not made with knockabout common sense or intuition.

Whether one considers this quality of certainty achievable is another matter, but if the members of the Committee had possessed this rigorous informed objectivity it would have led them quite rapidly to the conclusion that any attempt at

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10 Note the statement in Ch.4 para.31, where the Report refers to "...the possibility that [civil reactor information] may be used to fill gaps caused by military secrecy".

11 Ch.1 para.23; "much relevant information...in fragmentary form".

12 New Scientist, 19 Feb 1989, p.26; in this case these figures are the targets that a civil reactor design analysis and component testing should conform to.

an independent Australian review of the accident risks presented by U.S. naval reactors was impossible.[13]

This insight leaves two clear choices; either to accept the assurances of the U.S. Navy, abandon the safety plans and leave the safety of the Australian public in the hands of the visiting military force, or find some way of excluding these dangerous machines from our ports. But instead the Committee has conducted an extended parody of an investigation, which has produced this weighty tome with its apparently well-meaning but politically harmless recommendations.

During the collection of evidence, Senator Sir John Carrick said: "In the end this document of ours has to stand the test right round the world".[14] As an Australian and a parliamentarian, I rather hope this is not the case. Quite a large number of people in "the world" are very well informed on the technical details of naval nuclear reactors. I don't anticipate with any pleasure the sniggers at the Report's tortuous efforts to establish some simple fact, or worse, to arrive at a totally erroneous conclusion.

This observation reminds me of one of the more risible comments made in the Report. In chapter 7, on submissions to the Committee, it is stated that "none of the authors of these submissions claimed any expertise in naval reactor design".[15] Unfortunately there was also an absence of experts in naval reactor design on the Committee and I suspect that any naval nuclear reactor designer who declared

13 The Report does appear to reach this conclusion in Ch.3 under the heading "Inability to Quantify the Accident Risks", but continues to make frequent use of the apparatus of quantitative analysis to support a case for the adequacy of current planning concepts.

14 Evidence, 27 March 1987, p.597; see also Evidence, 14 May 1987, p.691, where a similar sentiment is expressed during the cross-examination of Dr T. Speed.

15 Ch.7 para.29.

a willingness to tell all and attempted to present evidence to the Committee would have been run over by a bus on the way to the committee room - probably a navy-blue bus.

However, having said this, I should also observe that the Report is in some respects an excellent summary of the publicly available material on U.S. naval reactors and it will serve as a useful source for parties interested in this subject. Of course, there are some qualifications to this statement. One is that the Report has a politically determined conclusion to justify; its arguments and selection of evidence should be treated with caution. Another is that as the Report is essentially an "alternative" document - dealing with military secrets but without the co-operation of the relevant authorities - it is impossible to know what important facts are missing, or to what extent deliberate mis-information has found its way into the Report.

(c) Nuclear weapons

This Report is the first parliamentary study to consider the possibility of contingency planning for nuclear weapon accidents. As the Report itself states, military secrecy is even more of an obstacle to an objective assessment of nuclear weapon accident risks than it is to the reactor enquiry.[16]

The contradictions in Australian nuclear weapons policy are particularly relevant to this discussion. Australia's acceptance of naval nuclear war-fighting weapons in our harbours is at variance with our declared policy on deterrence. This has become even clearer since the INF treaty was signed, since naval nuclear weapons have a similar de-stabilising potential as well as a lower level of

16 Ch.11 para.13-14.

control safeguards. U.S. and U.K. warships that enter Australian ports do so without declaring their weapon loading under a policy called "neither confirm nor deny", which pretends to be a security measure aimed at potential enemies. In fact this policy is aimed primarily at the citizens of "friendly" countries.[17]

The Committee's basic approach has been to minimise the risks and assert that the "disarmed" nature of the weapons and their safe storage during port visits ensures that accidents will not happen, or are so unlikely that they are not worth planning for.[18] The Report then proceeds - rather unnecessarily - to assert that even if an accident were to occur it would probably not be serious.[19] At the beginning of chapter 11 the Committee promises to use the same methodolology and terminology as the reactor accident assessment.[20] However, although the "risk x consequences" formula is implicit through the nuclear weapons discussion, the Committee has heavily stressed the unlikelihood of a nuclear weapons accident occurring.[21] By reducing the probability of accident occurrence to a vanishingly small number the Committee avoids an extended discussion of accident consequences because even quite a large consequence multiplied by a very tiny probability still results in a small risk.

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17 The Soviet Union claims to have the ability to detect nuclear weapons remotely, Sweden developed the capability within days - if it did not have it already - and in 1966 a U.S. aircraft carrying "advanced nuclear detection" equipment detected plutonium contamination areas while overflying the Palomares accident site at an altitude of 100 and 200 feet. Obviously Australia could develop this capability if it does not have it already (see Ch.2 para.2). See also G. Brown, "NCND Nevermore", Bulletin of Concerned Asian Scholars, Dec. 1988.

18 Ch.11 para.114.

19 Ch.12 para.69.

20 Ch.11 para.4-8.

21 The Report does refer to the Department of Defence as having assessed "likelihood and consequences" without finding an accident that "requires specific contingency planning"; Ch.11 para.8.

A major emphasis was placed upon the need for a "credible" accident scenario before the risk could be considered serious.[22] This, too, is an emulation of the reactor methodology, where one particular type of accident is the basis for safety planning. Considering the attitude of the Committee and the shortage of hard information, this process was unlikely to produce a finding in favour of nuclear weapon accident contingency plans. However, in the last stages of the preparation of the Report, the Committee experienced a partial change of attitude towards the possibility of Australian planning for nuclear weapons accidents; I deal with this specifically at the beginning of section 3 of this dissent.

What should have been stressed are the real possible consequences of a contaminating nuclear weapons accident, which could certainly be more serious than the Committee's reactor "reference accident" and perhaps more serious than even an "uncontained" reactor accident. This is because the likely contaminant - plutonium-239 - has a very long half-life and, in a particulate form, tiny quantities of this substance are capable of producing human cancer fatalities.[23]

With such serious possible consequences we must demand extraordinary benefits or extraordinarily certain safeguards, especially since military secrecy restricts access to the information necessary for even a rudimentary examination of accident probability.

22 See Ch.12 para.45 and Ch.12 para.53 for examples of accidents that the Committee finds not "credible".

23 There are 15 different isotopes of plutonium, but Pu^{239} is the variety used for nuclear weapons. Small amounts of other isotopes have no effect on its contamination potential. I shall refer to this isotope as "plutonium" in the remainder of this dissent.

(d) A late development on U.S. naval nuclear weapons

On 1 May 1989, "The Age" newspaper reprinted an article from "The New York Times" that reported the imminent retirement of several of the older short-range tactical nuclear weapons on U.S. warships. These include SUBROC and ASROC anti-submarine missiles and Terrier anti-aircraft missiles. It was suggested that the decommissioning of all these weapons would be completed by 1991 and that their replacement by new nuclear systems would not occur before the late 1990s; it is possible that the U.S. Navy will not deploy new nuclear systems but continue to rely largely on conventional anti-submarine and anti-aircraft missiles.[24]

There are several reasons why these weapons are being discarded; firstly, all of them are geriatric and probably less safe and less reliable than modern weapons like the Tomahawk cruise missile; secondly, improvements in the accuracy and effectiveness of conventional missiles offset the greater power of the nuclear warheads; thirdly, budgetary constraints have postponed the development of replacement systems and there are probably also considerable savings in the maintenance, training and security areas.[25]

However, there is a less sanguine aspect of this development. The U.S. Navy enjoys several advantages over the navy of the U.S.S.R. that are similar to the Warsaw Pact's conventional weapons advantage over NATO forces - an

24 The impending retirement of the older weapons is not news, but the U.S. Navy's tacit admission that they do not need them is. However, a request for US$66.3 million for 1990 to develop a long-range, dual-capable version of the Standard anti-aircraft missile is currently awaiting Congressional approval. The U.S. Navy still has the 28 year old B57 nuclear depth bomb which is aircraft-delivered.

25 See the Report Ch.11 para.33 (fn.50) for reference to the U.S. Congress refusal to fund the nuclear Sea Lance replacement for the ASROC missile.

edge that could compel NATO into a first-use of tactical nuclear weapons in any sustained major conflict.

At sea the position is reversed. Among other advantages, the U.S. aircraft carrier fleets are major conventional assets, but are also potentially vulnerable to the nuclear weapons that the Soviet Navy relies upon. The U.S. Navy plan (Sea Plan 2000) is to attempt to restrict a war at sea to conventional weapons, with the accurate long-range Tomahawks initially reserved for land installation strikes if the war escalates.

Professor Desmond Ball has pointed out that this doctrine lowers the threshold for an armed clash between the superpowers and that a U.S. attempt to win by conventional means would probably lead to nuclear war anyway because of the Soviet dependence upon tactical nuclear weapons.[26]

The financial reasons for decommissioning and the fact that this development is in line with U.S. Navy war planning may explain why the announcement of this development has just leaked out, rather than being dressed-up as a peace and disarmament initiative. In practical terms it does mean that the number of nuclear weapons on some types of visiting warships will decline until the deployment of new nuclear weapons - if the U.S. decides that new nuclear weapons are necessary.

(e) This dissent

In the following sections of this dissent, I have chosen to concentrate on only some of the issues that I see as central to the argument of the Report. I am very conscious of how incomplete this treatment is and others will want to take

26 Professor Desmond Ball, "Nuclear War at Sea"; International Security, Winter 1985/86, p.28, p.25.

issue with propositions and arguments in the Report that here are skimmed over or not mentioned at all. However, the Report itself, despite its length, is only a partial - and I would say partisan - treatment of the evidence available. This is not only a product of the genuine scientific uncertainties that exist in the areas under discussion, but much more a result of the military secrecy that applies to both naval reactors and nuclear weapons.

Scientific uncertainties can be resolved by research and experiment, but military secrecy is active opposition to the collection of accurate information. Military secrecy is thus a crippling disability for the whole endeavour of the Committee's enquiry.

2. Nuclear-Powered Ships in Australian Ports and Coastal Waters

Non-specialists find statistics and the jargon of the sciences difficult but in this case some discussion of the statistical and numerical propositions in the Report is a necessity.

(a) Clarifying terms used in the Report

The first item is the use of special terms and redefinitions of common words found in the Report. One of the important special terms that may puzzle readers of the Report is "reference accident". They will assume this term carries some special authority. In fact, the "reference accident" is just a guess based on a sketchy knowledge of naval reactors and their safety features together with the hopeful assumption that a relatively minor accident is more likely than a catastrophic one. The "reference accident" looks like the "maximum design accident" used in probabilistic risk assessment of nuclear reactors but has no proper analysis to back it up.

Redefinitions include the crucial terms "credible" and "incredible". In the Report these terms are used to define a boundary between accidents that could happen and accidents that are effectively impossible. I doubt that Aristotle would be very happy with this dichotomy, since accidents are by definition unanticipated and, before the event, always have an "incredible" character. After the event even the most bizarre and unlikely accidents become necessarily "credible". These terms too are used in formal risk analysis but they are only meaningful when they are the end-products of some defined process of assessment; they are not labels that can be just stuck on.

"Conservative" is a term used in the Report to indicate a safety-oriented approach, for instance, in the assumption of the "worst-case" consequences in a hypothetical accident. In practice this has meant rejecting the possibility of a really serious accident, choosing a lesser accident as the "reference" and throwing the odd factor of 10 into calculations where it will do no harm to the desired conclusion.

A similar approach is evident in the treatment of "probability" and "consequences". These terms are in no way equivalent. We can often be much more certain about the consequences of accidents than their probability. For instance, the limits of the consequences of a contaminating reactor accident are defined by the dangerous elements in the reactor core that could be dispersed. There can be genuine disagreement about the exact dimensions of accident consequences under different circumstances but these difficulties are minor compared to estimation of accident probabilities.

When dealing with a novel technology having a brief history like naval nuclear reactor technology, the most useful skill for estimating the probability of an accident is a gift for prophecy. Yet this is the area where the Committee has concentrated its investigation. The psychological advantage of this choice is that a discussion of probability comes before an accident happens (it is futile afterwards), while discussing the possible consequences of an accident requires imagining that it has already occurred.

(b) Probabilistic risk assessment of nuclear reactors

The Committee has attempted to support its arguments on reactor safety by selective references to the probabilistic risk assessment (PRA) techniques that are applied to civil nuclear reactors. These techniques are valuable design tools for engineers who want to eliminate weaknesses from complicated systems without waiting for them to fail and building a better one next time. This approach requires an intimate knowledge of literally every nut and bolt in a system and is very expensive. The first comprehensive nuclear reactor analysis, called the Rassmussen Report (or WASH 1400) and costing US$4 million in 1975, has been heavily criticised for its methodology. Subsequent studies like the Sizewell B assessment have attempted to correct these deficiencies - but not to everyone's satisfaction. I recommend to readers interested in pursuing this subject Dr T. Speed's very accessible paper incorporated in the Hansard evidence.[1]

Ignore the claims in the Report that it is not attempting a quantitative analysis. It does attempt some quantitative rankings to justify the choice of the reference accident and alludes to other numbers of uncertain provenance. The usual scientific motive behind quantitative analysis is to escape from vague phrases like "perfectly safe", "an infinitesimal risk" and "she'll be right mate" into objective precision. The numbers that come out of this effort are not yet very reliable but they are an attempt to replace vague assurances with a sort of calculus of risk; this is important for modern societies which depend upon dangerous substances and dangerous concentrations of energy but also demand a high standard of health and safety. Unfortunately this Report has taken the vague assurances and appended various numbers to add authority to its predetermined conclusions.

There are several points on formal risk analysis and especially probabilistic risk assessment (PRA) that need to be made very clearly:

1 Evidence, 14 May 1987, p.622-657

(i) This sort of assessment is concerned with achieving a maximum level of safety in the design and construction of nuclear power plants. The result is usually expressed in failures per so many years. Ten thousand years (10^4 years) has become the standard and has achieved the status of a magic number. It seems that any nuclear accident has been assigned a maximum probability of one in 10,000 years.[2] Engineers who understand the construction and operation of these plants do not prostitute these theoretical figures into unequivocal assurances of public safety.[3] Richard Feynman's comments on the NASA risk estimates he discovered while a member of the Challenger Inquiry illustrate this point rather well. Feynman was surprised to discover that the NASA estimate for failure of the main engines of the Space Shuttle was 1 in 100,000 missions. Although the main engines did not fail in the accident, during previous missions there had been many problems with cracked pump turbine blades, split casings, and faults in many other components. Feynman was discussing engine failure with a manager and three engineers and as an experiment handed out pieces of paper and asked each of them to write down his estimate of main engine failure. Two of the engineers estimated 1 failure in 200 missions, the other estimated 1 in 300; the manager estimated 1 in 100,000 missions.[4]

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2 Once in 10,000 years was used by the Minister for Power and Electrification in the Ukraine three months before the accident at Chernobyl; according to the film "Above and Beyond", the scientists of the Manhattan project were required to guarantee the detonation of the Hiroshima bomb to a standard of one failure in 10,000.

3 ibid., p.671

4 Richard P. Feynman; "What do <u>you</u> care what other people think", 1988, W.W. Norton & Co. NY, p.179-82. Also note Feynman's comments on p.183:

"As far as I can tell, engineering judgment means they're just going to make up numbers" (this comment refers to a pipe-rupture probability assessed as 1 in 10^7 per mission), and:

"It was clear that the numbers for each part of the engine were chosen so that when you add everything together you get 1 in 100,000".

(ii) It is not necessary to be a technical expert to have grave doubts about the quality of the insurance provided by PRA. None of the major reactor accidents (Brown's Ferry, Three Mile Island, Chernobyl) have followed the sort of accident paths predicted by PRA. This could mean that PRA is protecting us from certain classes of accidents but it seems just as likely that it is still basically irrelevant to many accidents that happen in the real world.

(iii) The most dangerous elements in nuclear reactor systems walk in through the front door. Human error has been the major factor in serious reactor accidents - and in many other advanced technology accidents. Not just as the initiator of accidents, it also appears in errors of reaction and other compounding mistakes that can turn a minor problem into a catastrophe. This latter mode of human error was critical in both the Chernobyl and Three Mile Island accidents and it is interesting to note that five of the eight operators on duty at Three Mile Island were graduates of the U.S. Naval Reactor school.[5] I believe that it is impossible to contain human error by attempting to write it into a risk assessment system. As Dr Speed pointed out in his evidence to the Committee, it is impossible to anticipate "new, inspired pieces of human stupidity...".[6]

(iv) Civilian reactor PRAs cannot be transferred and applied to naval reactors. The greatest similarity between the two systems is that they share the same acronym (PWR - standing for "pressurised water reactor"). The fuel is different (very highly enriched), the size of the reactors is different, performance demands and cycles are different, the safety systems are different and the locations and operating environments are different.[7] This does not mean

5 Evidence, 27 March 1987, p.611

6 Evidence, 14 May 1987, p.682

7 Note a U.S. Department of State telegram from the Canberra U.S. Embassy of 25 March 1987, containing a draft press release on the visit of Professor Jackson Davis: "...Professor Davis has made

that naval reactors are more dangerous than civil reactors - they may in some respects be safer - but it is would be absurd to make trade-off adjustments and apply the civil safety assessments to these military machines.

If specific and comprehensive PRA assessments have been done on naval reactors - and there is no strong evidence that they have - they carry little assurance if their methodology and conclusions are not open to independent review and criticism.[8] Nuclear reactor-powered warships are machines designed for war, so some aspects of reactor safety are probably compromised for this reason. We know about the "battle-short" switch that overrides the automatic reactor shut-down (SCRAM), we know that the Committee could not determine under what conditions the containment would be vented through a pressure-relief valve. Other safety compromises may still be completely concealed military secrets.[9]

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hypothetical comparisons of commercial reactor and U.S. naval nuclear reactors. These are entirely misleading since there are vast differences between U.S. nuclear powered warships and commercial nuclear power plants with respect to the reactor size, plant design, fuel integrity, manner of plant operation and operator supervision. Consequently, commercial concepts regarding accident potential or accident consequences do not apply".

8 Note the reference in Ch.3 para.28 to the U.K. estimates of 1 in 10^4 reactor years for a contained accident and 1 in 10^6 reactor years for an uncontained accident. I believe that ANSTO holds a copy of a document titled BR 3019 which is usually available to "friendly" institutions - but not to the Committee. Apparently this document includes these estimates but we have no indication of how these figures were derived. Note also the discussion in Ch.4 para.35-46, where it becomes apparent that there is little, if any, real civil overview of naval reactor design and operation.

9 Ch.4 para.109-14 for reference to the "battle-short switch" and Ch.4 para.75-7 for a discussion of the venting of containment. This could be very important, the venting might need to be automatic, with rupture discs, or the captain may have a choice of irradiating the vessel or venting the steam and volatiles to the environment.

(c) The U.S. Navy safety record

The Committee is justified in saying that since the fatal accident at the SR-1 research reactor in Idaho in 1961 the U.S. Navy has had no major acknowledged accident to a nuclear reactor and therefore there probably has been no major accident. Two reactors have been lost (on the USS Scorpion and the USS Thresher) but it is claimed that reactor failures were not the cause of either of these accidents.[10]

If this is correct, the U.S. Navy can claim over 3000 operating years without a major accident. This compares very well with the apparent record of the U.S.S.R., which is the only nation with comparable aggregate years of naval reactor service. The Soviets probably made some unwise early choices in reactor technology, have arguably been more casual about safety generally and have adopted a more experimental approach to reactor design - resulting in more powerful reactors.

By contrast, the U.S. approach - largely under the guidance of Admiral H.G. Rickover - has been very conservative, tending to forgo performance for the sake of safety. This caution may be partly explained by considering the probable adverse public reaction to a serious reactor accident.[11]

However, military secrecy prevents the Committee from finding out the vital details of naval reactor construction and operation and, even more important, from examining operating logs and safety reports where incidents and mistakes with accident potential may be recorded. Near

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10 See Ch.5 para.16-17 and note 20 for just some of the different versions of the accidents to USS Scorpion and USS Thresher.

11 Ch.4 para.133 and n.187.

disasters that could have placed civilian populations at risk are the incidents most likely to be kept secret.

(d) Mean annual severity calculations

An important quantitative element that has the potential to confuse readers of the Report is the use of the concept of "mean annual severity". This is a theoretical construct that is used merely in an attempt to rank potential accidents in order of their seriousness. It is not a direct measure of the actual impact of an accident. Many small, relatively harmless accidents might produce the same MAS figure as one catastrophic accident. This technique should have been left on the back of the original envelope. Its utility in discriminating between different hypothetical accidents is very doubtful and yet these calculations are at the core of the Committee's argument rejecting the need to plan for an uncontained accident.

A contained pipe-rupture melt-down

Only a few worked examples of mean annual severity are presented in the evidence (see Appendix 1). One of these is a contained melt-down caused by pipe failure, where the failure rate per foot of pipe is taken from extensive industrial experience. The pipe failure probability comes to 10^{-4}. (Who says there is no order in the universe?) Some plausible estimates of reactor core inventory and emission rates are proposed and these figures are multiplied together to produce a mean annual severity of 0.1 Curies of Iodine-131 per reactor year.

A contained melt-down with open door

A variant on this accident involves the entirely coincidental opening of the interlocked and alarmed doors to the containment compartment at the moment that a pipe-work rupture takes place. Much more Iodine-131 is released - 100 times the amount in the previous example - but the ungenerous assumption that the containment is violated for one hour per year pulls the multiple down to a trivial MAS of 0.001.

There is an air of unreality about this sort of accident scenario; it is more plausible to imagine the alarm disconnected and the doors chocked open with pieces of wood for some practical purpose, or that after some initial mistake or emergency, the doors might be opened as part of an attempt to avert a serious breakdown or perhaps to rescue a misplaced crew member. The Australian Navy has had recent experience of how hard it is to keep track of every crew member, even on a submarine.

A pressure-vessel rupture accident

The third MAS calculation involves a single-stage catastrophic failure of the reactor pressure vessel which ruptures the containment. The core inventory and release is the same as the open-door example (100,000 Curies) and the rupture probability, like the pipe failure, is taken from industrial experience. We have a century of experience with high pressure boilers and there are many of these devices in service. The submission mentions embrittlement by neutron irradiation and the high standard of reactor vessel testing. I presume that these vessels are very carefully assembled and tested but whether the dimensions of embrittlement are yet fully understood is less certain.

The product of the catastrophic failure probability and the 100,000 Curies of Iodine-131 produces a MAS of 0.01. The ANSTO submission then concludes that the contained ("reference") accident is obviously the proper accident upon which to base safety planning since it has a MAS that is 10 times the uncontained rupture model.

The conservative contained footnote accident

Alert readers will notice another contained accident MAS calculation in footnote 15 of Chapter 7 of the Report, where 3750 curies of Iodine-131 are assumed released over a 24 hour period. This calculation uses even more conservative assumptions than the reference accident example and results in a MAS figure of 0.375 curies per reactor year. This is nearly four times more serious than the standard reference accident and one wonders why it is not given more prominence in the Report. It is hard not to suspect that these figures are somewhat rubbery.

It seems obvious that there must be many more ways for a reactor to fail than just simple rupture failures of the pipe-work and the pressure vessel. Although a serious contamination accident might almost necessarily involve a mechanical break in the reactor's primary coolant system, there must be many possible sequences that terminate with this serious condition. Some other scenarios were evaluated qualitatively by ANSTO - for which read "guessed at" - but not calculated.

It is worth noting again that some scientists from ANSTO probably possess information about naval reactors not available to the Committee either because ANSTO holds confidential documents that it is not allowed to release to the Committee, or because individuals have worked in related areas overseas under security classifications that still constrain them. The Committee has been given only a vague indication of some such special competence,[12] but the superficial nature of the MAS survey gives nothing away and does little to inspire confidence.

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12 Ch.3 para.26-7 and n.19.

I, for one, have no confidence that the MAS survey has any relationship to likely accidents and it is impossible to know whether even the few figures given are accurate within a factor of 10 or even 100.

(e) MAS calculations you can do at home - collision risks

One of the accidents mentioned in the submission but not quantified to produce a MAS estimate rather intrigued me. It related to ship collisions capable of damaging a warship's nuclear reactor. Some of the elements are quantified and it might be instructive to fill in the rest and produce a MAS figure for such an accident.

[A] According to Lloyd's Register of Shipping (1986) there are about 14,000 merchant ships in the world fleet over 7000 tons (a large destroyer is about 7000 tons). Jane's Fighting Ships only lists about 320 naval vessels over 7000 tons. Let us add 500 to make the total 14,500.

[B] ANSTO estimates that there are an average of two collisions per annum capable of damaging a reactor. Think of collisions as having one striker and one struck ship; we are considering the possibility of a nuclear-powered vessel being the struck ship.

[C] ANSTO estimates the consequences - core inventory available for release - for an uncontained accident as 100,000 curies of Iodine-131.

[D] ANSTO refers to the probability of a collision taking place in a river or harbour as 0.3 (coastal waters - 0.5).

[E] I nominate a special naval safety factor of 10. This assumes that a reactor powered navy vessel is ten times less likely to be involved in a collision than a merchant ship. I think that this is reasonably generous; no amount of regulation could stop a drunken container-ship helmsman striking an anchored or docked warship.

[F] I disagree with ANSTO on the probability of a nuclear-powered ship sinking immediately after a collision. Naval ships are designed to stay afloat even when severely damaged. Furthermore, the Liverpool Safety Plan - one of our best sources - characterises an uncontained accident as being a fairly sudden event.[13]

The basic formula is Probability x Consequences = Mean Annual Severity. In this case it is:

[1/A x B x D x 1/E] x C = mean annual severity

1/14,500 x 2 x 0.3 x 1/10 x 100,000 = 0.414

This is four times the mean annual severity of the reference accident. It is even slightly larger than the 0.375 estimate lurking in the footnote. The difference is that I don't expect my calculation to be taken seriously. Once we move into the more complicated real world there are many factors that can only be guessed at and are therefore subject to conscious - or even unconscious - adjustment to produce an appropriate final figure. However, on p.200 of the Report mention is made of an estimate of collision risks for nuclear-powered merchant vessels where the risk of release of fission products from collision is estimated as 10 times as likely as an accident like the reference accident - if there is no special collision protection. The quotation goes on to say "similar probabilities arise from grounding...".[14] It seems plausible to me that accidents like collision, grounding, fire or conventional explosion would be as likely to lead to a reactor accident as a spontaneous failure of reactor components.

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13 Ch.7 para.109; see note 135 for a differing opinion from ANSTO.
14 Ch.7 para.64, n.78 and see also Ch.7 para.71.

(f) The "realistic" revised accident and MAS

It is not necessary to place too much weight on criticism of the MAS technique. The Report has conspired to undermine its utility by fiddling about with the "reference accident" in another attempt to enhance the apparent safety of nuclear-powered ships.

The Australian Ionizing Radiation Advisory Committee (AIRAC) suggested that ANSTO revise the reference accident to take account of recent evidence - largely from the Three Mile Island accident - suggesting that the release of volatiles (like Iodine-131) from the reactor and from containment might be much lower than previously supposed. Other factors are also adjusted down to "realistic" levels but the reduction in Iodine-131 alone has a major influence on the MAS discrimination.

The revised "realistic" model has a probability of the usual one in 10,000 and an emission of only 100 curies of Iodine-131, which calculates to a MAS of only 0.01, which is the same as the uncontained accident.[15] Thus the whole discriminatory function of the MAS technique comes to nothing. If the "real" risk of the contained accident is no greater than the uncontained accident (as measured by MAS), then accident planning should be based on both accidents - as it is in the Liverpool Safety Plan, where the better-informed authorities consider an uncontained accident unlikely but not absurd.

15 I would reject a claim that the uncontained accident could be similarly revised down. The process apparently responsible for the reduction of the amount of free Iodine-131 available for release during the contained accident at Three Mile Island (i.e. combination of caesium and iodine in a high pressure steam atmosphere) probably would not apply to a low-pressure uncontained accident.

The MAS technique seems to have a very limited utility to me, and it might do better as a board game than as a serious technique for the ranking of reactor hazards. I don't blame ANSTO for attempting to quantify these sample accidents but I do blame the Committee for presenting this incomplete and undigested mess of figures as an argument for the safety of nuclear-powered warships.

(q) The revised accident

The revised "realistic" accident model is another example of either the Committee's inability to process information and make decisions, or its desire to present a long and confusing document.

ANSTO and the Committee inherited the "reference accident" from the 1974 study that led to the conditional resumption of nuclear-powered ship visits in 1976, and there is an obvious reluctance to abandon it and start again. There is frequent mention in the Report of how "conservative" (safety-oriented) the reference accident assumptions are, but if the reference accident is the properly assessed basis for planning, what function does the "realistic" accident serve? Indeed, why does it even appear in the text of the report?[16]

Its function is an extension of the psychological process of the Report, which is rather like a fairy-tale (a very dull one) that is attempting to wean us from our unreasonable fear of nuclear reactors. The uncontained accident is a huge fire-breathing monster of an accident that could make a really big mess. This is placed beside the stolid, middle-of-the-road "reference accident" - more inconvenient than dangerous - and suddenly the big monster seems insubstantial, "incredible", to use the language of the

16 See Ch.7 para.16 and para.23-4 for the reasons offered in the Report.

Report. Then the curtain is twitched aside and we see the "realistic" accident, which is tiny and really quite cuddly and not at all dangerous. How childish our fears were!

The problem is, to extend the metaphor, that the big messy monster is always lurking in the core of the reactor. Fallible human engineering and the much more fallible human operators must cooperate to keep it in. Sooner or later it will escape.

(h) Other reactor risks

Outside the recognised accident models there are other risks associated with nuclear-powered ships that, while perhaps less likely, are not successfully discounted by the Report.

Core melt-through

There is the possibility, after a loss of coolant accident, that the molten core could melt through the bottom of the reactor vessel and then perhaps through the hull. It appears that the fission-decay energy available in the 40 MW(t) reactors makes this unlikely, but there might - under adverse circumstances - be enough energy in the larger reactors (85 -100 MW(t) and larger) to melt through both metal containments.[17] During the Three Mile Island accident the average peak temperature of the debris on the reactor floor was about 1900°C and in some areas 2800°C.[18] The melting point of most steels is only about 1500°C. No one has ever dumped a molten reactor core onto the bottom of a harbour; the physical reactions, the nature of the fission product emissions and the effect on the environment are a matter for speculation.

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17 Ch.7 para.52-9. This passage should be read carefully. The fact is, although it may indeed be unlikely, that soon after shut-down, the fuel in a larger reactor <u>may</u> contain enough fission-decay energy to melt through the vessel.

18 Evidence, 27 March 1987, responses by ANSTO to Questions on Notice.

Nuclear "fizzle"

There is also the danger posed by a low-grade critical mass explosion. A U.S. reactor core contains - on average - about 200kg of highly enriched uranium (over 90% U235). This is effectively weapons-grade material and if a large enough mass is present in the right configuration - as little as 25kg in roughly spherical form might be enough - there could be a partial nuclear explosion or "fizzle".[19] This could be equivalent to a few hundred kg of TNT. This is not much by nuclear weapons standards, but it is enough to render discussions on levels of containment and the percentage release of fission products irrelevant; it would be all over the place like the proverbial dog's breakfast.

It is only elementary caution to structure the base of the reactor vessel (perhaps by partition) so that a critical mass cannot accumulate, but is this true for every position of the reactor; for instance, after grounding or capsize? There may be technical reasons why the risk of either melt-through or fizzle are very low, but neither I nor the rest of the Committee are aware of them. It would be truly unfortunate if Australia's first encounter with a nuclear accident was with one of these events rather than the manageable reference accident.[20]

Ageing Reactors

One of the factors that is glossed over by estimates like once in 10,000 reactor years is the fact that like any other machines naval reactors wear out; corrosion, thermal fatigue and neutron embrittlement are some of the still only partially understood mechanisms involved. Many U.S. naval reactors are approaching the limits of their original

19 See the discussion in Ch.4 para.50-2 and n.69.

20 Either one of these accidents could release the whole core inventory to the environment. In Ch.4 note 35, a British figure is cited; 10,100,000 curies for an uncontained accident.

design-life and some may have already have exceeded it. The Report quotes the director of the Naval Nuclear Propulsion Program giving evidence before a Congressional Committee in 1986: "... these ships were originally designed for a 20-year lifetime. Now I am asked to make them go for 30 years, but they were designed for 20 years. We have a large fleet approaching its original design limit".[21] Each model of reactor has a land-based counterpart that is kept ahead - in operating time - of its sea-going fellows in an attempt to predict problems before they emerge on ships in service.[22] However, even this commendable caution cannot guarantee that individual reactors are not degrading more rapidly in some respect. We have seen recently how the ageing of civil aircraft, combined perhaps with a casual approach to maintenance, has introduced a new mode of fatigue failure accident. The first sign of this syndrome in nuclear reactors could be a major system failure in an Australian port.

(i) Reactor accident conclusion

If we had a documented history of perhaps a hundred naval nuclear reactor accidents we would be able to begin calculating and predicting accident probability. Even if we had access to comprehensive operating records we would have some idea of what accidents were probable and whether improvements in equipment and training could avert them.

Since we have none of these, all we can say with confidence is that there are very dangerous substances in a reactor core, with the potential to cause serious health problems for anyone exposed to them. This is the major proposition of the many submissions that have argued against allowing nuclear-powered ships into Australian harbours. The Report

21 Ch.4 para.121.
22 Ch.4 para.138 and n.196.

has dismissed and criticised these submissions for minor mistakes and misinterpretations or for claims that are unsubstantiated by the official records, although the Committee has accepted that the planners - and I include the Committee - should bear the burden of proof of the adequacy of safety planning.[23]

I believe that a concentration on the consequences of possible accidents is the only reasonable approach and that the Committee's ill-informed attempt to quantify the probability of various defined accidents is futile and misleading.

23 Ch.3 para.44-5.

3. Nuclear-Armed Ships in Australian Ports and Coastal Waters

(a) Special problems with the secrecy of nuclear weapons

Military secrecy is an even greater obstacle to evaluation of nuclear weapon accident risks than it is to a reactor accident assessment; as a signatory nation to the Non-Proliferation Treaty, Australia is obliged to avoid seeking out technical information on nuclear weapon construction. Despite severe limitations on its access to information on nuclear weapons, naval storage practices and comprehensive accident records, the Committee initially decided to recommend no accident planning for a nuclear weapon accident. However, at the last minute - on the 7 April 1989 - some additional paragraphs (Ch.11 para.115-17) were inserted with a recommendation that work on the "draft" nuclear weapon accident plan be continued. This is rather odd since this plan was dismissed in Chapter 2, paragraph 8, and the argument proceeded as if it did not exist. Readers of the Report will notice the stilted emphasis on the document's lack of "formal status" or "official approval" that accompanies its eleventh hour resurrection.[1] I have a personal interest in this document.

(b) The "unauthorised" VSP(N) nuclear weapons accident plan

I discovered that this plan existed during a visit to Brisbane on 20 September 1988; it came up during a conversation with the Head of the Queensland State Emergency Services, who actually had a copy of the document on his desk at the time. It may well have been a draft document as it appeared to be only a few pages in length. However, it was developed enough - and official enough - to have been distributed to at least one Head of State Emergency Services

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1 Ch.11 para.115.

for comment. I resisted the temptation to seize it and run out the door and in a way this was unfortunate since neither I nor the rest of the Committee - as far as I know - have seen it since.

When the Committee asked about this plan it received only assurances about its informal and unofficial nature, which rather begs the question of why this orphan document was not shown to the Committee - a group unlikely to become hysterical over a hypothetical nuclear weapons accident. The Visiting Ships Panel (Nuclear), which is chaired by the Department of Defence, was the body "unofficially" preparing the plan and it was the Minister for Defence who wrote a letter on 22 December 1988 to the effect that since the document "...was still in the development stage and had no official status, he did not believe that its release to the Committee would serve a useful purpose".[2] We must thus add the Minister for Defence to the list of those who have treated this Senate Committee with disdain. Of course, at the time this plan came to light, the Minister for Defence was making his famous "there will be no accidents" statement in the media. Fortunately, on this occasion, he was right, but having to admit the existence of a "real" nuclear weapons accident plan might have been embarrassing.

(c) The Committee's argument on weapons accidents

The Committee has made an attempt to extend to a weapons accident the "probability x consequence = risk" formula and has backed this up with assertions about naval discipline, magazine safety and the "disarmed" nature of nuclear weapons during port visits. In order to present a "worst-case" argument, the Committee decided to ignore the unfriendly U.S. policy of "neither confirm nor deny" and to assume that

2 Ch.2 note 11; I quote the text of the note, not the letter.

nuclear certified ships are carrying nuclear weapons.[3] However, the indeterminate presence of the weapons acts - as it is meant to do - as a subliminal safety factor.

The argument that leads the Committee to its desired conclusion is contrived. The public record shows two U.S. nuclear weapons accidents on foreign soil that led to widespread plutonium contamination - fortunately in thinly populated areas. Neither of these accidents realized their full potential and both were aircraft accidents but they demonstrate the possible distribution of plutonium by explosion alone (Palomares, Spain) and by explosion and fire (Thule, Greenland).

Despite this evidence - and other lesser examples - the Committee has decided that the manifest accident potential of nuclear weapons can be contained by assurances and safety systems. They found it impossible to imagine a sequence of events that could lead to a "credible" accident and therefore decided that accident planning was unnecessary.

Although AIRAC stated that it believed that control and emergency procedures should be in place for ports visited by nuclear-armed warships, the Report ignores this recommendation and makes a point of stating that AIRAC stressed that it had performed no calculation of the probability of a nuclear weapons accident nor had AIRAC "developed a reference accident".[4] Even the Committee cannot produce "calculations" of any substance on nuclear weapons accident probability and the only overseas figures appear to be a few vague U.S. estimates. One is of the probability of accidental nuclear detonation; less than one in a billion for normal environmental conditions and less

3 Ch.11 para.24.

4 Ch.11 para.3; but notice ch.11 para.13 where the lack of the information necessary to conduct a "rigorous theoretical assessment" is clearly stated.

than one in a million for extreme cases like a fire.[5] There is no indication that these are calculations rather than guesses and the plump roundness of the figures rather suggests the latter.

Although the Report states, in reference to these figures, "Assuming that formal risk assessments have been made...", this proposition is rather contradicted by the footnote to this paragraph (19) which quotes a U.S. Department of Defense expert declaring that the estimate for the accidental detonation of the conventional explosive in an older nuclear weapon was somewhere between 10^{-3} and 10^{-6} (a factor of a thousand); "...we cannot quantify it" he said. As this note states, a nuclear explosion requires the prior explosion of the conventional explosive so we can in fact assume that formal risk assessments have not been made or, if they have, that the results are not available.[6]

Part of the rationale for the different treatment of reactor and weapons accidents is the observation that a reactor is a "dynamic" system and a nuclear weapon is not.[7] This is not entirely fair to nuclear weapons. Mr Beazley told the Committee that the implosion explosive was always assembled with the fissile material in weapons likely to be brought into Australian ports; it is the energy latent in this explosive that provides the most likely immediate cause of widespread radiological contamination.[8] Despite some understatement, even the Report - in the sections dealing

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5 Ch.12 para.13; see also Ch.11 para.51.

6 Ch.12 para.14 and note 19; the claim is made that the probability for the "modern devices...is at least as good as one in a million and <u>maybe</u> better" (my emphasis).

7 Ch.12 para.32.

8 Ch.11 para.64; "...the nuclear material in modern nuclear weapons is kept together with the other nuclear components of the weapon at all times". The Minister for Defence in this passage is confirming, but avoids stating directly, that the explosive and the fissile material are in there together all the time.

with fire and explosion - gives an indication of how serious an accident of this sort could be.[9]

(d) The evidence of Professor W. Jackson Davis

The most comprehensive treatment of the possible consequences of a nuclear weapons accident that was presented to the Committee is contained in a submission by Professor Jackson Davis on behalf of Greenpeace.[10] Prof. Davis models the release of 5kg of plutonium - assumed to be the fissile content of one nuclear weapon - in various Australian ports, under a range of possible enviromental conditions. The Report makes several criticisms of Prof. Davis' submission, some of which are not without substance, but I do not believe that they invalidate his basic proposition.

For instance, Prof. Davis proposes that the total plutonium content of one warhead could be released as a respirable aerosol by a fuel fire with a duration of three hours. Evidence from various experiments - including tests at Maralinga - suggests that distribution from this energy source might be much lower than 100%. A variety of release percentages are cited; 0.1%, 1%, 3% from fire alone, and another set, 1-10% or up to 20% by explosion.[11] I am inclined to accept the percentages for fuel fires, although I believe that release percentages could be higher for other types of fires, especially missile propellant fires. However, the quoted release percentages from detonation of the conventional explosive are contradicted by the evidence from at least one of the accident reports.[12]

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9 Ch.12 para.23-28 (explosion) and Ch.12 para.46-53 (fire).

10 Evidence, 27 March 1987, pp.462-500.

11 Ch.12 para.19; Ch.12 para.21 (n.26) for dispersion percentages by fire. Ch.12 para.26-7 (n.34) for dispersion by explosion. See also Evidence, 14 March 1988, pp.723-4 (AIRAC) for a reference to the Maralinga experiments with dispersion by explosive.

12 See section 3(g) below.

The Report also states that "one of the accident scenarios put to the Committee by Professor Jackson Davis rests on the assumption that there would be 100 nuclear weapons on a visiting nuclear weapons capable warship".[13] This is not correct; while he mentions "up to 100 warheads", his scenario rests on the assumption that only one weapon is incinerated.[14] The Committee calculates "an average of less than 4" for ASROC - the most common tactical nuclear missile.[15] And while this is probably correct for many vessels, both nuclear and conventionally powered U.S. aircraft carriers routinely carry up to 100 nuclear weapons. The U.S. Navy has nine such conventionally powered ships that have unrestricted access to Australian ports.[16] The Committee was also unhappy with the sketchy scenario offered by Prof. Davis in which a three-hour fire of unspecified origin releases the plutonium.

It is clear that all these alleged deficiencies are the result of Prof. Davis' concentration upon the consequences of an accident rather than the many possible sequences of events that might lead to an accident. In assuming the dispersal of the contents of one warhead rather than the destruction by fire and explosion of an entire aircraft-carrier load of up to 100 bombs, he is being conservative. And if only one warhead were to be destroyed and a lesser percentage of plutonium released, we could still face severe consequences.

I believe that this focus on results is the correct starting point for an assessment; the U.S. documents certainly

13 Ch.11 para.26.

14 Evidence, 27 March 1987, p.593.

15 Ch.11 para.27; but see note 38 for a discussion of the deployment of Terrier anti-aircraft missiles.

16 J. Handler and W.M. Arkin: Neptune Papers No.2(May 1988), "Nuclear Warships and Naval Nuclear Weapons: A Complete Inventory", p.13, p.43.

emphasise the risk of airborne contamination by plutonium as the most likely serious result of a weapons accident.[17] (U.S. forces have also held regular NUWAX exercises to train personnel in reactions to a nuclear weapon accident; an Australian observer attended the 1981 exercise and the Department of Defence has been briefed on others.) In demanding a rattling good yarn as a prerequisite for a serious examination of weapons accident consequences the Committee is failing in its duty.

Prof. Davis concluded that the range of long-term casualties - as victims of alpha-particle induced cancers - from his hypothetical accidental release of 5 kg of plutonium in Sydney Harbour range from 33 to about 11,000, depending on ambient weather conditions, with possible massive economic and environmental costs.[18] This represents an accident potential that far exceeds any other humanly mediated peacetime disaster. If a fully laden jumbo jet were to crash in a heavily populated part of Sydney - or any other Australian city - we might expect about 1000 deaths, but the major effects would persist for no more than a generation. A large-scale plutonium contamination could turn a large part of an Australian port city into a ghost town and, apart from the more immediate casualties, would present an insidious and worrying health threat for centuries.

(e) Plutonium contamination

The Report does, somewhat obliquely, address the dangers of aerosol forms of plutonium, tending to minimise the possibility of the aerosol form being produced by an accident as well as the dangers to human health.[19] Given

17 Ch.12 para.23 and note 29; Ch.12 para.26 and note 33.

18 Evidence, 27 March 1987, p.489, p.494; note that two different dose factors are also applied.

19 Ch.11 para.35-42; note also the "balancing" statements of note 58.

the Committee's view on the "incredibility" of any accident, this seems an unnecessary excursion.

Fortunately, no large population has yet been exposed to high levels of plutonium contamination - and I hope that an Australian city does not become the laboratory for this experiment - so exact exposure risks remain debatable. But the U.S. authorities - both civil and military - do not regard plutonium contamination lightly; acceptable limits are very low and major efforts have been made to clean up after plutonium releases.[20] Radon gas in both industrial and domestic situations can induce cancers through its "daughter" isotopes in the same way as plutonium; this problem is the focus of continuing concern and study. And the British National Radiological Protection Board is currently trying to establish a study of the distribution of plutonium and americum around British nuclear power plants, suspecting that these elements might provide an explanation for the puzzling clusters of childhood leukemia cases around some of these plants.[21] It is just not accurate to imply that plutonium is a relatively benign substance. It is also widely accepted that the recent data on Hiroshima and Nagasaki will result in a lowering of the radiological exposure reference levels by a factor of about four. These are just some indications of the fact that the malign effects of many radioactive substances are not disappearing as we learn more about them.[22]

20 For instance, P.R. Ehrlich cites a maximum permissible concentration of plutonium in air of 6×10^{-14} Ci/m^3 and in water 5×10^{-6} Ci/m^3. Since there are 16 grams per curie for plutonium, the figures by mass are 9.6×10^{-13} g/m^3 for air and 8×10^{-5} g/m^3 for water. P.R. Ehrlich, A.H. Ehrlich & J.P. Holdren, "Ecoscience", 1977, W.H. Freeman & Co., San Francisco, p.454.

21 New Scientist, 19 Feb. 1989, p.26.

22 Ch.7 para.112.

(f) The accident at Thule in Greenland

In referring to the accident at Thule in Greenland, where four nuclear devices exploded when a B52 bomber crashed and burned, the Report implies that the accident was relatively harmless in any radiological sense. In chapter 11 the Report says, "A small amount of plutonium became airborne but the total amount of the plutonium dispersed in this way outside the immediate crash site was considered of no biological significance".[23] But it is worth taking a closer look at this accident which is quite thoroughly reported in USAF Nuclear Safety, Jan/Feb/Mar 1970.[24]

A small fire which started in the cabin heating system of the aircraft could not be controlled with the available fire extinguishers. It spread and all electrical power was lost as the aircraft made its approach to the Thule base for an emergency landing. The crew bailed out and the B52 crashed on the sea ice over deep water about 8km from the base. All four unarmed bombs exploded, reducing the airframe to small fragments, and plutonium was blown into the burning fuel. The fuel burnt fiercely and a 7-9kt wind (groundspeed) blew the smoke away from the base and populated areas, mostly out to sea.

Before the clean-up started there were two periods of high winds (one of 12 hours and one of 24 hours duration), with wind speeds of 25kts gusting up to 45kts, further diluting the plutonium spread over the snow and ice.[25] Where the aircraft struck the ice - which was about 1m thick - it was cracked but most of the debris remained on the ice surface or in the layer of snow and ice melted by the fire. This

23 Ch.11 para.104; see also the reference in Ch.11 para.39.
24 USAF Nuclear Safety, Jan/Feb/Mar 1970, Vol.65 (part 2) Special Edition.
25 ibid., p.14.

refroze within minutes of the cessation of the fire and thus immobilized the plutonium oxide particles blown downward by the explosion and caught in water and unburnt fuel.

A major clean-up exercise was instituted, at vast expense. The main phase lasted for two months and 700 people were involved. More than 5.5 million litres of the most heavily contaminated snow and ice (containing about 3kg of plutonium) was removed and shipped back to the United States.[26] Attempts were made to speed up the melting of the rest of the most contaminated ice (containing an estimated 350g of plutonium). No attempt was made to clean up the plutonium contaminated pieces of wreckage that had sunk to the sea floor.

Various surveys were conducted by U.S. and Danish scientists during and after the clean-up. Radio-ecological surveys showed the greatest concentrations of plutonium in bottom-living sea animals (up to 1000 times background levels in bivalves). Levels were significantly raised in many species, including particulate contamination of eider ducks. An examination of dietary and working practices of the native Greenlanders concluded that ingestion and respiratory doses were unlikely to reach the threshold limit.[27] Urine tests on humans were largely negative; early positive tests may have resulted from contamination of the samples. However, plutonium levels were significantly raised up to 20km from the crash site.[28] In this context we should remember that the widespread background plutonium levels are not "natural" - the early atmospheric tests injected about 5 tons of plutonium into the global enviroment. Such testing is now considered A Bad Thing by all parties.

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26 ibid., p.38; note also that two trains, one of 66 railroad cars and one of 81 cars was necessary to transport the waste when it arrived in the United States (p.90).

27 ibid., p.74-9.

28 ibid., p.78.

(q) Issues raised by the Thule accident

I mention this accident in some detail partly because it receives little attention in the Report, but also because, as an "achieved" accident it is a valuable precedent.

Firstly, the accident was precipitated by an apparently minor event in a peripheral system. The safety equipment proved to be inadequate and a major system failure followed. I doubt that the Committee would find this scenario "credible".

Secondly, the aircraft carried four nuclear weapons. Although these were fusion weapons, as far as we know the fission components and the quantity of plutonium would be approximately equivalent to four naval nuclear weapons.[29] The fission components - including the explosive - probably belonged to the same design generation as many of the naval weapons aboard visiting warships. Although some safety systems may have been retro-fitted to currently deployed naval weapons, it is believed - as the Report states - that some naval weapons cannot easily be converted to use Insensitive High Explosive.[30]

Thirdly, the aircraft crashed at high speed (estimated at about 500kts) but at a shallow angle, and the explosive in all four bombs detonated - with considerable force. Interestingly, the entire plutonium content appears to have been atomised and oxidised to small particles of plutonium oxide, either by the force of the explosion alone or the combination of the explosion and fire. The plutonium oxide particles had a count median diameter of 2 microns (with a

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29 See below n.30.
30 Ch.11 para.55-6 and n.88.

standard deviation of 1.7) and the calculated mass median diameter was reported as 4 microns. Ten microns is considered the upper limit for dangerous respirable particles.[31] There is no mention in the report of large lumps of plutonium. A very high percentage of the plutonium was clearly present at the accident site in the form of a respirable aerosol. I calculate that about 70% of the plutonium was dispersed beyond the clean-up area, most of it as a respirable aerosol.[32]

This accident casts a new light on the section of the Report that stresses the difficulty of producing a plutonium aerosol; it appears that explosion and fire and perhaps explosion itself is capable of reducing a high percentage of a weapon's fissile content into a respirable aerosol. This real-life accident has many of the characteristics of the scenario offered by the AIRAC submission, but with the addition of a fuel fire.[33] The Committee refers in passing to this scenario but avoids an examination of its consequences by failing to find a "credible" context.

The Greenland accident is scarcely the worst that could happen, and several features tended to minimise its effects. The area around the accident site was very thinly populated and at the time of the accident the wind was blowing away

31 USAF Nuclear Safety, vol.65, p.38; see Ch.12 n.32 for a U.S. source for the 10 micron respirable particle limit.

32 ibid.; from a statement on p.40 giving the volume of water required to dilute 350g of plutonium to the maximum permissible level ($5x10^4$ m^3) - which represents a very high level - and a comment on p.20 by the SAC On-Scene Commander, Maj. Gen. R.O. Hunziker, that 1/500th of a cubic kilometre of water would dilute all of the plutonium oxide from all of the weapons to "drinking water standards" (probably the same level), we can calculate that roughly 14kg of fissile material was involved in the accident and that about 10kg must have been dispersed beyond the clean-up area. This estimate is supported by a casual reference to the need to evaluate a possible critical mass accident in storage tanks (p.20). This question would not have arisen if there had been less than about 8kg of plutonium metal present in the four bombs.

33 Ch.12 para.24-5.

from inhabited areas. The fire was brief and fierce, producing a high thermal loft which tended to dilute the plutonium. The environment was seasonally self-cleansing, and the high winds also diluted the contamination. Nevertheless, the decontamination was difficult and clearly very expensive.

(h) Additional information from the Palomares accident

The Palomares accident took place in Spain in 1966. A B52 carrying four fusion bombs collided with a KC-135 tanker during re-fueling. The bombs fell from the aircraft as it disintegrated; three of the bombs deployed their 64ft parachutes as designed, the other may not have. One of the bombs fell into the sea, one fell on land without detonating, one parachute-retarded weapon suffered a partial detonation and the last a much more complete explosion which excavated a crater six feet deep and twenty feet wide. Fragments of the exploded bombs were found some hundreds of yards away and plutonium contamination was obviously widespread, although the records are somewhat sketchy because the equipment used by the clean-up force was inadequate and prone to breakdowns. Vegetable matter and soil from the badly affected areas were shipped to the United States for burial.[34]

Reports of this accident are less comprehensive in many respects than those of the Greenland accident. For instance, I have not found mention of a survey of the particle size of the plutonium contamination, although some indications lead me to believe that it was quite small since some areas were contaminated by the wind resuspending the particles.[35] Reading the report of the clean-up one gathers

34 U.S. Defense Nuclear Agency, Technology and Analysis Directorate, Palomares Summary Report, (DNA, 1975).
35 ibid., p.50.

that although it was extensive - and also clearly a very expensive exercise - some corners were cut. Lightly contaminated land was merely ploughed but the most vivid example concerns some buildings that could not be de-contaminated to an acceptable level with water; they were whitewashed.[36]

(i) Other weapons risks

Accidental nuclear explosion

Some of the submissions by individuals or groups strongly opposed to the visits of nuclear-armed warships have explicitly or implicitly accepted the assurances - reiterated in the Report - that the risk of an accidental nuclear explosion is extremely remote.[37] I have been inclined to accept this myself, with the reservation that naval weapons especially may not be proof against the ingenuity of a mentally disturbed naval officer.

However, the tones of surprised relief in official accident reports make me wonder if we have not been too gullible on this matter. Consider this official comment from the 1975 Palomares Summary Report:

"Small as it is, the probability of a nuclear yield in an accident makes weapon safety the first concern at all levels of military command...It is reassuring that the safety engineering that was employed in the weapons was successful in preventing a nuclear explosion at Palomares and it is important to note that there has never been an accidental nuclear explosion involving United States weapons".[38]

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36 ibid., p.60.

37 Ch.12 n.1 for submissions discounting nuclear detonation and Ch.12 para.2-17 for a discussion of nuclear detonation risks.

38 Palomares Summary Report, p.24.

This is scarcely the confident tone of one who knows that an accident to a nuclear weapon cannot produce a nuclear yield - a full or partial nuclear explosion; and I wonder if the development of Insensitive High Explosive was motivated not only by a desire to reduce the probability of an accidental contamination but also to reduce the risk of an accident that could result in at least a partial nuclear yield. This is one obvious area where the military might lie about the real risks. One could speculate about an explosive wavefront impinging simultaneously on two sides of a nuclear warhead, but I don't know whether this could produce a nuclear explosion. Nor does the Committee and we are unlikely to find out.

Explosives on ships

The Committee has alluded to the good magazine safety record of the western navies and even the Falklands War where some damaged ships were saved from total destruction by their fire-fighting systems; of course, some were not.[39] It seems obvious from the Thule and Palomares accidents that full detonation of the explosive in a nuclear weapon would rupture both the magazine and the hull in lightly constructed modern warships.

I notice that the NATO Safety Principles for the Storage of Ammunition and Explosives states that "it is likely that an initial explosion of any significant size will cause the complete loss of the vessel".[40] If a nuclear-capable ship were to suffer a large conventional munitions explosion it seems very likely that the nuclear weapons would also explode. Although this risk may be small, it must be added to the intrinsic risk of the nuclear weapons themselves. Even the best fire-fighting system will not stop an

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39 Ch.11 para.75.

40 NATO Safety Principles for the Storage of Ammunition and Explosives, 1982, part iv, ch.6, para.604.

explosion once it has begun and I have grave doubts about its ability to control propellant fires. There is good reason to believe that nuclear warheads are kept assembled with their missile propellent in the more modern types of magazine. The recent accident on the USS Iowa serves as a reminder that nuclear weapons and nuclear-capable warships are festooned with safety systems not because they are safe, but because they are dangerous.

(j)Weapons accident conclusion

Unlike the Committee, I have little difficulty in imagining a nuclear weapons accident. If a release like that in Greenland were to take place in an Australian port I would not much care what unlikely sequence of events had led to the accident; the results could be terrible. If, for instance, there was a major plutonium contamination in Sydney Harbour not only could many people be exposed to a dangerous and very long-lived radiotoxin, but the commercial life of the city would be brought to a stand-still and harbour-side properties would be going for a song.

The Committee is demonstrably wrong in its assertions about plutonium aerosols, and it is impossible to know what else it is wrong about. I confess to a state of ignorance mixed with foreboding about the probability of a nuclear weapons accident, and I believe that the Committee shares with me at least the ignorance. I do not believe that our allies would provide us with the information necessary to make a realistic assessment, nor would I wish them to. As I observed at the beginning of this section, our Non-Proliferation Treaty commitments oblige us not to seek to acquire this information. To be consistent, however, we should determine not to have anything to do with nuclear weapons, in our harbours or anywhere else.

Finally, in view of the consequences of a full-scale contamination accident, I cannot imagine that the hypothetical VSP(N) Nuclear Weapons Accident Safety Plan could offer a worthwhile defence; nothing short of total exclusion will do.

4. Access, Targets and Dry-docking

(a) The strategic importance of access

The U.S. Navy particularly wishes to keep Australian ports open to its warships, not, I believe, primarily for their rest and recreation facilities, although the well-being of its personnel is an important part of a navy's effectiveness. It is the strategic potential of Australian ports as sources of supply and maintenance that is more important. In a time of crisis many of the rules and "assurances" about U.S. naval practice in Australian ports would be lightly discarded. Not only may we have to suffer the increased risks associated with practices that are currently proscribed during peacetime "goodwill" visits, but, because of our undiscriminating acceptance of nuclear-powered and nuclear-armed warships, we may also suffer war damage associated with these vessels even if the U.S. is engaged in a war of which our Government disapproves.

(b) Conventional targeting of nuclear warships

One risk is that of nuclear-powered and nuclear-armed warships being struck by conventional missiles. If the U.S. Navy's plan to fight a conventional war at sea is realised (see below), then Australian ports may be exposed to the risk of nuclear accidents resulting from conventional missile strikes. The Australian ports most likely to suffer from a conventional missile striking a nuclear vessel would be Western Australian ports already receiving large flotillas of U.S. warships that would present particularly attractive targets for an enemy.

The possibility of collateral damage from conventional missiles was raised in an article in "The Australian", where the plan to locate a petrochemical plant next to HMAS

Stirling was mentioned.[1] During a recent visit to Australia, Professor K. Subramanyan, former director of India's Institute for Defence Studies and Analysis, referred to the danger to coastal installations from missiles that have ranges of up to several hundred kilometres.

It is not only a war with the U.S.S.R. that could expose nuclear warships to attack. India is expanding its navy, leases one nuclear-powered cruise-missile submarine from the U.S.S.R. and probably plans to deploy more of them, and sees itself as an emerging great power.[2] U.S. support for Pakistan led the U.S. Navy to threaten India in 1971 by sailing the USS Enterprise into the Bay of Bengal during the conflict that led to the creation of Bangladesh. This made a deep impression upon Indian strategic theorists and they plan to be ready if the U.S. tries this again. India has dual-capable long-range missiles for its nuclear-powered cruise-missile submarine, and U.S. fleet concentrations on Australia's west coast would be a natural target. A conventional missile strike on a nuclear-powered vessel could clearly cause an uncontained reactor accident. Similarly, a strike on a nuclear-armed vessel could produce a major plutonium contamination.

(c) Nuclear targeting of U.S. warships

Only very odd people like to think about nuclear war. Most of them are nuclear strategic theorists, the people who invented concepts like "mutual assured destruction". Members of the Committee are not odd in this way, although it could be argued that some unpleasant exercise of the

1 The Australian, 22-3 April 1989, p.24.

2 See Dr M. McKinley,"At Anarchy's Rim: Australia and the Indian Ocean", a paper delivered at the Bicentennial Conference ANU, December 1988, p.25 for a forecast that India will aquire six nuclear-powered submarines. See pp.22-26 for a discussion of Indian military expansion, especially naval expansion.

imagination is part of their job. Nuclear targeting did come up during the presentation of evidence by Professor Jackson Davis, when there was a rather heated exchange that wandered over whether nuclear-capable U.S. warships would be targets for nuclear weapons, as well as "theatre" nuclear wars and the "nuclear winter" theory (see Appendix 2b). Senators Hamer and Sir John Carrick entered freely into this discussion and offered some pungent opinions, despite the terms of reference, so I feel I have a special licence to mention nuclear targeting.

On this occasion, Senators Hamer and Sir John Carrick refused to take seriously the possibility of nuclear targeting of visiting warships in a "theatre" or "limited war" - which makes me wonder if they were vocationally suited to a committee considering the accident risks presented by vessels largely designed for that very purpose.[3] However, the latest U.S. Navy plan (Sea Plan 2000) to fight a nuclear-armed enemy with nuclear-armed warships but using only conventional weapons is only another variant of a "limited war" theory that could - if it is ever put into effect - run out of control and bring nuclear missiles down into Australian ports. Again, the target ports are most likely to be the recipients of large numbers of U.S. warship visits. Although analysis shows that the U.S.S.R. has a large surplus of missiles available it is impossible to prove that our ports are targeted, just as it is also impossible to prove that the "Joint Facilities" are targets. Yet our Government has conceded that the latter are likely targets by preparing contingency plans for a nuclear attack.

3 Evidence, 27 March 1987; Senator Hamer stated that targeting of allied nuclear-capable vessels in Australian ports was "very improbable speculation" (p.586), and Senator Sir John Carrick refused to consider the concept of theatre or limited war valid in a Pacific context (pp.584-9). Note a reference in the Report to "theatre nuclear weapons" on warships visiting Australia, Ch.11 para.22.

(d) Dry-docking nuclear-armed ships

Australia's official position on the repair and dry-docking of nuclear-armed ships is ambiguous. The incumbent Minister for Defence appears to be ready to compromise the Government's policy and at least the spirit of its treaty obligations (under the South Pacific Nuclear Free Zone Treaty) for the convenience of our allies.[4] In a recent letter to the Committee (11 April 1989) the Minister claims that dry-docking of nuclear-armed warships does not constitute the stationing of a nuclear device and therefore does not violate the provisions of the Treaty.[5] If Mr Beazley is right it is because Australia conspired to dilute this Treaty to the point where Mr Spender - if he ever becomes Minister for Defence - could effect his projected deployment of "allied" nuclear weapons without withdrawing from the Treaty by christening his missile sites "HMAS Dry-dock".

The dry-docking issue has arisen with warships of the Royal Navy, but the apparent refusal to dry-dock the HMS Invincible attracted the unconcealed wrath of the United States. As a subordinate ally of the U.S. the Royal Navy is obliged to play the "neither confirm nor deny" game with its NATO-integrated nuclear weapons and it is unclear exactly why the Australian Government was reluctant to offer dry-docking facilities. I had hoped that the Government was motivated by a reluctance to involve Australia any more intimately with nuclear weapons.[6] However, the abandonment of principle and the emphasis upon pragmatism that is

4 See HR Hansard, 8 December 1983, p.3515: Mr Gordon Scholes; "We are totally opposed to nuclear weapons being on Australian soil, and that is a policy we will not depart from".

5 Letter from the Minister for Defence, 11 April 1989.

6 See Senator David Hamer's "Additional Statement", Report p.219 for another explanation.

evident in current Government policy decisions suggests that nuclear-capable vessels will be dry-docked in Australia in the future.

In 1983 Senator Gareth Evans - as Attorney-General - made a lengthy statement in Parliament and said that there was no established policy in place to cover dry-docking situations for "non-conventional weapons", guidelines ought to be established, discussions had taken place at a ministerial level and further discussions would take place at an official level. Senator Evans said that guidelines would be available in months rather than days or weeks.[7] Years later, there is still no declared and justified policy, but the current Minister for Defence is clearly willing to dry-dock nuclear weapons capable vessels, without de-ammunitioning, for "external repairs". He speaks of possible "de-ammunitioning ...(perhaps at sea to a sister ship)" as a way of saving our allies from having to declare the nature of the armaments aboard a more seriously damaged ship.[8]

What will happen in a real emergency will be another matter altogether.

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7 The Senate, 15 December 1983.
8 Ch.11 para.84-5.

5. Conclusion and Recommendations

The United States has assured us that special safety plans are not necessary for visits by either nuclear-powered or nuclear-armed warships; as a matter of policy it refuses to comment upon plans produced in defiance of this advice. This Senate Committee has implicitly rejected this advice from our ally but has conducted this enquiry without the will or the political freedom to do more than apply a rubber-stamp to the existing arrangements.

Military secrecy has proved to be an insuperable obstacle for this enquiry. Many important facts and details have been withheld from the Committee and although an absence of information on a certain point might be noticeable we cannot know what this means. However, it is the military features of naval reactors which compromise safety that are most likely to be secret.

The Committee's naval reactor argument is replete with technical terms, large figures and ingenious calculations. A close examination reveals these to be mostly guesses and unverifiable assertions.

The Committee correctly confesses to ignorance about many aspects of nuclear weapons. Despite this, the Committee concludes that all the nuclear weapon accident hypotheses presented in submissions are "incredible" and that no accident contingency planning is necessary. Nevertheless, it also suggests that an embryonic Department of Defence nuclear weapon accident contingency plan should be completed. If a nuclear weapon accident in an Australian port really is incredible then completion of this plan would be a waste of public resources.

Throughout the Report accident consequences are minimised. Not only does the Committee avoid examining the worst-case consequences of nuclear weapon accidents, it also avoids assessing the possible long-term effects of contaminating accidents involving either nuclear weapons or nuclear reactors.

This Report has failed to establish the necessary technical base for the formulation of safety plans and has revealed the inadequacy of the existing plans. Despite its length and complexity the Report is only a thin shadow of the report that would be commissioned by a Parliament truly concerned about the exposure of the country's citizens to nuclear risks. Such a report could not be begun without the wholehearted cooperation of the nations designing and deploying the nuclear reactors and nuclear weapons.

I therefore RECOMMEND that all nuclear-powered warships be excluded from Australian ports until a thorough safety analysis confirms a level of safety acceptable to the Australian people.

I further RECOMMEND that all nuclear weapons be excluded from Australian ports and that only warships recognised by independent international authorities as not nuclear capable should be invited to enter Australian ports.