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NAVAL NUCLEAR PROPULSION PROGRAM—1979

DOCUMENTS

HEARING

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DEPARTMENT OF ENERGY AUTHORIZATION LEGISLATION (NATIONAL SECURITY PROGRAMS) FOR FISCAL YEAR 1980

BEFORE THE

PROCUREMENT AND MILITARY NUCLEAR SYSTEMS
SUBCOMMITTEE

AND

SEAPOWER AND STRATEGIC AND CRITICAL
MATERIALS SUBCOMMITTEE

OF THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

NINETY-SIXTH CONGRESS

FIRST SESSION

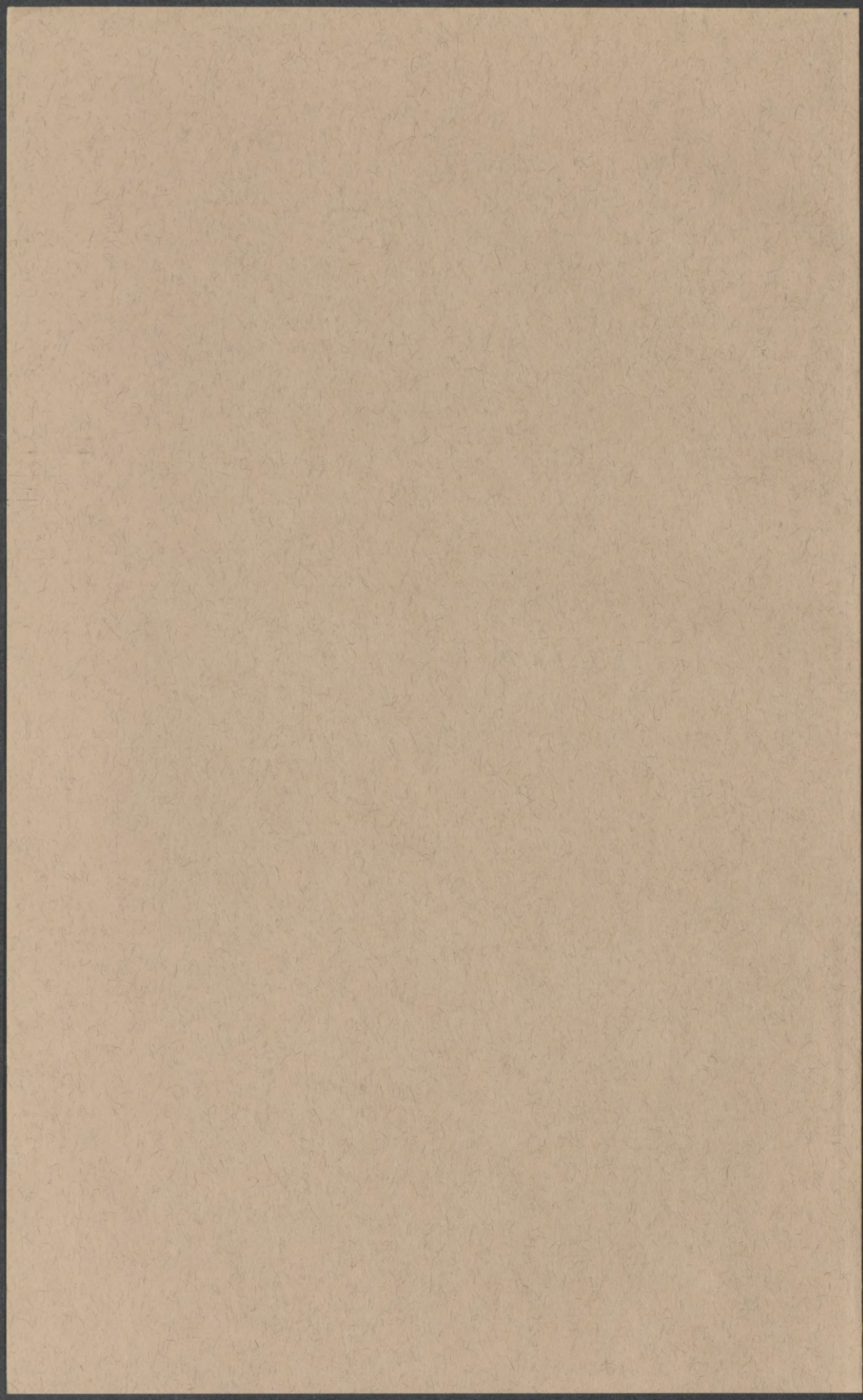


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H E A R I N G

ON

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FIRST SESSION



MARCH 1, 1979

U.S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1979

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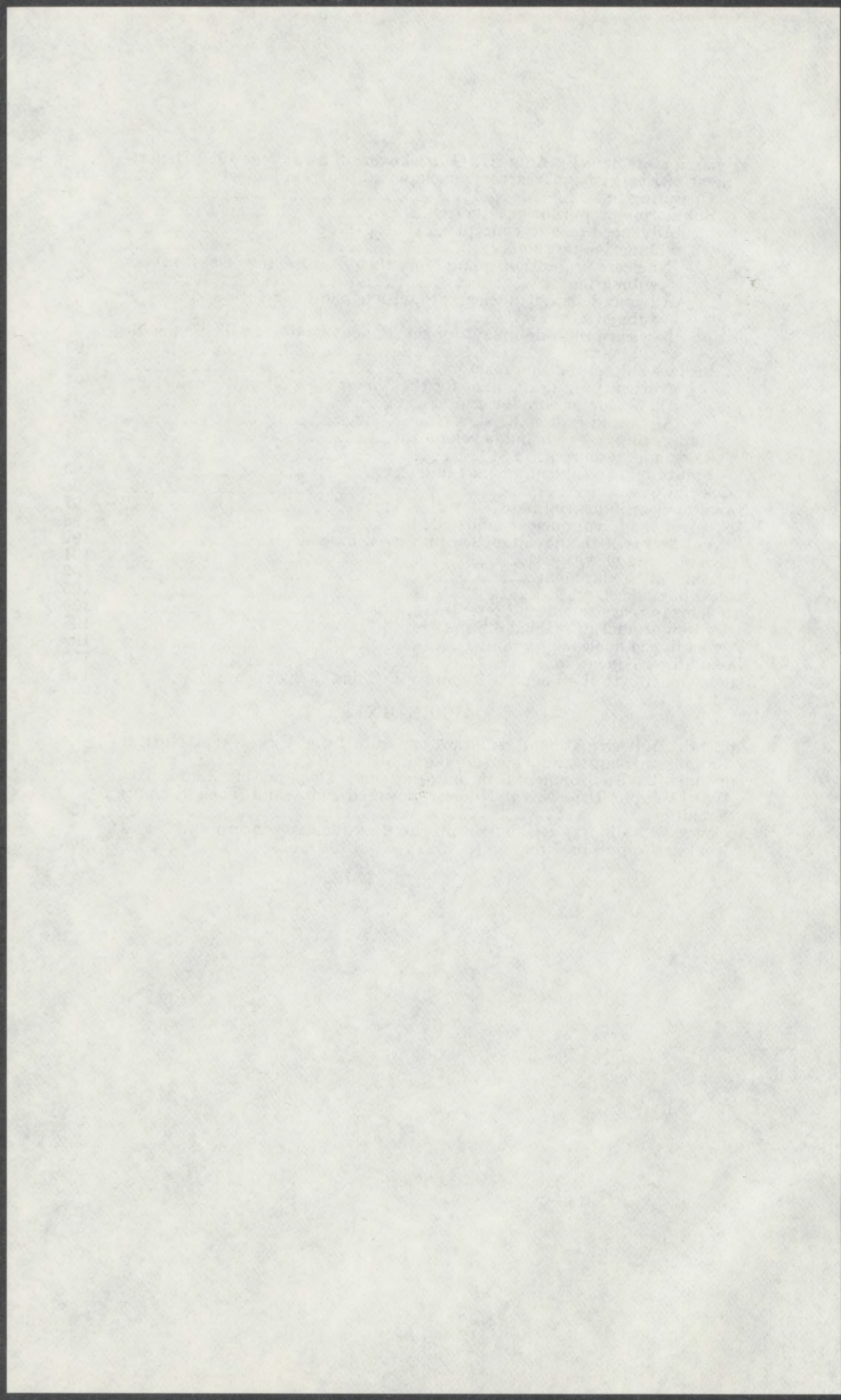
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FOREWORD

CONGRESS OF THE UNITED STATES,
COMMITTEE ON ARMED SERVICES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., April 28, 1979.

In accordance with changes to the House Rules (House Resolution 5), adopted on January 4, 1977, the Armed Services Committee assumed legislative functions formerly held by the Joint Committee on Atomic Energy for national security programs of the Department of Energy (formerly the Energy Research and Development Administration). At that time, the Armed Services Committee established a Subcommittee on Intelligence and Military Applications of Nuclear Energy to oversee these programs; this subcommittee was renamed the Procurement and Military Nuclear Systems Subcommittee on January 26, 1979.

Two previous hearings on the naval nuclear propulsion program were held since the Armed Services Committee assumed responsibility for the program. These were April 27, 1977, "Naval Nuclear Propulsion Program—1977", and March 1, 1978, "Naval Nuclear Propulsion Program—1978."

This third hearing, which was held on March 1, 1979, was held jointly with the Seapower and Strategic and Critical Material Subcommittee of the Committee on Armed Services.¹

MELVIN PRICE,
*Chairman, Armed Services Committee,
U.S. House of Representatives.*

¹ The following hearings and reports on the naval nuclear propulsion program were published by the Joint Committee on Atomic Energy:

Mar. 18, 1976, hearing: "Naval Nuclear Propulsion Program—1976."
Mar. 5, 1975, hearing: "Naval Nuclear Propulsion Program—1975."
Feb. 25, 1974, hearing: "Naval Nuclear Propulsion Program—1974."
Mar. 28, 1973 and Feb. 8, 1972, hearings: "Naval Nuclear Propulsion Program, 1972-73."
May 5, 1971—Sept. 30, 1972, hearing and subsequent inquiry of the Subcommittee on Military Applications: "Nuclear Propulsion for Naval Warships."
Mar. 10, 1971, hearing: "Naval Nuclear Propulsion Program—1971."
Mar. 19, 20, 1970, hearings: "Naval Nuclear Propulsion Program—1979."
Apr. 23, 1969, hearings: "Naval Nuclear Propulsion Program—1969."
July 25, 1968, hearing: "Nuclear Submarines of Advanced Design," pt. 2.
June 21, 1968, hearing: "Nuclear Submarines of Advanced Design."
Feb. 8, 1968 and Mar. 16, 1967 hearings: "Naval Nuclear Propulsion Program, 1967-68."
Jan. 26, 1966, hearing: "Naval Nuclear Propulsion Program."
February 8 and April 8, 1965, hearings: "AEC Authorizing Legislation Fiscal Year 1966," pages 808-821, & 1037-1045.
June 26, 27, July 23, 1963, and July 1, 1964, hearings: "Loss of the U.S.S. Thresher," December 1963, report: "Nuclear Propulsion for Naval Surface Vessels."
Oct. 30, 31, and Nov. 13, 1963, hearings: "Nuclear Propulsion for Naval Surface Vessels."

Mar. 31 and Apr. 1, 1962, hearings: "Tour of the U.S.S. Enterprise and Report on

(Continued)

(Continued)

Joint AEC-Naval Reactor Program."

- June 15, 1961, hearings: "Radiation Safety and Regulation" pages 359-368.
Apr. 9, 1960, hearing "Naval Reactor Program and Polaris Missile Systems."
Mar. 10 1960, hearing before the Subcommittee on Legislation: "AEC Authorizing Legislation Fiscal Year 1961," pages 147-184.
Feb. 17, 1960, hearing: "Development, Growth, and State of the Atomic Energy Industry," pages 81-86.
Apr. 11 and 15, 1959, hearings: "Review of Naval Reactor Program and Admiral Rickover Award."
Mar. 23, 1959, hearing before the Subcommittee on Legislation: "AEC Authorizing Legislation—Fiscal Year 1960," pages 251-279.
Feb. 27, 1958, hearings before the Subcommittee on Agreements for Cooperation "Amending the Atomic Energy Act of 1954," pages 159-174.
June 24, 1957, hearing before Subcommittee on Legislation: "Authorizing Legislation," pages 383-395.
Mar. 7 and Apr. 12, 1957, hearings: "Naval Reactor Program and Shippingport Project."
May 9, 1955, hearings before Subcommittee on Authorizing Legislation, "Authorizing Legislation," pages 85-91.

(VIII)

HOUSE OF REPRESENTATIVES, COMMITTEE ON ARMED SERVICES, PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE AND SEAPOWERS AND STRATEGIC AND CRITICAL MATERIALS SUBCOMMITTEE,

Washington, D.C., Thursday, March 1, 1979.

The joint subcommittee met at 10 a.m., pursuant to notice, in room 2218, Rayburn House Office Building, the Hon. Melvin Price (chairman of the subcommittee) presiding.

The CHAIRMAN. The subcommittee will be in order.

INTRODUCTION

Chairman Bennett and I agreed to hold a joint hearing to receive testimony on Navy nuclear propulsion, an area where the two subcommittees have direct interest. Admiral Rickover will be the principal witness. Admiral Rickover is the Deputy Commander for Nuclear Propulsion for the Naval Sea Systems Command of the Department of Navy. He is responsible for the administration and operations for all work done in public and private shipyards on the Navy's nuclear propulsion systems. He will testify on the Presidential budget request for the authorization of appropriations for the naval research and development program for the Department of Energy for fiscal year 1980.¹

Admiral Rickover will also address the possible exposure to low-level nuclear radiation of those persons associated with naval nuclear propulsion plants and support facilities.

We will receive testimony on past and current procedures adopted by the Navy to reduce potential exposure. As the members are aware, Secretary Califano released an 800-page draft which, after 9 months and at least four major revisions, reached the conclusions on possible effect of low-level radiation on people. Mr. Califano referred to the low-level exposure as a serious public health issue to which a definitive answer may never be found.

In my years of association with Admiral Rickover, I know how concerned he has always been for the health, safety, and welfare of those associated with all aspects of the naval nuclear propulsion program. Admiral, we look to you to tell us what the Navy has done to reduce the potential for occupational exposure to low-level radiation. You may proceed, Admiral.

STATEMENT OF ADM. HYMAN G. RICKOVER, USN, DIRECTOR, NAVAL NUCLEAR PROPULSION PROGRAM; ACCOMPANIED BY WILLIAM WEGNER, DEPUTY DIRECTOR; MURRAY E. MILES, DIRECTOR, NUCLEAR TECHNICAL DIVISION; AND DAVID T. LEIGHTON, ASSOCIATE DIRECTOR FOR SURFACE SHIPS

Admiral RICKOVER. Mr. Chairman, an issue which is receiving considerable attention presently is the question of the health effects due

¹ See pp. 91-96 for fiscal year 1980 Budget Request.

to low-level radiation. This is not a new issue but there are those, particularly some in the news media, who would have us believe they just discovered it. I am aware there is considerable interest in this matter on the part of the members of this committee as it pertains to shipyard employees involved in naval nuclear work, and I have been assisting your staff in the review they are conducting.

Because this is a complex issue that has involved many organizations and activities, I have prepared a statement devoted only to low-level radiation exposure. I have another statement that deals with other programmatic aspects of the naval nuclear propulsion program. As I have been engaged in work involving radiation for over 30 years, I will address some of the recent issues in order to clarify the coverage provided by the news media. I should point out that the views I am expressing to you this morning are my own, and they do not necessarily reflect those of my superiors.²

APPROACH TO RADIATION

I would like to add one thing. I remember when I started work in nuclear power at the first central station nuclear powerplant at Ship-pingport, and the Atomic Energy Commission insisted that I brief all utility people on the question of safety. I made the point at that time that in considering safety for nuclear power I was proceeding as if my son would be directly involved in it and would be subject to the radiation. Therefore, I was using criteria which would affect my offspring. This is the attitude that I have taken consistently in the prosecution of the program, whether it is radiation or anything else. I believe you know the record of safety in the naval nuclear power program has been amply demonstrated. I want to make that point clear, because there has been lots of talk of coverups and all that nonsense by various staff members of certain committees of Congress who are new to nuclear power and believe that every possible Government employee is *ipso facto* a rogue who is trying to hide the truth from the public. I deeply regret that, and I hope that these staffs and their congressional Members take steps to stop this.

We have enough of this going on in Government as it is. An impression is being created today, particularly by the press, that every Government servant, including Members of Congress, are out to fool people. And I think it is time that this is stopped. We have a very complex country. We are faced with the most difficult problems we have ever been faced with. And if the impression is going to be created that all public servants are inherently dishonest and trying to cover up, we are in for one hell of a time. It is time that the press assumed some responsibility in the actions they take. I know that none of you can comment on that because you are running for public office but, as I told you before previously, I am not running for public office because I don't think I could be elected dogcatcher in a small community.

Now, after this diatribe, I will continue with my testimony.

The CHAIRMAN. Admiral, I could comment to this extent, that no program—and I have been associated with this program since the

² See Adm. Rickover's May 4, 1979 testimony before Science and Technology Subcommittee on R&D entitled "Perspectives on Nuclear Reactor Safety."

start of it—has been exposed more to public scrutiny than the atomic energy program. There have been reams of publications on it. I don't know of anything that has been withheld from the general public.

Admiral RICKOVER. Thank you, sir.

RADIATION EXPOSURE LIMITS

Since the beginning of the naval nuclear propulsion program, I have followed the radiation exposure limits used in the United States and internationally. These limits are not established by me or by the Navy. I do not have the authority, responsibility, or means to carry out the extensive work that is necessary to determine radiation exposure limits.

International and national organizations have been established to develop recommended radiation limits. The U.S. occupational radiation limits were approved by the President based on recommendations of the Federal Radiation Council in 1960. That Council no longer exists; its functions have been taken over by the Environmental Protection Agency.

The basic U.S. occupational radiation limits for an individual are (1) 3 rem per quarter year and (2) 5 rem accumulated dose for each year beyond the age of 18. Thus, 12 rem per year is allowable so long as one does not exceed his cumulative limit.

In my work I have always used the most restrictive official standards on radiation. For example, in 1966, when I learned of the suggestion by the International Commission on Radiological Protection that exceeding 5 rem in 1 year should be infrequent, I implemented a rigorous 5-rem limit. In 1974, the Department of Energy implemented 5 rem as a yearly limit for its contractors. In 1979, the Nuclear Regulatory Commission and other Government agencies are also considering adopting 5 rem as a yearly limit, which I have had in effect since 1966.

There have been suggestions that the limit should be reduced even more. What the limit should be is not for me to say. It must be based on careful research and weighing the potential risks with the benefits. I assure you, however, that if it is determined that the radiation limit should be reduced, I will implement the change for my work. Of course, if such a change were to result in curtailment of nuclear ship operations, I will report that to Congress where the final decision on what to do must be made.

NAVY RECORD ON OCCUPATIONAL RADIATION EXPOSURE

Last year I testified before you on the record of the naval nuclear propulsion program in controlling radiation exposure, and provided a report for the record. I understand copies of this report were circulated to the members earlier this week. An updated report has just been issued that includes data covering 1978. I would like to provide copies to the members and, with your permission, include a copy in the record.

The CHAIRMAN. Without objection, that will be done.

[See Appendix 1, page 119.]

Admiral RICKOVER. Page 2 of this report shows a graph of the total occupational radiation exposures to personnel operating ships and to

employees in the shipyards. In 1978 the total exposure was about one-quarter the amount in the peak year 1966, even though the number of nuclear-powered ships nearly doubled during the intervening period.

A copy of the graph follows:

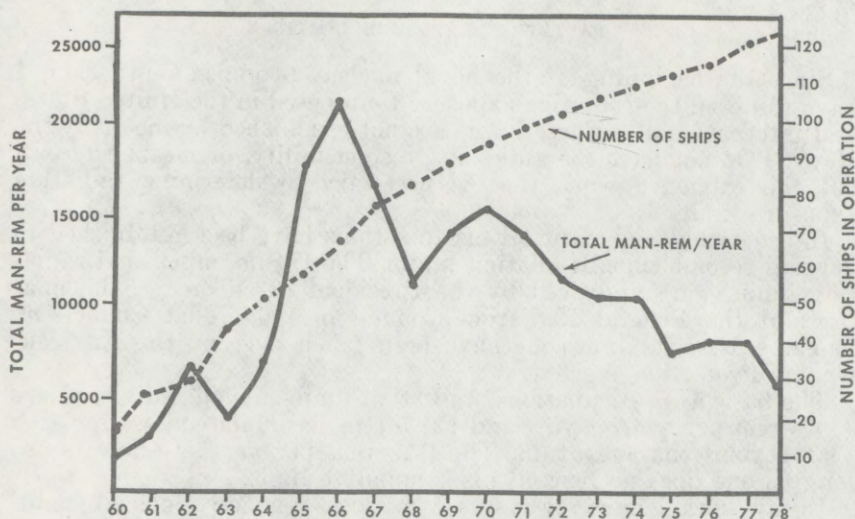


FIGURE 1

TOTAL RADIATION EXPOSURE RECEIVED BY MILITARY
AND CIVILIAN PERSONNEL IN THE NAVAL NUCLEAR
PROPULSION PROGRAM 1960 - 1978

No civilian or military personnel in the naval nuclear propulsion program have exceeded quarterly or annual radiation exposure limits since 1967. The maximum exposure received in 1978 by an individual was 3.068 rem, the only person out of 37,387 military and civilians to receive more than 3 rem in 1978. The average annual exposure of shipyard radiation workers in 1978 was one-quarter of a rem. The average annual exposure of ship nuclear propulsion plant operators in 1978 was one-tenth of a rem.

In fact, today a man gets less radiation by being submerged in a submarine than if he were up in the atmosphere. Actually, it is about one-third. It is the safest place to be. And I advise any of these critics of radiation to immediately try to enlist in the nuclear service. They will be safer.

As a related matter there is another report which describes the record of the naval nuclear propulsion program in handling radioactive waste. I have copies of this report for the members, and with your permission I would also like to include a copy in the record.

The CHAIRMAN. Without objection, it will be included in the record. [See Appendix 2, page 158.]

Admiral RICKOVER. This is the 14th annual report I have made on this subject.

The results show that the total gamma radioactivity discharged to all harbors in each of the last 8 years has been less than two-thousandths of a curie. The radiation to which people are exposed from

two-thousandths of a curie is less than the radiation one person would get in about seven or eight chest X-rays.

If one person were able to drink the entire amount of radioactivity discharged into any harbor in 1978, he would not exceed the annual radiation exposure permitted by the Nuclear Regulatory Commission for an individual worker.

DEVELOPMENTS REGARDING DR. NAJARIAN AND BOSTON GLOBE STUDY

With regard to actions concerning health effects due to radiation exposure, I first received the report of radiation studies of the workers at Hanford in December 1977. Hanford, as you know, is a weapons activity and not my responsibility. But since the report cited some apparent health effects, I requested those responsible within the Department of Energy to arrange for an independent study of the effects of radiation on the health of shipyard workers. This study is being performed by Johns Hopkins University and they have visited and obtained data from all six naval shipyards which do nuclear propulsion work as well as the Electric Boat Division of General Dynamics.

In February 1978, Dr. Thomas Najarian and the Boston Globe, in a joint—and mark that word “joint” so you will understand later on why the Boston Globe takes a consistent stand no matter what the facts are—in a joint venture, published a study they had conducted which caused wide concern. Their study alleged that radiation had caused increased cancer death rates at Portsmouth Naval Shipyard. They had reviewed State records and found 1,722 death certificates of persons identified on the certificates as shipyard workers. They contacted the next of kin of about one-third of these to identify which were radiation workers. The report alleged that shipyard employees in the study determined to have been exposed to radiation had a cancer death rate twice the national average, and 80 percent higher than the rate for shipyard workers who, according to the study, did no nuclear work.

So there you have a direct comparison according to their study.

Since issuing this report, Dr. Najarian has spoken before many gatherings, and many newspapers have repeatedly reported on this study in a manner which leads the readers to believe its findings are accurate. In a number of cases it has been erroneously summarized; the conclusion being that the overall death rate for Portsmouth radiation workers is six times normal. All of this has resulted in strong public and congressional interest and the establishment of the Center for Disease Control's epidemiological study of Portsmouth.

SCIENTIFIC CODE IS TO ALLOW INDEPENDENT REVIEW

I would like to interpolate for a moment about the responsibility of people who yell fire. When a man who is a scientist or calls himself a doctor speaks in accordance with the precepts of science, he must make his data instantaneously available to anyone who cares to look at it so that his peers can determine and criticize if necessary what he says. Otherwise it is not considered valid by the scientific community. A man who calls himself a doctor and assumes the mantle of

science is bound by these moral rules which have been set up for many centuries. Dr. Najarian has refused consistently to supply all of the data upon which his so-called facts are based. Recently he has given some of that data. I strongly recommend that this committee hear Dr. Najarian and ask him to turn over all his data, and that the committee appoint a group of their own choosing which they believe to be competent to study these figures and report whether or not they are accurate.

Now, so much for Dr. Najarian at the moment. As far as the Boston Globe is concerned, the press vaunts itself on its freedom to publish whatever it desires, because it is protecting the public interest. When the Boston Globe was asked to supply its data, they would not. It seems to me this is quite inconsistent with the freedom and obligation of the press. Here they are stirring up the public to think that they are being maltreated, and yet when they are asked for the data, they will not furnish it. I think this is a reprehensible use of the press and I believe the organization which the press has established to check the accuracy in media should investigate this issue and see to it that no such events can happen in the future. If the Boston Globe is correct, when they warn the public about dangers, it seems to me they have the obligation to furnish the data for disinterested people to look at and determine whether it is accurate or not. In the absence of such an intent by the Boston Globe, no rationally minded person would believe other than that they have something to hide. If they have nothing to hide, let them show their data. I hope that this gets published by the press to show how reprehensible even the press can be.

COMMENTS ON NAJARIAN STUDY

There are some important developments which have not received much attention. One is that the Najarian study has been reviewed by other experts who found it to contain serious deficiencies. The British National Radiological Protection Board found a number of problems ranging from biased and inadequate data collection to failure to account for the effects of other carcinogens. I understand that even Dr. Najarian has recently determined that some of his original leukemia cases he thought to have occurred in radiation workers were not in fact nuclear workers. That the results of the Najarian study are highly questionable has received virtually no public notice.

A second important fact is that neither Dr. Najarian nor the Boston Globe have been willing as I said, to cooperate fully with the Center for Disease Control or some other independent organization in verifying the study. This is particularly reprehensible since it is leaving the public under a continuing cloud of anxiety. For a doctor and a newspaper to be unwilling to provide all of their data in a situation like this is contrary to the public interest and certainly inconsistent with their public and professional obligation. I have yet to see an article in the Boston Globe reporting on their and Dr. Najarian's reluctance to cooperate and the reasons for it. If they are genuinely interested, as I said, in the health of the public and of the shipyard workers, and not just in publicity, they should and would have cooperated fully

and immediately. That they have not is, in my opinion, unconscionable and raises questions of public policy on the "freedom of the press."

Does anyone have the freedom to frighten the public and never admit making a mistake? I don't think so.

NAVY COOPERATION WITH CENTER FOR DISEASE CONTROL

With regard to the study by the Center for Disease Control, CDC, I have insured full cooperation by the Navy to the CDC people and their panel of independent scientific and medical experts established to monitor and review the study. The Navy has provided CDC the personnel records of the 25,000 workers who worked at Portsmouth for at least 1 day since January 1, 1954. That is when they first started doing nuclear work.

The Navy has also provided CDC with the radiation histories for the approximately 10,000 workers who had potential radiation exposure since 1959. CDC states that their efforts will take several years to complete.

Now, the fact that it is going to take several years has been construed by some as another coverup. It is not that at all. It will take quite a few years to get at the bottom of this whole issue of radiation. This is what the Secretary of HEW, Mr. Califano said the other day. This is a very complex situation and it is so recognized by those who are expert all over the world. It will take many years to find out what the effects are and try to separate them from the effects of other things that cause cancer.

Nevertheless today anyone who has cancer immediately can think he can say it was due to radiation.

UNION ACCESS TO CDC CONFERENCE

You may have read news reports regarding the unions not being allowed to attend meetings between the shipyard and the oversight panel. That is, the CDC's oversight panel. One union representative charged this was a coverup. The conference at Portsmouth attended by CDC and the members of the oversight panel was at the express request of CDC. Throughout preparations for the visit, we met all of the CDC's requests. There were two cases where persons, not associated with the CDC team or the oversight panel, requested permission to join the 1-day conference. The Navy deferred the decisions to CDC since this was CDC's conference, not the Navy's. It would have been inappropriate for the Navy to decide who should or should not be party to their conference.

Another complicating factor was the consideration that the CDC had requested access to personnel records of shipyard employees; records which contain information falling within the restrictions of the Privacy Act. Due to their status as official members of a Government-sponsored investigation, the CDC team and their group of consultants were given access to these records which were to be reviewed on the day of the conference. Unless CDC was willing to designate outsiders as official members of their team, access could not be granted to these records without violating the Privacy Act.

Thus, when the Department of Labor requested that two representatives involved in occupational safety and health activities be allowed to join the conference. CDC was asked if they wanted these individuals added to their official list. CDC replied that they did, and the Navy arranged for the two OSHA representatives to be given status as team members with full access to all records and proceedings. Although the Navy had accepted these Department of Labor representatives, they eventually withdrew and did not participate.

On the request of a representative of the international union, the same procedure was followed. However, in this case, CDC did not elect to add the name to the list; accordingly, union involvement was limited. Recognizing the interest of the unions in this matter, the Navy arranged with CDC to have the local union representatives meet separately and independently with the group of consultants so they could air their views and ask any questions regarding what the consultants had received from the shipyard. At this meeting the representative of the international union was also invited and did attend.

There was no similar problem during the more recent visit to the Portsmouth Shipyard by staff members of the House Armed Services Committee. The congressional staff specifically requested to have union representatives in their meeting. Since this was their meeting, the Navy had no objections, and union representatives were present at all meetings and tours during the entire visit.

COMMENTS ON STATEMENTS ALLEGING EARLY PROBLEMS IN RADIATION CONTROL

An issue I will now discuss is the statements made by a few former shipyard workers who have claimed that workers died from radiation exposure during early employment in nuclear propulsion work.

One worker has recently claimed he knows of more than 40 shipyard nuclear workers who have died of cancer. I am not surprised. There have been almost 10,000 workers at Portsmouth who have received radiation exposure since nuclear work started in the yard. Of these 1,600 would be expected to die at some time of cancer from causes other than radiation work. What is surprising is that he does not know of more cases.

Charges have been made that film badges were sometimes worn incorrectly or that some workers wore film badges assigned to others. Undoubtedly a few workers violated rules without getting caught. But there were detailed procedures to prevent such mistakes, as summarized in the Navy radiation report referred to earlier.

It is probably more significant that numerous tests at shipyards have shown that radiation exposures measured by film badges averaged 15 percent higher than actual radiation exposures. Perhaps I should accede to the claims that radiation exposure records are inaccurate and reduce the film badge exposure records by 15 percent.

RADIATION INJURY CLAIMS

Another subject is radiation injury claims and this is a very important one not only to this committee, but to other committees in Congress.

In 1978 a private contractor worker in New Mexico was awarded \$75,000 in worker's compensation because he feared radiation. No physical injury was claimed. No excessive exposure to radiation was claimed. In 1979 the Connecticut Supreme Court awarded compensation to a municipal employee for injuring his ankle playing ping-pong before his work shift started. A compensation claim was approved for a Navy worker for headaches allegedly caused by sitting at a desk with his head down—he would probably have done more harm with his head up—the implications of this award are enormous. In the last 10 years over \$75 million has been awarded to naval shipyard employees for alleged hearing loss in a compensation program that the General Accounting Office investigated and found riddled with fraud and abuse.

Three claims for radiation-induced injury have been awarded to naval shipyard employees; all are awards which I believe to be improper.

I am not against the payment of legitimate claims where the causes can be substantiated and it can be clearly shown that the Government is at fault. I recognize this is a difficult and perplexing area that the Government is going to have to face and I am glad to see that Secretary Califano has made this an item of priority.

I have heard suggestions that the Navy should pay all shipyard worker claims for cancer just to be sure that we do not miss any that may be related to radiation. At a typical shipyard, there have been about 10,000 workers authorized to receive radiation exposure from naval nuclear propulsion work since the beginning of the program. Their average exposure is about 1.5 rem, which is only one one-hundredth of that which they are authorized to receive during their working lifetime. This is only one-tenth of that which they receive from medical and natural background during their lifetime.

Scientific estimates indicate that an average of 1.5 rem of radiation exposure for 10,000 people may cause one to two extra cancer deaths. In a typical group of 10,000 in the United States 1,600 will die from cancer. In fact, anyone who lives long enough is going to die of cancer. Adding shipyard radiation work changes the expected number of cancer deaths from 1,600 to 1,601 or 1,602. To pay compensation to 1,600 individuals so that one or two possibly deserving ones are not denied is ridiculous and unaffordable.

The Navy's experience with hearing loss claims demonstrates there would be no lack of claims if such a program were offered; only an empty U.S. Treasury could stop the stampede. But today, there is still enough money left in the Treasury, and some Government agencies appear willing to hand it out readily, by encouraging claims.

Inflation may soon solve this problem anyway, either it will not pay to make claims or the taxpayers will go on strike against Government officials who are so generous with their taxes.

SHIPYARD INSPECTION REPORTS AND CONGRESSIONAL TESTIMONY

Another issue I would like to address is an accusation made in December of last year by the critical mass energy project. This is an organization which is opposed to all nuclear power. This group

charged that I mislead a congressional committee when I testified before the Subcommittee on Health and the Environment of the Committee on Interstate and Foreign Commerce. They stated I failed to mention a strongly worded 37-page radiological inspection report I issued 3 months before the hearing. They stated the report contradicted my testimony regarding the state of affairs at the Portsmouth Shipyard.

In all my testimony before Congress I have always presented the facts as I know them, and when my opinion has been sought, I have given it as straightforwardly as I could. I assure you I will continue to give the most forthright testimony I can before any congressional committee.

The accusation by the Critical Mass group and treatment by the media were directed at me personally.

As I said before it is popular to attack the Government or anyone who represents it, especially if the topic is a nuclear one. The Government representative is inherently wrong, and the so-called "public interest" groups are always right. The fact is that the issue before the subcommittee during the February 1978 hearings was the effects of radiation on the health of shipyard workers, particularly at Portsmouth. And this is precisely the topic I dealt with in some detail. As was discussed at the hearing, a final answer will require extensive analysis such as is now being done by the Center for Disease Control and the Johns Hopkins University.

The idea that there was in some way a conflict, because I did not in my testimony specifically refer to the findings of a Portsmouth radiological control inspection conducted prior to the hearing, was just not correct. Of course I was aware of the inspection, but this was just one of many actions going on all the time at all the yards to check their performance. Had the inspection discovered anything indicating that shipyard workers were exceeding their radiation exposure limits, or being adversely affected by radiation, this would have had a bearing on the subcommittee's investigation.

Incidentally, it is rather interesting dealing with some of these committee staffs. For example, I got a letter from a Congressman on the committee—I am not talking about this committee—but 2 days earlier it was in the Washington Post. I replied to the letter. The letter was published in the Washington Post and 2 days later the Congressman called me and asked me where my reply was. These are rather strange events that are happening in some staffs in Congress, which would imply that maybe they are more interested in publicity than getting at the facts. This has happened a number of times.

At the hearing I was dealing with the results of my efforts as they related to the question of "the effects of low-level radiation on health" which was the express topic the chairman had indicated to be the purpose of the hearing.

To my recollection, no one raised other aspects of radiological controls during the hearing. Had they been raised, I would certainly have addressed them. In fact, the chairman emphasized several times that the subcommittee's concern was the effects of radiation on human health.

GOVERNMENT NOTHING MORE THAN INFORMATION AGENCY

I think the problem now is that in some staffs there is excessive zeal beyond what the members and the chairman of that committee want—again, I would like to emphasize I certainly am not talking about this committee—and this is getting to be a very worrisome thing, because with the tripling of the staffs in Congress and each one of them being avid to show that he is doing a job, we are being overloaded with paperwork. This government today, the executive branch, has already become nothing more than an information-furnishing agency. We can no longer get our work done, we have so many demands by staffs and all sorts of other people. There has got to be some restraint. If Congress wants to keep the executive branch working, you have got to do more than make us information-furnishing agencies.

It is almost impossible today for anyone who wants to do his work to do it. Even with a 16-hour day, it is no longer possible.

In all of life there must be restraint and you cannot get a lot of young people—I am sure that members who have been around a long time fully understand what I am talking about—we cannot get a lot of young people on staffs who use their positions to hound the executive branch.

The executive branch can no longer do its work. And if the executive branch cannot do its work, what is the purpose of the legislative branch?

Furthermore, you have got the Freedom of Information Act which I will discuss at the afternoon session. That has become a monster. Everybody can tie us up in knots and again we are no longer doing our work. We are giving lots of information, but no work. And you are paying for all of it. You have to choose what you want. If you do not trust your people, you ought to get rid of them. That is a very simple way. If you do not trust the people in the executive branch, get them out and get somebody else in.

Fire the President and have them put in somebody else if you don't think he is doing a good job. But don't hound us. We are by law compelled to do this. We no longer are doing anywhere near the technical work that we need to. And, as you know, the nuclear program has operated well from a technical standpoint, but if this keeps on the way it is, I am very much afraid I can no longer guarantee the operation of the Nuclear Fleet, because we have not got the time to look out for it. We only have so many hours a day, and these are legal demands that get precedence over everything else.

I strongly urge this committee and other Members of Congress to slay the monster which you have created with the best of intentions.

Now, I could give you some better English on this, but I think I make my point clear this way. And I see by the nods of some of the members that perhaps you agree with me.

RADIATION CONTROL REQUIRES LOOKING FOR PROBLEMS

The text of the hearing, when it is published, will show I did not say there were no problems in carrying out radiological work at the Portsmouth Shipyard. Of course there are problems at Portsmouth.

There are problems at any shipyard or, for that matter, at any industrial activity engaged in significant work involving radiation or any other type of work. If there are no problems, why should anyone be looking for them? If they look but find no deficiencies, they are either not looking hard enough, or they have finally discovered perfect human beings.

I have been searching for such people all of my life, Mr. Chairman, and I regret to say that outside of you, I have not found any yet—and my wife, too. I just say that. I also see another female member of the committee, and I will extend that to you, Mrs. Holt.

You notice that I am not adding the male members of the committee. [Laughter.]

So far I have found such perfect persons only in the news media. They never make mistakes—at any rate, they rarely admit them. And no one is consistently investigating them.

Inspecting a shipyard is one of the methods I use to determine if it is performing its job to my standards. In my testimony, I stated that I conduct regular radiological control audits and that in several cases I have had to stop radioactive work because I was not satisfied with a yard's performance. I am the only one that has ever done it. There have been three cases and I have actually stopped the yard until they improved their situation.

I have required that any condition which can be improved, should be improved, and I consider such a condition a deficiency until improvement has been demonstrated.

My inspection report on Portsmouth is typical of inspection reports I issue periodically on all shipyards engaged in naval nuclear propulsion work. These inspections review every facet of the yard's performance in a most critical way: Training, drills, work practices, radiation, et cetera.

Although the Portsmouth inspection report contains 37 pages of deficiencies there were no observations during this inspection which would likely be cited as violations of the requirements in the code of Federal regulations used by other Government agencies to regulate the handling of radioactive material. The deficiencies can only be called so in comparison with the self-imposed high performance standards of radiological control implemented by me. They were my personal standards, not official standards.

The language used is strong because that is the way I approach the control of radiological work and all other work. I do not let even the most minor defect in any of my work pass without requiring it to be recorded and brought to the attention of senior management, in writing, and then my attention. All day long I get letters with the most minor details, not only of radiation but of all other work. And that is why this program keeps on going the way it does. And I deeply resent implications that I am permitting bad situations to occur. Of course deficiencies occur. I cannot control everyone. But I have my own local people there watching and we solve them and take care of them.

The shipyard inspection reports are written in a very critical style for a specific purpose. I want all concerned to realize I mean business. However, if the inspection reports are reviewed carefully, it will be

seen that they do not alter the conclusions I presented in my testimony or in the two Navy reports I have previously discussed. It is because of this kind of tight scrutiny that shipyard workers are not being overexposed to radiation, and are staying well within the Federal limits specified for occupational exposure.

I have tried to address some of the current issues being raised in the area of low-level radiation and health effects as they relate to matters for which I am responsible. I realize this statement is lengthy, but the complexity of the issue makes it difficult to deal with them briefly.

NEED FOR PERSPECTIVE ON RADIATION

In closing, I would like to cover one final aspect, the need for perspective on radiation as it relates to the actual world in which we live.

A proper perspective on radiation is essential if we are to continue to achieve the benefits of nuclear power, medical diagnosis, and medical treatment using radiation. Most of the press coverage on radiation is biased and does not provide a balanced view. Probably this is because most newspapermen have little technical background in the field, and obtain their stories from a few highly vocal opponents of nuclear power. These people have to justify their own particular theories and ideas. As a result, much of what the public reads is distorted and creates needless anxiety and fear, particularly because of the pejorative nature of most headlines, which is the occupational disease of headline composers.

The fear of radioactivity can be likened to the fear of electricity following the invention of the electric light bulb 99 years ago by Thomas Edison. Public fears of electricity were so inflamed that wall plaques had to be installed in rooms with electric lights assuring people that "The use of electricity for lighting is in no way harmful to health, nor does it affect the soundness of sleep." They did not mention other things, that is all they said. I remember one time during World War II when we introduced fluorescent lighting in the Navy, I was there and introduced it, and one officer came around to me and complained. He had read that it induced sterility in men. And I asked him, at his age, what was he worrying about?

Yet, the use of electricity has transformed man's life on Earth from a relative short one of drudgery to one where long life and higher aspirations can be realized.

Radiation is a natural part of man's environment. The average person in the United States receives each year from natural radioactivity in the Earth and cosmic radiation about 0.1 rem. Yet rarely do accounts which the public reads give even this simple and well-known fact. It is clear that the public needs more balanced information on radiation from man's activities if they are to make informed choices.

In May 1978, the President requested an interagency task force to formulate a program on low-level radiation. Two days ago Secretary Califano released the draft reports from this task force. These reports provide a signal service in getting more balanced information available on radiation in the hands of the public.

In my program one of the best tools we have to minimize a worker's radiation exposure is training. We train him to understand the technical aspects of radiation and give him information on its effects so that he can place his exposure in proper perspective. Many of the ideas on ways to minimize radiation exposure while performing nuclear work have come from workers themselves, in direct response to this training. This has also resulted in more efficient maintenance work on nuclear propulsion plants. In the same manner, I believe a proper public information program can go a long way toward helping the public minimize unnecessary radiation exposure, while permitting the benefits we derive from its many legitimate and valuable uses.

A number of newspaper accounts over the past year have reported on the occupational radiation exposure by shipyard personnel engaged in naval nuclear propulsion work. The thrust in many cases is that their occupational radiation exposure is resulting in some unique health hazards. How this occupational exposure compares to other sources of radiation normally encountered in life or to other common risks in life is rarely touched upon.

FACTS ON RADIATION EXPOSURE

Here are some facts—and I think you will be quite interested in them:

The average lifetime occupational radiation exposure of 1.5 rem for shipyard personnel is about one-tenth the amount of radiation exposure the same people receive over their lifetimes from natural background and medical X-rays.

This 1.5 rem average lifetime occupational radiation exposure can be compared roughly to the 5 rem received in a year from smoking one pack of cigarettes per day. So, if all these people that are yacking about this want to do some good for the people, they first ought to prohibit smoking and certainly the newspapers with their avidity for protecting the public, should immediately stop advertising cigarettes. I think that is a rather reasonable statement.

Another way of looking at this is to compare the total occupational exposure of shipyard workers to other sources of exposure.

In 1978 the total occupational radiation to all shipyard workers involved in naval nuclear propulsion work was 3,700 man-rem. Here is what this compares to:

Twenty million man-rem to the population of the United States each year from natural background radiation;

Seventeen million man-rem to the population of the United States each year from medical and dental radiation; and

Six hundred twenty-five thousand man-rem to the population of the United States each year from radioactivity in natural gas used for cooking.

Maybe we ought to stop using gas, because the total radiation exposure to the public from gas is 200 times as much as the total radiation from work at the shipyards.

One hundred thousand man-rem the 1 million inhabitants of Denver could avoid each year if they moved to a region such as Washington, D.C., which has lower natural background radiation levels—I assure you I own no real estate in Washington—and

Twelve thousand man-rem total to passengers in jet airplane flights in the United States each year from cosmic radiation at the high altitudes.

From this comparison it is evident that if a total of 3,700 man-rem of occupational radiation exposure is of great concern, there are many other common activities and situations that should be of far greater concern and the subject of immediate investigation.

I trust that these examples should put the small radiation exposure from the Naval nuclear propulsion program into some perspective.

Nevertheless, let me express it in one last example which is particularly relevant to Members of Congress. The total radiation exposure received last year by the Members of Congress and their staffs from natural background and medical sources was about the same as the total occupational radiation exposure received by the employees of all nine shipyards from their work associated with Naval nuclear propulsion plants.

From these examples, I think you can see just how out of balance most of the news coverage has been on this subject.

CONCEPT OF ACCEPTABLE RISK

Now, I have one other brief thing to bring up, and that is the concept of acceptable risk.

A riskless society is what is being asked for more and more. More people want a riskless, workless, and painless society. And we are gradually getting that. That, of course, will stop at some point when the Treasury has no more money. But there is literally nothing that one does without some risk, not even breathing.

Of course, there is also a risk in not breathing. There of course you can instantly see the payoff. I have here some statistics on what it takes to reduce your life expectancy by 8 minutes. In other words, here is what you can do to increase your risk of dying 8 minutes sooner than would otherwise be the case: Smoking 1.4 cigarettes, spending 3 hours in a coal mine, traveling 6 minutes by canoe, traveling 10 miles by bicycle, or traveling 1,000 miles by jet plane. Your risk of dying in an automobile in 1 year is 1 in 5,000. People accept this concept of risk in everything they do. Why is it so difficult for people to accept the same concept in dealing with radiation?

Mr. Chairman, I tried to put the issues into perspective, because when you use the word "radiation," it immediately causes a stir. I have tried to give you some comparisons.

LOWER SHIPYARD ADMINISTRATIVE LIMITS ON RADIATION EXPOSURE

The CHAIRMAN. Thank you very much, Admiral. I think that was a very challenging and well-organized statement. I am certain that the committee gained a little more knowledge about what this problem is all about by listening to you.

Now, the Federal standard for occupational exposure to ionized radiation is and has been for quite a few years—and I think you mentioned it in your statement—a whole body count of 5 rem per year or 3 rem in any 3-month period. The general philosophy has been to reduce all worker exposure to the lowest practical limit. At Portsmouth

Shipyard in 1978 the administrative criteria for exposure was set at 2 rem per year and 1 rem in any quarter. Are those correct figures?

Admiral RICKOVER. Yes, sir.

The CHAIRMAN. Now, our goal has been lowered for 1979 to 1 rem per year and $\frac{1}{2}$ rem per quarter. Were the administrative criteria goals attained in 1978?

Admiral RICKOVER. Well, I will reply to that this way: In relation to the Federal standard for occupational exposure to ionizing radiation—I am repeating some of your question—no Portsmouth worker exceeded the shipyard administrative control levels in 1978, not one. To achieve a factor of 2 reduction in these control levels for 1979 will be difficult for the yard, but it is potentially achievable. You realize that this is far less than what is allowed by present requirements.

The CHAIRMAN. Did you say that the 1979 goals are potentially attainable?

Admiral RICKOVER. We are going to try to meet them, yes, sir.

The managers and supervisors now make it clear to their workers that these administrative levels have to be met, and the management takes this requirement seriously.

In their training sessions, explanations are given that the purpose of these lower administrative levels is to help reduce total radiation exposure. Workers get training in understanding the risk of radiation. The record shows that the shipyards have been successful in getting the message across to the workers since the radiation exposures have been decreasing. As I noted earlier, there is only one person with over 3 rem in all of 1978. Management is evaluated on how well their subordinates meet the administrative levels. They are also evaluated on minimizing the number of workers exposed. That is another way of reducing radiation: Reduce the number of people who are exposed to it. In keeping cumulative radiation exposure for each major job as low as possible, during the entire overhaul period we help keep the exposure down. We set a goal at the beginning of a job and try to meet a very low level. This is about as important a thing as we have. I believe that you will find out that there is probably no agency in the Government that takes as much care in this as we do.

UNDERSTANDING OF EXPOSURE GOALS

The CHAIRMAN. Do the workers and their union officers, the community and the media, understand that the prescribed naval shipyard administrative goals are significantly below the dose level considered conservative by the U.S. standards-setting agencies and United States and international health monitoring organization?

Admiral RICKOVER. The shipyard workers pretty well know they are working to levels which are quite less than Federal standards.

The involvement of the workers is the key to achieving these results. Thus, the lower control levels are widely publicized within the shipyards. Now, it is not the Navy's job to advertise to the community. However, the Navy, in answering many questions from the media, pointed out that the exposures are controlled below Federal standards. Of course, this information infrequently gets printed.

Although 2,000 copies of the 1978 Navy report on radiation exposure were distributed to every newspaper, radio station, TV station, and the

wire services which expressed an interest, little information has been published from it. It does not make the kind of news the media wants to print. I am pretty sure that the people in the community who work for the shipyard, and their families, know the kind of job we are doing in controlling radiation, but not those who only read the press. That is why you do not see much outcry from the workers about it.

They know pretty well what is going on. You have an occasional man that wants to make something out of it. They know that. We make sure they know.

The CHAIRMAN. Mr. Bennett.

UNION ACCESS TO SAFETY AND HEALTH MATTERS

Mr. BENNETT. The committee has received a letter from the AFL-CIO director of occupational safety and health, and in this it is said, "The policy should be established by the U.S. Government which will guarantee the right for any union or group of unions such as the Metal Trades Council at Portsmouth, to designate any person as their safety and health representative or consultant. And that person should have access to any Government navy yard and to all legitimate data and information concerning occupational safety and health situations in that yard."

Could you comment on that proposition?

Admiral RICKOVER. I mentioned that earlier, but I would like to amplify that one, to answer your question.

There are several issues that are involved in commenting on that proposal. First is the implication that union representatives at Portsmouth were excluded by the Navy from participating in a recent visit by the CDC representatives, and their team of consultants. As you know, Congress insisted that an independent agency, the CDC, conduct a study of the questions raised concerning the Portsmouth Yard, and other shipyards which are engaged in nuclear work, to determine if there was a link between low-level radiation exposure and cancer.

At that time I assured certain Members of Congress that the Navy would cooperate fully in the investigation and would not in any way attempt to influence or inhibit the CDC group. The CDC team began the investigation and scheduled a visit of their group of consultants—they created a group of consultants of their own. They have not consulted us. We have no business being consulted and we were not. The Navy thought these preparations had met all of CDC's requests.

I discussed in my prepared statement two cases where persons not associated with the CDC team or the group of consultants requested permission from the Navy to join the 1-day conference at the Portsmouth Yard. The Navy was not engaged in any coverup, as one union representative charged. Indeed, the newspapers reported Dr. Leonard Hamilton, speaking for the five consultants at the conference, as saying, "There is no Navy coverup." He was reported saying that the Navy had allowed the group to do whatever they wanted and "we had an actual glimpse of the actual radiological exposure areas, and their controls looked impressive to us."

The second issue involved is whether or not I agree with the proposal you have just read. In general terms I fully support the active participation of the union in matters which affect their well-being.

However, as in any organization, there are situations in which both management and labor must be free to meet without a requirement for both parties to be present, or represented.

In the case of naval yards, the Navy and the unions have operated for years under a mutual agreement which addresses the issue of union participation in policy meetings which affect the health and safety of the shipyard workers.

There is nothing in the Navy's actions regarding the union and the conference of CDC consultants that is inconsistent with this agreement.

In view of the fact that each naval yard negotiates a separate agreement with the union, it would be inappropriate for me to sit here and tell each or both sides what should be in their particular agreement. I can only suggest that if the AFL-CIO director of occupational safety and health feels that such a clause should be in such proceedings, he should make that desire known to the union representatives in each yard and that they take that up with the shipyard commander.

I cannot go beyond that. In other words, I was asked, and a Government agency was appointed. Anyone they wanted—we did not question them—anyone they wanted was permitted to come. And what actually happened was that an AFL-CIO representative wanted to join that group. They did not have her as part of their team. That person had no more right to go in there and inspect records than any other member of the public. We are limited by the Privacy Act; we cannot go beyond that.

The CHAIRMAN. Mr. Badham.

Mr. EMERY. Would the gentleman yield?

Mr. BADHAM. I will yield

POSITION OF UNIONS AND WORKERS AT PORTSMOUTH

Mr. EMERY. Thank you very much for yielding. I wanted to bring out an important point.

Since this is in my district, I have met with the shipyard commander and the people on this issue for quite a while.

With respect to the attitude of the union toward the Navy, I must emphasize that, from my meetings with the union representative, the union does not generally feel that there has been a coverup. They do not generally have any concern over the health and safety of union workers at the shipyard. There was one individual who made a press statement which was amplified on considerably, but that one particular individual's point of view does not represent the prevailing attitude of the shipyard workers. They are satisfied that they are being treated safely and reliably, and they have no major concerns over the allegation that the Navy somehow has been covering up health and safety problems.

There is one point I would like to make with respect to the access of some Metal Trades Council to records. I believe the president of the Metal Trades Council has met with the shipyard commander and others, and the only problem that exists is being allowed to sit in on the examination of records and the CDC evaluation and the like is the necessary security clearances. And it is my understanding that those security clearances are now being processed, and as soon as the

president of the Metal Trades Council has in fact gotten those, he will be permitted access to those records that obviously cannot be shown to every Tom, Dick, and Harry who might want to see them. So I think that that problem is under control at this time and I have not been notified to the contrary since my meeting with them 2 weeks ago.

LITTLE WORKER CONCERN OVER RADIATION HEALTH EFFECTS

Mr. BADHAM. I thank the gentleman for his consideration.

Admiral, the newspapers have reported that workers at the shipyard who are actually receiving radiation exposure have experienced and demonstrated little concern over the health effects of radiation.

Has the Navy fully informed all of those workers of the risk of radiation exposure?

Admiral RICKOVER. Yes, we do. We conduct seminars—I would like to answer that in a more formal way.

I expected that question would be asked, so I wanted to go on the record on it. It is precisely because the workers have been well trained in the risks associated with low-level radiation exposure that they are not upset.

The workers understand the risks reasonably well and they are aware of the stringent radiological controls used in the shipyards.

The shipyard workers who are expressing the most concern appear to be those who do not receive any radiation exposure.

Perhaps we should do more with those people. But then it takes a lot of time and work. And the only ones we try to educate thoroughly are those who are actually doing the work. Because the others are not extensively trained in radiation, they may fear they receive radiation exposure from people who have worked in a radiation area, or by walking along the pier next to a nuclear ship. With the scare stories regularly published in newspapers, it is not surprising that some workers get concerned. The shipyards spend about 50,000 man-hours a year to provide nonnuclear workers limited radiation training.

To train them to the same extent as nuclear workers is not possible. We just cannot do it. We do not have the money. I am glad that both of you talked this way. I think you are beginning to realize that there is not a feeling of unconcern by the Navy about these workers. I believe, when you first got into it, you heard scare stories and you were naturally concerned, because you are close there, and you represented them. I think you will find now that we are just as concerned as you are or anyone else.

Mr. BADHAM. Thank you.

I yield back the balance of my time.

The CHAIRMAN. Mr. Dan Daniel.

PERSONAL EXPERIENCE WITH RADIATION

Mr. DAN DANIEL. Thank you, Mr. Chairman.

Admiral, I expect that with all of your experience in dealing with radiation, I have had as much as you have. I spent 3 years in a TB sanatorium once, and I received an X-ray once a week and a fluoroscope probably about three times a week. And I am a pretty healthy fellow today. Nothing ever gets wrong with me that a night's sleep will not cure.

Admiral RICKOVER. May I ask when that was, what year?

Mr. DAN DANIEL. I dislike to tell you but I will. It was in 1937.

Admiral RICKOVER. In 1937 people were not anywhere nearly as concerned with radiation as they are now. But it depends on how many X-rays you get. That number of X-rays to your chest will give you far more than you are allowed to get in the Navy yard and there is correspondingly a risk involved.

Mr. DAN DANIEL. There is a risk involved in anything we do.

Admiral RICKOVER. There is a risk involved in running for election as a Congressman, too.

Mr. DAN DANIEL. Quite risky.

Admiral RICKOVER. More risk than radiation.

Mr. DAN DANIEL. I am advised that when you sleep in a house that is built on a concrete slab, that you also get a considerable degree of exposure.

Admiral RICKOVER. Yes; you know, there is lots of radiation in the stone in New Hampshire, the granite.

May I say this off the record, since I said I would not say this, Mr. Chairman?

The CHAIRMAN. This will be off the record.

[Further discussion was off the record.]

SHIPYARD ACCIDENT RESPONSE

Mr. DAN DANIEL. Admiral, what sort of accident response program or plan do you have for dealing with emergencies in the shipyard where radioactive material may be involved?

Admiral RICKOVER. The Navy has an extensive coordinated emergency response program for dealing with emergencies, including radiation which could arise at the yards. This includes plans issued by Navy headquarters organizations and detailed procedures issued by the yards. The Navy response actions and plans have been reviewed with State authorities to insure coordination with State plans. That is in every State. The shipyard plans include provision for emergencies which affect only the shipyard and for those which could affect areas outside the yard. The shipyards have designated emergency response teams, equipped emergency control centers and emergency response equipment.

The shipyard plans provide for radiation monitoring inside and outside the yard and even aerial monitoring. Notification of the State agencies is covered. The plans also provide for coordination with local fire departments, police departments, and hospitals.

Mr. Price, the provisions of these emergency plans are monitored through regular training exercises. The more you hear about this issue, the more you realize that a lot of thought has been given to all this potentiality. We just have not been sitting quietly and letting these matters go. In fact, I was probably one of the first people in the world who started being concerned about all this.

DEFICIENCY REPORT

Mr. DAN DANIEL. Admiral, turning to the other side now, the program for Portsmouth, I understand there was a 37-page report on

deficiencies written by your own people on radiological control programs.

Can you discuss that with the committee?

Admiral RICKOVER. I have discussed it to some extent. But I have information here which I will read which amplifies that if I may.

Mr. DAN DANIEL. You may just provide it for the record if you like.

Admiral RICKOVER. I will do that, sir.

[The following information was received for the record:]

It is a fact of human nature that people make mistakes. The key to a good radiological control program is to find the mistakes while they are small and prevent the combinations of mistakes that lead to significant problems. I pay more attention to errors and their prevention in the naval nuclear propulsion program than to any other single subject. Requiring constant focus on improving performance of radiological work has proven effective in reducing errors.

I demand that performance of radiological work continually improve. Failure to improve is a major deficiency of management. The shipyards with the highest number of incidents and deficiencies are obviously the ones I concentrate on most heavily.

Periodic comprehensive inspections of shipyard radiological controls are one means I use to ensure steady improvement in all shipyards. These inspections cover all radiological control requirements. My inspectors emphasize actual performance rather than just review of records. Written and oral examinations are conducted, drills are performed, and physical working conditions are inspected. Radiation exposure reduction is reviewed in detail with production, radiological control and engineering personnel. Selected shipyard personnel are interviewed on their evaluation of radiological controls.

As I said in my opening statement, the language in the reports of these inspections is strong because this is the way I approach the control of radioactive work. I do not let even the most minor aspect pass without requiring it to be recorded and brought to the attention of management. The inspections reports deal only in deficiencies; they do not discuss areas where the shipyard is doing well.

MEDICAL EXAMINATIONS

Mr. DANIEL. Another thing I would like you to provide for the record. That has to do with the types of examination, and the frequency of examinations given and whether or not they are given to people who work in radioactive areas and those who do not. Would you provide a rather comprehensive response?

Admiral RICKOVER. Yes, sir; I will.

By the way, we do give routine medical examinations for people entering the program regularly while they are in it and before they leave, but I will provide more details for the record.

[The following information was received for the record:]

Radiation medical examinations have been required since the beginning of the naval nuclear propulsion program for personnel exposed to radiation. In these examinations the shipyard doctor pays special attention to any condition which might indicate that radiation ex-

posure would cause an increased degree of risk. Passing this examination is a prerequisite to obtaining the dosimetry badge which permits entry to areas where radiation exposure can be received.

Radiation medical examinations are given by the shipyard prior to initial radiation work, and at termination of radiation work in the nuclear propulsion program (or at termination of employment) if the worker has received more than 0.5 rem in any year. In addition, during each 3-year period anyone who has received more than 0.5 rem in 1 year receives a radiation medical examination. The basis for selecting 0.5 rem as a criterion for examination is that those who receive less than 0.5 rem in a year have not exceeded radiation exposures permitted by Federal regulations for members of the general population.

A radiation medical examination includes review of medical history to determine, among other subjects, past radiation exposure, history of cancer, history of radiation therapy, and family history of cancer. In the physical examination particular attention is paid to evidence of cancer as well as cataracts in the eyes. Laboratory procedures include urinalysis, blood analysis, and comparison of blood constituents to a specific set of standards. In event disqualifying conditions are found in an examination of naval civilian or military personnel, the individual is barred from receiving occupational radiation exposure until the results of the examination are reviewed by the Navy's Bureau of Medicine and Surgery Radiation Effects Advisory Board. Only after approval of the Board would the individual be permitted to receive occupational radiation exposure.

Shipyard radiation medical programs have been inspected by industrial medicine experts from the Navy's Bureau of Medicine and Surgery.

In the last year, shipyard radiation medical programs have also been reviewed by a Department of Energy team at one naval shipyard, by Johns Hopkins University personnel at six naval shipyards and one private shipyard, and by Center for Disease Control personnel at two naval shipyards. These teams have each had industrial medicine experts. They all stated the radiation health program was excellent.

Mr. DAN DANIEL. Thank you, Mr. Chairman.

The CHAIRMAN. I think it is advisable to take a 10-minute recess and respond to this quorum call and come back.

[Recess.]

The CHAIRMAN. Mr. Stump.

CDC VISIT TO PORTSMOUTH SHIPYARD

Mr. STUMP. Thank you, Mr. Chairman.

Admiral, I understand that a panel from CDC and the National Institute for Occupational Safety and Health recently visited the Portsmouth Naval Shipyard. What have they told you if anything concerning the radiological control program at Portsmouth?

Admiral RICKOVER. I believe that their visit confirmed that the shipyard people, and they themselves, are not concerned. We have pretty good relations with the people up there and particularly their unions and they are kept informed. Now, if you wish any more information

on this, more detailed information, I will be glad to supply it for the record. I mentioned earlier that one of the consultants was quoted in the papers as saying our controls were impressive.

Mr. STUMP. No. I think that is sufficient.

Thank you, Mr. Chairman.

That is all.

The CHAIRMAN. Mr. Stratton.

SECRETARY CALIFANO STATEMENT

Mr. STRATTON. Thank you, Mr. Chairman.

I wanted to make a couple of comments and then to ask a question, Mr. Chairman.

I wondered, Mr. Chairman, whether, if it has not already been done, if it would not be well to put in the record the text of Secretary Califano's statement of the 27th on this subject which has been referred to, and particularly pages 11 and 12 which make the same point that Admiral Rickover made. If that has not already been done, Mr. Chairman, I would ask unanimous consent that that be included in the record.

The CHAIRMAN. Without objection that will be done.

[The following information was received for the record:]

STATEMENT OF JOSEPH A. CALIFANO, JR.
SECRETARY OF HEALTH, EDUCATION, AND WELFARE

IN MAY, 1978, THE PRESIDENT DIRECTED THAT THE SECRETARY OF HEALTH, EDUCATION, AND WELFARE "COORDINATE THE FORMULATION OF A PROGRAM" COVERING (1) RESEARCH ON THE EFFECTS OF RADIATION EXPOSURE, (2) PUBLIC INFORMATION ON RADIATION, (3) CARE AND BENEFITS FOR PERSONS ADVERSELY AFFECTED BY RADIATION EXPOSURE, AND (4) STEPS TO REDUCE ADVERSE RADIATION EXPOSURE.

TO HELP CARRY OUT THE PRESIDENTIAL DIRECTIVE, WE ESTABLISHED AN INTERAGENCY TASK FORCE ON IONIZING RADIATION COMPOSED OF THE DEPARTMENTS OF DEFENSE, ENERGY, AND LABOR, THE VETERANS ADMINISTRATION, THE NUCLEAR REGULATORY COMMISSION, THE ENVIRONMENTAL PROTECTION AGENCY, AND THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE AS CHAIR.

IN OCTOBER, 1978, THE CONGRESS DIRECTED, IN PUBLIC LAW 95-622, THAT THE SECRETARY OF HEALTH, EDUCATION, AND WELFARE "ESTABLISH A COMPREHENSIVE PROGRAM OF RESEARCH INTO THE BIOLOGICAL EFFECTS OF LOW-LEVEL IONIZING RADIATION" AND "CONDUCT A COMPREHENSIVE REVIEW OF FEDERAL PROGRAMS OF RESEARCH ON THE BIOLOGICAL EFFECTS OF IONIZING RADIATION."

I. SUMMARY OF ACTIONS

IN CARRYING OUT THESE MANDATES, I AM TAKING TODAY SEVERAL ACTIONS:

FIRST, I AM RELEASING FOR PUBLIC COMMENT DRAFT WORK GROUP REPORTS OF THE INTERAGENCY TASK FORCE ON IONIZING RADIATION. THE REPORTS COVER: RESEARCH ON THE HEALTH EFFECTS OF LOW-LEVEL RADIATION; WAYS TO PERMIT SCIENTISTS ACCESS TO RECORDS FOR EPIDEMIOLOGICAL RESEARCH, CONSISTENT WITH INDIVIDUAL PRIVACY; THE PROVISION OF INFORMATION TO THE PUBLIC ABOUT RADIATION EXPOSURE; THE COMPENSATION OF THOSE WHO ARE

INJURED; AND THE REDUCTION OF RADIATION EXPOSURE. THEY REPRESENT THE MOST COMPREHENSIVE SINGLE REVIEW EVER UNDERTAKEN OF ISSUES RELATED TO RADIATION. ALTHOUGH THESE REPORTS HAVE BEEN PREPARED WITH THE ACTIVE PARTICIPATION OF HIGH OFFICIALS IN THE AGENCIES REPRESENTED ON THE TASK FORCE, WHICH WAS CHAIRED BY HEW GENERAL COUNSEL PETER LIBASSI, THE PAPERS DO NOT HAVE THE FINAL APPROVAL OF THE HEADS OF THE AGENCIES INVOLVED. A TASK FORCE PAPER ON INSTITUTIONAL ARRANGEMENTS WILL BE MADE PUBLIC SHORTLY. THESE WORK GROUP REPORTS WILL BE WIDELY DISTRIBUTED TO THE MEMBERS OF CONGRESS, SCIENTISTS, HEALTH CARE PROVIDERS, VETERANS GROUPS, LABOR UNIONS, ENVIRONMENTAL GROUPS, THE NUCLEAR INDUSTRY AND OTHERS FOR REVIEW AND COMMENT.

SECOND, I AM TODAY REPORTING ON THE FINDINGS OF AN HEW STUDY THAT SUGGEST A HIGHER THAN NORMAL INCIDENCE OF LEUKEMIA AMONG PERSONS PRESENT AT THE "SMOKY" NUCLEAR BOMB TEST IN AUGUST, 1957. THESE FINDINGS, COMBINED WITH RESULTS FROM SEVERAL OTHER STUDIES, UNDERLINE THE NEED FOR ADDITIONAL RESEARCH TO DETERMINE WHETHER THE RISKS ASSOCIATED WITH LOW-LEVEL RADIATION ARE HIGHER THAN SCIENTISTS HAVE PREDICTED IN THE PAST.

THIRD, WE ARE EXPANDING OUR RESEARCH PROGRAM IN SEVERAL IMPORTANT RESPECTS:

- AN OUTSIDE SCIENTIFIC PANEL APPOINTED BY DR. DONALD FREDRICKSON, DIRECTOR OF THE NATIONAL INSTITUTES OF HEALTH, WILL REVIEW THE PREVIOUSLY UNPUBLISHED HEW PAPERS ON THE HEALTH EFFECTS OF RADIATION EXPOSURE ASSOCIATED WITH THE ATMOSPHERIC TESTING OF NUCLEAR WEAPONS. THE PANEL WILL RECOMMEND ANY ADDITIONAL RESEARCH NEEDS IDENTIFIED IN THIS REVIEW. I WILL MAKE THESE UNPUBLISHED PAPERS AVAILABLE TO THE PUBLIC, AND I WILL RELEASE THE FIRST 3,500 PAGES TOMORROW.

- DR. FREDRICKSON WILL ALSO OVERSEE A REVIEW OF RESEARCH ON LOW-LEVEL RADIATION CURRENTLY BEING CONDUCTED THROUGHOUT THE FEDERAL GOVERNMENT TO INSURE THAT A COMPREHENSIVE RADIATION RESEARCH PROGRAM IS PLANNED AND CONDUCTED.
- DR. WILLIAM FOEGE, THE DIRECTOR OF THE CENTER FOR DISEASE CONTROL, WILL PUT TOGETHER A COMPREHENSIVE RESEARCH PROGRAM ON OCCUPATIONAL EXPOSURE TO LOW-LEVEL RADIATION.
- UNDER AN HEW CONTRACT, THE UNIVERSITY OF UTAH WILL STUDY THE POSSIBLE LONG-TERM HEALTH EFFECTS FROM RADIOACTIVE FALLOUT IN AREAS DOWNWIND FROM THE NEVADA NUCLEAR WEAPONS TEST SITE.

IN FY 1978, THE FEDERAL GOVERNMENT SPENT \$76.5 MILLION ON RESEARCH ON THE HEALTH EFFECTS OF LOW-LEVEL IONIZING RADIATION. THE DEPARTMENT OF ENERGY ACCOUNTED FOR \$48 MILLION OF THIS TOTAL; HEW FOR \$15.3 MILLION; AND THE BALANCE WAS DIVIDED AMONG SEVERAL OTHER AGENCIES. AS PART OF OUR REVIEW, WE WILL CONSIDER WHETHER ADDITIONAL RESOURCES ARE NECESSARY TO SUPPORT INCREASED RESEARCH.

FOURTH, I AM DIRECTING DR. DONALD KENNEDY, COMMISSIONER OF THE FOOD AND DRUG ADMINISTRATION, TO ACCELERATE FDA'S EFFORTS TO REDUCE UNNECESSARY EXPOSURE TO RADIATION FROM THE USE OF X-RAY AND NUCLEAR MEDICINE PROCEDURES. WORKING WITH THE STATES, THE FDA HAS ALREADY REDUCED BY 60% THE DOSE THAT PATIENTS RECEIVE FROM DENTAL AND MAMMOGRAPHY (BREAST) X-RAYS. THE FDA WILL EXPAND AND EXPEDITE ITS CURRENT PROGRAM FOR SETTING SPECIFIC GUIDELINES FOR THE USE OF COMMON X-RAY PROCEDURES, AND SPECIFIC GUIDELINES FOR THE EDUCATION, CERTIFICATION, AND TESTING OF X-RAY, NUCLEAR MEDICINE, AND RADIATION THERAPY TECHNICIANS.

II. PARTICULAR AREAS FOR EMPHASIS

THESE ACTIONS ESTABLISH A BROAD-GAUGED RESPONSE TO THE CONCERNS THAT HAVE BEEN EXPRESSED ABOUT THE HEALTH EFFECTS OF LOW-LEVEL RADIATION. BUT TWO AREAS DESERVE SPECIAL EMPHASIS.

1. MEDICAL, DENTAL, AND OCCUPATIONAL EXPOSURES

I HAVE ASKED MRS. FREDRICKSON, FOEGE AND KENNEDY TO GIVE SPECIAL ATTENTION TO MEDICAL, DENTAL AND OCCUPATIONAL EXPOSURES BECAUSE THEY REPRESENT SUCH A MAJOR PROPORTION OF THE RADIATION EXPOSURE WE CAN CONTROL. CONSIDER THE FOLLOWING FACTS:

- ABOUT HALF OF ALL THE RADIATION TO WHICH THE GENERAL POPULATION IS EXPOSED COMES FROM BACKGROUND RADIATION--FROM NATURALLY OCCURRING RADIOACTIVE MATERIALS IN THE WATER, SOIL, AND AIR.
- OF THE REMAINING HALF THAT COMES FROM MAN-MADE SOURCES OF RADIATION--WHICH WE CAN PRESENTLY AFFECT--NEARLY 90 PERCENT COMES FROM MEDICAL AND DENTAL USE OF X-RAYS AND OF RADIOACTIVE MATERIALS FOR TREATMENT AND DIAGNOSIS.
- THE REMAINING TEN PER CENT COMES FROM FALLOUT, INDUSTRIAL USES, PRODUCTION OF NUCLEAR POWER AND CONSUMER PRODUCTS.

THESE PERCENTAGES REPRESENT AVERAGE EXPOSURES FOR THE GENERAL POPULATION. MANY INDIVIDUALS MAY RECEIVE SIGNIFICANTLY HIGHER DOSES--SUCH AS THOSE WHO GET LARGE NUMBERS OF X-RAYS, AND, IN PARTICULAR, THOSE WHO WORK WITH RADIATION. WORKERS IN A NUMBER OF OCCUPATIONS, INCLUDING, FOR EXAMPLE, URANIUM AND PHOSPHATE MINERS,

NUCLEAR ENERGY PLANT EMPLOYEES, CERTAIN HEALTH CARE PERSONNEL, AND RESEARCHERS ARE EXPOSED TO RADIATION WELL BEYOND WHAT A MEMBER OF THE GENERAL PUBLIC RECEIVES.

WE WILL BOTH STEP UP RESEARCH ON THE EXTENT OF RISK IN THESE AREAS AND ALSO SEEK WAYS TO REDUCE THE AMOUNT OF EXPOSURE IN MEDICAL, DENTAL, AND OCCUPATION SETTINGS.

2. THE NEED FOR RESEARCH

FOR MORE THAN THIRTY YEARS, THE FEDERAL GOVERNMENT HAS RESEARCHED THE HEALTH EFFECTS OF LOW-LEVEL RADIATION AND HAS SET STANDARDS TO PROTECT THE HEALTH OF BOTH THE GENERAL PUBLIC AND OF WORKERS.

TODAY, GENERAL GUIDELINES FOR RADIATION EXPOSURE ARE SET BY THE ENVIRONMENTAL PROTECTION AGENCY AND INDIVIDUAL REGULATORY AGENCIES USE THESE GENERAL GUIDELINES TO FORMULATE SPECIFIC REGULATORY STANDARDS TO PROTECT THE PUBLIC HEALTH.

ALL OF THESE STANDARDS REST ON CURRENT SCIENTIFIC ASSUMPTIONS ABOUT THE EXTENT OF THE RISK FROM EXPOSURE TO LOW LEVELS OF RADIATION.

SEVERAL RECENT STUDIES--OF NUCLEAR WORKERS AT THE HANFORD RESERVATION IN THE STATE OF WASHINGTON, OF UTAH RESIDENTS DOWNWIND FROM THE NUCLEAR BOMB TESTS OF 20 TO 30 YEARS AGO, AND OF NEW YORK, MINNESOTA, AND MARYLAND RESIDENTS EXPOSED TO MEDICAL X-RAYS--RAISE QUESTIONS ABOUT THESE SCIENTIFIC ASSUMPTIONS. ALTHOUGH NONE OF THESE STUDIES IS CONCLUSIVE, THEY DO SUGGEST THAT THE INCIDENCE OF LEUKEMIA PRODUCED BY LOW LEVELS OF RADIATION MAY BE HIGHER THAN SCIENTISTS PREVIOUSLY THOUGHT.

SMOKY. BASED ON INFORMATION ON 85 PERCENT OF 3,213 INDIVIDUALS PRESENT AT THE SMOKY TEST IN 1957, WE HAVE FOUND 8 CASES OF LEUKEMIA--MORE THAN TWICE WHAT WOULD HAVE BEEN EXPECTED IN THIS POPULATION. IT IS NOT, HOWEVER, EASY TO INTERPRET THESE FINDINGS. THEY COULD BE EXPLAINED, FOR EXAMPLE, IF INDIVIDUALS RECEIVED HIGHER RADIATION DOSES IN THE SMOKY TEST THAN RECORDS REFLECT; OR IF INDIVIDUALS WERE EXPOSED TO OTHER CARCINOGENS IN ADDITION TO THEIR RADIATION EXPOSURE AT THE SMOKY TEST. NEVERTHELESS, THESE SMOKY FINDINGS ADD TO THE QUESTIONS RAISED BY THE OTHER STUDIES.

AS THE SUMMARY OF THE WORK GROUP SCIENCE REPORT STATES: "THE RESULTS OF RECENT STUDIES OF POPULATIONS EXPOSED TO VERY LOW LEVELS OF RADIATION RAISE SERIOUS QUESTIONS . . . AND SUGGEST THAT RISKS MAY BE HIGHER THAN EARLIER PREDICTIONS. BECAUSE OF VARIOUS METHODOLOGIC QUESTIONS INVOLVED IN THESE STUDIES AND BECAUSE CERTAIN OF THE STUDIES ARE STILL INCOMPLETE, THE WORK GROUP CONCLUDED THAT THEIR RESULTS ARE NOT YET CONCLUSIVE . . . FURTHER EPIDEMIOLOGIC AND EXPERIMENTAL WORK IS NEEDED TO CLARIFY THE POSSIBLE HEALTH EFFECTS OF LOW-DOSE RADIATION."

BUT LET ME UNDERScore THE CAUTIONS THAT DRs. FREDRICKSON, UPTON, FoeGE, AND KENNEDY HAVE EMPHASIZED TO ME: THE LATENCY PERIOD FOR CANCERS INDUCED BY LOW-LEVEL RADIATION IS LONG--AS LONG AS 20 TO 30 YEARS. CANCER CAUSED BY RADIATION IS BELIEVED TO BE A SMALL PROPORTION OF TOTAL CANCERS, AND A PARTICULAR CANCER MAY HAVE MORE THAN ONE CAUSE. TO DETERMINE THE RISKS OF LOW-DOSE RADIATION CAN REQUIRE SYSTEMATIC FOLLOW-UP OF LARGE NUMBERS OF SUBJECTS OVER LONG PERIODS OF TIME. DEFINITIVE ANSWERS ARE NOT LIKELY TO BE AVAILABLE SOON.

III. OUR GOAL

THE COMMITMENT I EXPRESS TODAY IS TO SEEK THOSE ANSWERS AS OPENLY, AS OBJECTIVELY, AS CAREFULLY, AS SCIENTIFICALLY AND AS RAPIDLY AS WE CAN,

THE LONG RANGE HEALTH EFFECTS OF EXPOSURE TO LOW-LEVEL IONIZING RADIATION CONSTITUTE A SERIOUS PUBLIC HEALTH ISSUE. THE QUESTIONS CONCERNING LOW-LEVEL RADIATION DEMAND A SYSTEMATIC RESEARCH PROGRAM THAT IS CONDUCTED IN AN OPEN AND CREDIBLE MANNER TO PROVIDE THE MOST ACCURATE INFORMATION POSSIBLE TO BOTH THE PUBLIC AND GOVERNMENT.

AS WE TAKE STEPS TO ASCERTAIN MORE PRECISELY THE RISKS FROM VERY LOW LEVELS OF RADIATION EXPOSURE, WE MUST ALSO REMEMBER THE BENEFITS SOCIETY DERIVES FROM THE USE OF RADIATION. WHILE THE RESEARCH AND PUBLIC DISCUSSION CONTINUES, WE MUST TAKE CARE NEITHER TO EXAGGERATE NOR TO UNDERESTIMATE THE DEGREE OF RISK FROM RADIATION. THE GOVERNMENT MUST EXPLAIN FULLY THE SCIENTIFIC BASIS FOR ITS POLICIES AND BE READY TO REEVALUATE THEM AS NEW INFORMATION BECOMES AVAILABLE. THE STEPS WE ARE TAKING TODAY ARE INTENDED TO PROVIDE A FIRM, OBJECTIVE AND SCIENTIFIC BASIS FOR SETTING GOVERNMENT POLICY AND REGULATORY STANDARDS ON LOW-LEVEL RADIATION.

DISTORTED PUBLIC TELEVISION PROGRAM

Mr. STRATTON. And in all modesty, Mr. Chairman, I had the occasion last Sunday to see a television film that appeared on public television called "Paul Jacobs and the Nuclear Gang" and I was so disturbed by its implications which are right along with what Admiral Rickover has been talking about, that I was constrained to make a 1-minute speech on the House floor. And if there is no objection, I would like to ask that that be put into the record, too, because it is an example of what not only the printed media are doing in this regard, but what the electronic media are doing. And in this case, it is public television that is doing it, a one-sided distorted completely biased account. And there is an editorial in the Washington Post this morning that says that maybe public television ought to shape up a little. And on the basis of that presentation, I would certainly agree.

I ask unanimous consent that that be also inserted in the record.

The CHAIRMAN. Without objection it will be done.

[The following information was received for the record:]

[From the Congressional Record, Feb. 26, 1979]

GUILTY UNTIL PROVED INNOCENT? IS THIS THE NUCLEAR "DEMOCRACY" IN AMERICA?

(Mr. STRATTON asked and was given permission to address the House for 1 minute and to revise and extend his remarks and include extraneous matter.)

Mr. STRATTON. Mr. Speaker, last night there was shown on Public Broadcasting Television a film entitled "Paul Jacobs and the Nuclear Gang," a distorted, misleading, and intemperate attack on the whole field of nuclear activities in the United States—nuclear energy as well as nuclear weaponry. Films such as this make one wonder if America's opinionmaking community is capable of balanced, rational thought on this important subject; or if emotion and nonsense have already taken over when it comes to the important and difficult decisions our country will have to make in the closing years of the 20th century.

As a result of this distorted presentation, paid for by public funds and public contributions over a network created presumably to replace hype and hucksterism with solid facts and sane reasoning, I am constrained to make some modest observations of my own, Mr. Speaker.

Let us begin at the beginning. Let us not forget, Mr. Speaker, that while nuclear weapons ended World War II, they also put an end to any need for American Armed Forces to storm their way ashore on the home islands of Japan.

It was estimated after the war ended that an additional 1 million casualties and 100,000 "excess" deaths—to use a term that the television show employed—in another context—were prevented by the Japanese surrender. Many of those excess deaths would have been inflicted on American servicemen. I know, because I was one of those slated to go in on that invasion. Operation Coronet it was called, if my memory serves me correctly.

By the end of World War II Russia was also well on the way to a nuclear weapon, using national technical competence plus stolen American secrets—stolen by Americans, incidentally. Russia, not the United States, was the first to demonstrate that thermonuclear weapons—fusion weapons—would detonate in the multimegaton range.

Under a U.S. plan proposed in the United Nations in the 1940's—the Baruch plan—all nuclear weapons would have essentially been eliminated. The Soviets said "Nyet" and so the number of nuclear weapons proliferated. The cold war was getting hot. Should President Truman have unilaterally stopped testing and destroyed the U.S. fledgling nuclear weapons stockpile while the Soviets were continuing to test ever higher yield weapons in the atmosphere? The film did not bother to face up to that question.

It is common knowledge that tens of thousands of Americans actively participated as crews in U.S. atmospheric nuclear tests at the Pacific Ocean and

continental U.S. test sites. Some hundreds of thousands of others were observers in the years from 1946 to 1958 and 1961 to 1963. No U.S. tests were conducted, however, during the United States-Soviet moratorium of 1958 to 1961.

In 1961 the Russians abrogated that moratorium. They also detonated the largest known nuclear weapon, a "dirty" 58 megaton gravity bomb exploded over Novaya Zemlya, an island in northeast Russian Europe, in the Arctic Ocean between the Barents Sea and the Kara Sea areas. The fallout from that weapon liberally sprinkled a vast area of Russia. But the Soviets must be a hearty lot, for we have never heard of any potential excess cancer deaths being attributed to fallout from any of the hundreds of Soviet atmospheric tests conducted in the forties, fifties, and sixties. Nor have we ever heard that any Soviet Naval personnel or shipyard workers were affected by low-level radiation from nuclear propulsion plants or repair facilities. Nor have we ever heard that any Soviet citizen has been affected by the Soviet commercial nuclear power programs.

Can it perhaps be that we in the United States never hear about cancer or other illness associated with radiation exposure in Russia because there is no association; there is no proof; there is no freedom of the press; or all of the above?

But we do hear an awful lot about the association of illness and radiation in the United States. There are many well-intentioned, antinuclear people, plus many, many lawyers, who are trying to find a close relationship between low-level nuclear radiation, fallout from nuclear testing in the 1950's, and cancer. Their hopes for denuclearization, and huge monetary settlements from the Federal Government, certainly must have been whetted last night by that film I have referred to, as sad a piece of trash, facetiously called a documentary as has ever been foisted on the American people, the film "Paul Jacobs and the Nuclear Gang."

An interesting review of this film, written by Bill Curry, appeared in the Washington Post on Saturday, February 24. I believe the Curry piece will probably be about the most fair evaluation we can expect of that kind of vicious propaganda so adored by social activists and other assorted liberals. Jacobs referred to himself as a social activist, which is what Curry also calls him. I would use another characterization—anti whatever the United States has ever done in nuclear activities once the Rosenbergs were executed for giving nuclear data to the Soviets.

To make the point in another way, I cannot recall a single instance when Jacobs castigated the Russians, the People's Republic of China, the French, or the British for also conducting atmospheric testing or possessing nuclear weapons. Nor am I aware of a single polemic uttered by Paul Jacobs against the Communist Chinese who have continued atmospheric nuclear weapons testing since their first test in 1964, a period of 14 years. U.S. atmospheric testing really started in 1946 and continued for a total of 14 years. Our tests were bad news; the Chinese test, one must assume, were OK for Mr. Jacobs. Certainly he was aware that fallout from the Chinese tests was sprinkling the Japanese as well as the United States. Was Mr. Jacobs therefore an apologist for the Communist countries, or was his "national" guilt, because the United States used nuclear weapons against the Japanese, strong enough to make him hate only U.S. nuclear activities? One wonders.

A democracy demands many freedoms, rights, and precepts for those under its mantle. I cite two—freedoms of the press and the right to be considered innocent until found guilty by a jury of one's peers. That we have freedom of the press is obvious. No country that was not a democracy would be likely to permit and even fund a vicious, one-sided diatribe against that country's efforts to preserve its own freedom, to be presented on television, let alone on a television network supported by public funds.

Yet how strange it is that those who most violently cite freedom of the press as an inalienable right are also found among those who most often forget the principle of innocent until proved guilty. The makers of the Jacobs' film take the guilty stand that because Jacobs said it and Jacobs is dead, then it is so. Is our American democracy entering a new phase called "guilty by conjecture" at least wherever nuclear activities are concerned?

Curry writes that a "growing body of scientific evidence now indicates, after 25 years of governmental denials, that the United States did sustain civilian casualties of this atomic warfare."

Curry said "did sustain." Elmer Jacobson's doctor told Curry that the fallout which is supposed to have "burned" (a very strong word) Elmer Jacobson's face "very probably" caused a subsequent thyroid cancer. Why did the doctor not say, like Curry, it did cause Jacobson's cancer?

I wonder, too, who besides Paul Cooper saw soldiers lighting up like X-rays at the Smoky tests. I am not even sure I know how one "lights up" like an X-ray. Dr. Mancuso—there were at least five shots of him—was fired from the Federal research program which was trying to establish any verifiable link between low-level radiation and cancer, because after 14 years he had not published any results. Mancuso's incompetence is well documented in the General Accounting Office report: "Review of the Department of Energy's Controversial Termination of a Research Contract," January 2, 1979, EMD-79-21.

Jacobs is one of hundreds of thousands who die each year from cancer. Did Jacobs as a boy perhaps go to a Thom McAnn shoe store on Saturday afternoon to look through the fluoroscope machine screen at the bones in his feet? Since Jacobs had lung cancer, has it been established whether he did or did not smoke? Who else, besides Jacobs, wandered through a "hot spot" in the Nevada desert and developed lung cancer? Did Jacobs or Cooper or all the others ever get dental X-rays from uncalibrated and poorly maintained X-ray machines? Did they ever get radium or cobalt treatments? Is there proof that the supposed fallout victims did not get radiation doses from other sources? None of the questions are treated or even raised in the TV film.

If the fallout from testing is supposedly so deadly, how does one explain the fact that there were so many thousands of survivors at Hiroshima and Nagasaki who were caught in the open in the primary nuclear radiation detonation zone?

Curry calls this vicious antinuclear diatribe a powerful documentary. He writes so well that I am astonished by his misuse of the word documentary. Webster defines documentary as broadly factual or objective. Curry recognized that the Jacobs film was neither factual nor objective. Here is his comment:

"There is, however, a troubling aspect to 'Paul Jacobs and the Nuclear Gang.' At some point, very subtly, this documentary becomes a wide attack on those seeking to bring nuclear weaponry and energy into our lives. Powerplant protests at Seabrook, N.H., become part of a story on the absurdity of how atomic weapons were tested. Can they be so easily lumped together? It is impossible to render that judgment."

How can America continue as a democracy if we fight for freedom of the press but permit that freedom to be subverted by condemning as guilty without trial, those with whom our media representatives disagree? We live in a world today in which the Soviet Union has assembled a warmaking capability relatively greater than anything known from the beginning of history. There has never been a nuclear confrontation between the United States and the U.S.S.R., and that is because we have tested and maintained a semblance of nuclear equality. But do not count on the blessing lasting if we allow our nuclear strategic forces to decline in either quality or quantity vis-a-vis the Soviets.

For those who did not see the film, I am attaching Mr. Curry's review:

"[From the Washington Post, Feb. 24, 1979]

"UNDER A MUSHROOM CLOUD—'PAUL JACOBS AND THE NUCLEAR GANG'

"(By Bill Curry)

"They called our school Pleasant Ridge elementary and it sat on a hill in Cincinnati, Ohio, and one day in the 1950s, probably after our mothers quit going there to roll bandages for the Korean War, the workmen came by and put a big yellow thing on the roof.

"It was the Civil Defense siren and it was to warn us of the time when the Communists were going to nuke all of us in Pleasant Ridge to smithereens. We practiced for it by going down to the basement where we were to Be Quiet and stand along the whitewashed concrete walls where, we had learned from our CD films, our chances were best. Then the all-clear siren would sound.

"And on Sundays we would watch 'The Big Picture' on television and the U.S. Army would tell us in no uncertain terms what they were doing to protect us. We saw the film clips of the A-bomb tests going off and blasting buildings off

the face of the earth. Just like the bombs would have done to Pleasant Ridge elementary school in Cincinnati, Ohio.

"But a growing body of scientific evidence now indicates after 25 years of governmental denials, that the United States did sustain civilian casualties of this atomic warfare.

"Their names are etched on the headstones in the little cemeteries in rural Utah, Arizona and Nevada, and they were casualties not of Soviet or other enemy nuclear weapons.

"They were, apparently, American casualties of American bombs.

"No one told them to go stand in the basement of their local school, so while the kids walked to school and the ranchers herded their cattle and the women worked in their gardens, the Atomic Energy Commission rained radioactive fallout on them from more than 80 weapons tests from 1951 to 1962 at the Nevada proving grounds.

"Then they would drink the milk from their own cows or from local dairies, and nobody knows how much bomb-test radiation they got along with it.

"The childhood leukemia rate in Utah jumped after the bomb tests began and fell when they ended. Some of the soldiers on 'The Big Picture' who were playing war on the Nevada desert under a bright nuclear neon light also suffered leukemia.

"All of this can be said now in 1979 because a growing legion of journalists, scientists, politicians and fallout zone residents have revealed the extent of a quarter-century of death and illness—and the U.S. government's unwillingness to acknowledge or even ascertain the consequences of the testing program.

"But it has been said before, 22 years ago when social activist and journalist Paul Jacobs spoke and few listened and nuclear criticisms were said to spring from 'scare stories' that were 'Communist inspired.'

"On Sunday night at 8 on Channel 26, Paul Jacobs speaks his last words on the subject in a powerful one-hour documentary that is a wide-ranging and one-sided attack on all things nuclear. They are Paul Jacobs' final words because the reporter had become an unwitting and tragic participant in the story: Paul Jacobs was dying of cancer that he believed he contracted from his exposure to radiation while reporting in the fallout zone in 1957.

"And he died before his documentary, 'Paul Jacobs and the Nuclear Gang' was completed.

"Others in the film have also died since they were interviewed—Helen Reichman, Max Brinkerhoff, Elmer Jackson, Paul Cooper. It is compelling television, these people telling of their exposures to radiation and the illnesses that would strike them dead soon after.

"Few scenes have the emotional draw of a dying Paul Jacobs interviewing a dying Paul Cooper, the soldier exposed to radiation at a 1957 test blast called Smoky. Cooper is propped in bed, living on tubes and just about dead.

"And it is almost Strangelovian to hear these cancer victims' testimony interspersed with Official Explanations from a Defense Department employe with a German accent saying: 'National security demanded what was done . . . and the Army did the proper thing.'

"Meanwhile Paul Cooper talks of soldiers lighting up like X-rays at Smoky.

"In fact, much of the strength of this program comes from such editing—we are actually hearing a dialogue between the people and their government with sparse, sometimes too sparse, voice-over narration.

"'Paul Jacobs and the Nuclear Gang' is, nevertheless, a highly successful start for the Public Broadcasting System's 'Non Fiction Television,' a series of 12 programs produced under the Independent Documentary Fund. The fund was established last year with \$500,000 in grants from the Ford Foundation and the National Endowment for the arts to finance such programs by independent producers.

"Without slighting this program though, it is clear that much of the best and most persuasive footage is that which was produced by the federal government itself. The '50s were, after all, great theater.

"Official government footage from the '50s shows the whirlwind destruction of the test blasts—followed by soldiers walking out to ground zero. A narrator reminds us as the troops march out, almost with envy, 'the mushroom cloud [is] still hanging in the air.'

"It doesn't even look like it makes sense.

"Then there's the Atomic Energy Commission film clips showing placid scenes of St. George, Utah, the American Hiroshima. A mother feeds her baby, another

hangs wash, husbands go to work. It is a recreation of the day in May 1953 when radioactive fallout from test blast Harry drove residents indoors for hours, covered their cars with fallout that had to be washed off, sent Helen Reichman to bed with radiation sickness and burned Elmer Jackson's face.

"(His doctor in Salt Lake City has told me this exposure very probably caused Elmer Jackson's subsequent thyroid cancer.)

"And the AEC film continues: 'Actually, when the invisible cloud had passed the total amount of radiation deposited on St. George was far from hazardous. Then, you may ask: "Why were the people asked to stay indoors?" For a very simple reason. The Atomic Energy Commission doesn't take chances on safety.'

"It doesn't even sound like it makes sense.

"Finally, there is 'The Big Picture' reporting to us on soldiers running out there under the mushroom cloud, a sequence so patently poor in its amateur acting that only a frightened nation could believe it. But it raised nuclear weapons to the altar of a religion.

"First of all,' a chaplain tells a fellow soldier in a trench 'one sees a growing, very bright light, followed by the shock waves and then you hear the sound of the blast. Then you look up and you see the fireball, as it ascends up into the heavens. It contains all of the rich colors of the rainbow . . . it's a wonderful sight to behold.'

"This footage helped set a national mood against which these atomic test bombs were detonated.

"There is, however, a troubling aspect to 'Paul Jacobs and the Nuclear Gang.' At some point, very subtly, this documentary becomes a wide attack on those seeking to bring nuclear weaponry and energy into our lives. Power plant protests at Seabrook, N.H., become part of a story on the absurdity of how atomic weapons were tested.

"Can they be so easily lumped together?

"It is impossible to render that judgment. But it is impossible to forget that the experts criticized Paul Jacobs 22 years ago. Said he jumped to conclusion, didn't know what he was talking about. They recited their knowledge and credentials, gave us their assurances and crossed their hearts and hope to die that everything was okay.

"This is the bead-string that Paul Jacobs sees tying all the little nuclear pearls together. From A-bomb tests to weapons manufacturing to nuclear submarines to atomic power plants, his Nuclear Gang told the nation then—and tells it now—not to worry.

"All the predictions,' Jacobs says in the final moments of his documentary and of his life, 'have turned out not to be true,' whether it be health hazards from fallout or the disposal of nuclear power plant waste.

"His unstated question is whether the pressures to develop energy in the 1970s will be as great as the pressures to develop nuclear bombs in the 1950s. Will fear do today what it did then, and will it be 2004 before some bill comes due?

"His answer is an implicit yes, but Jacobs does not say it. Rather, those who finished his documentary after his death allow one of those in the so-called Nuclear Gang itself to answer. He is an official of the Rocky Flats nuclear arsenal near Denver where triggers are made for atomic weapons and after he recites a list of atomic outrages he says:

"We look back at those things and say let's not let them happen again. They were done under the contingencies of the time, and, therefore, I'm not sure we can call them mistakes, but things that we would do differently by virtue of more information at this time.'

"That is the message of 'Paul Jacobs and the Nuclear Gang.' If it is an excess, it is perhaps because Jacobs the reporter did become Jacobs the participant, with his terminal cancer.

"He could be wrong or he could be right."

[From the Washington Post, Mar. 1, 1979]

PUBLIC TV: HOW MUCH FREEDOM?

The documents released last week concerning the Nixon administration's pressures on public television only substantiate what people already knew: that Mr. Nixon and his White House staff wanted public television to reflect as exactly

as possible their view of the world—and did everything they dared to make that happen. They were only partially successful before the Watergate affair diverted their attention. But that half-completed campaign still haunts the world of public broadcasting.

This is what animates the Carnegie Commission's recent proposal to reorganize the national super-structure of public broadcasting. The members believe the Nixon attack not only exposed what could be a great weakness in the Corporation for Public Broadcasting, but also left scars that have defaced the corporation's work ever since. The commission, like many individuals in the television business, thinks the corporation yielded too readily to political pressure when it canceled most public-affairs programs in an effort to secure federal funds for the rest of its programs.

The commission's key proposals are 1) to extend to nine years the terms of the people charged with setting public broadcasting's basic policies and 2) to create a second board of directors to supervise programming. It believes these changes, along with others, such as almost-automatic funding, would create an environment in which politicians would find it difficult to influence the content of the programs that professional employees create or purchase.

There is something to be said for these proposals, although it is hard to find the perfect balance between independence and public accountability in a communications system that is financed in large part from tax revenues. Absolute independence, which is what the broadcasters would prefer, would put a lot of unchecked power over public opinion in the hands of those who run public broadcasting. It was Mr. Nixon's view—and there are plenty of responsible people who agreed with him—that public television had acquired too much autonomy and had become politically self-indulgent and frivolous before the White House attack began in 1971. On the other hand, too much accountability and too severely limited autonomy create the danger—as suggested by this new batch of Nixon administration papers—that public broadcasting might become a political and propaganda instrument by whichever group of politicians could maneuver most adroitly.

The basic problem is that public broadcasting is not subject to the kind of checks to which almost all other forms of mass communications must respond. For better and for worse, for instance, the television networks, as well as local stations, newspapers and magazines, are influenced heavily in their programming by viewer and stockholder response. Without viewers, or with unhappy viewers, profits drop, and management and programming are changed.

While the absence of this kind of discipline on public television and radio may be vital to fulfilling one of their missions—that of providing specialized and experimental programming—it also represents a void that something else must fill. Taxpayers who put up the money are entitled to some measure of control and some assurance that the broadcasters are not simply going to move off into ever narrowing circles of political and social idiosyncrasy.

The Carnegie Commission is right in concluding that public broadcasting needs more independence from political pressure than it enjoyed in the early 1970s. The Nixon White House's attempt to force changes in its policies was too successful. But whether it needs to be as blissfully free from direction as the details of this commission's report recommend is something else again. We think not. In passing a reorganization bill, Congress should come down somewhere in between what we have now and what the commission recommends.

Admiral RICKOVER. May I comment on that, Mr. Stratton?

Mr. STRATTON. First of all, let me get my question in, Admiral, because you might use up my 5 minutes before I get a chance to get the question in. But I would be very happy to have your comment.

IMPACT OF DISTORTED CHARGES

I would like to know, Admiral, what you feel is the impact of these distorted charges that are being made about nuclear energy, what is this actually doing to us as a result of these people—whether they are misguided or perhaps have more sinister motivations—but as a practical matter what is going to happen?

Admiral RICKOVER. Well, there are two aspects, Mr. Stratton. First there is no question that many uninformed people who have access to the press or TV are making statements not deliberately to confuse people, but because they have certain ideas. And they have ideas of their own they are trying to push. They are not scientifically inclined. They do not want to take the trouble to become familiar with the technical issues. No layman can talk intelligently about a technical issue unless he wants to spend some time to get into it, any more than a member of this committee can act in a responsible way unless he knows some of the facts.

Mr. STRATTON. Isn't it true that what is happening here is that it is undermining, first of all, the use of nuclear energy in the Navy and second, isn't it undermining the use of nuclear power at a time when our other sources of energy are beginning to run out? The kind of things that went on in Seabrook, N.H., the kind of thing that is going on in my own State of New York means that we are not getting any nuclear reactors built to generate the electricity we need, is that true?

Admiral RICKOVER. Yes, sir. Whether or not we have nuclear power should not be decided by scare tactics. Whether we should or not have it should be decided by citizens and wherever it has been put to a vote of the citizens, as recently in California, the people have decided that that they want nuclear power.

Mr. STRATTON. And isn't it likely that if this keeps up, the United States will not have any nuclear power, and the Russians will have a whole lot of it?

Admiral RICKOVER. I do not think it is a question of whether the Russians have it or we do not. The force of circumstances is very soon going to require that we have it. Now, I was remarking to one of the members a few minutes ago that I have been testifying about the energy situation in Congress since 1959, pointing out exactly what was going to happen. And it happened here recently in Iran. And that issue can cause great distress and mixup and we still cannot see it. But this is one of the things that you must face with most people particularly in the United States.

We are not used to living in an unpredictable society. It is coming on us, and we cannot see it and we think that the Government per se, is going to take care of the problems. I remind you that, when we had the 1973 oil crisis, there was a 16-year-old girl in Bethesda who said it was the duty of the Government to supply her with all the gasoline she needed, that was one of the Government's duties. And I think we all tend to look to the United States as a big cow that can supply milk for everybody. We do not realize that as citizens we have responsibilities. And one of these responsibilities is to try to learn something about our world and what the problems are. Not even this Iranian crisis has caused a ripple. I thoroughly agree with you, we are going to come to nuclear power, because when the energy gets short, it does not make any difference how we get it, we are going to have to get it.

The CHAIRMAN. Mr. Emery.

STATUS OF REVIEW OF NAJARIAN STUDY

Mr. EMERY. Thank you, Mr. Chairman.

I know that we are running out of time so I will try to be brief.

Admiral, most of the recent aggravation over potential problems with low-level radiation came to light when Dr. Najarian of the Boston VA Hospital released the study that really triggered this whole incident. Who has seen the study, who has had an opportunity to review the data and the technique to determine whether, fact, it is valid?

Admiral RICKOVER. I do not believe anyone has seen all of the data. He has been asked repeatedly to furnish the data. He has now agreed to furnish parts of it, I believe.

I do not know whether you were in the hearing room at the time, but I strongly recommend that you use your subpoena powers to get that—you may not get it any other way.

The committee does have the power to subpoena the data, and turn it over to some group that you think is capable of looking at it. That is the only way that you can solve this problem.

But you may do more good than that. You may stop other people from coming out with unsupported statements.

NEED FOR FULL AND IMPARTIAL EXAMINATION

Mr. EMERY. The reason I ask the question, Admiral, is that I think it absolutely vital that any study, whether it is favorable or unfavorable to nuclear energy, nuclear powerplants or X-rays or whatever, be examined by a trusted, competent, impartial observer who can make value judgments with all the facts on the table so that we will have an opportunity to understand exactly what was done and how it was done.

I say this because I do not think that we, in the Congress or the Navy or the Pentagon, or the citizens for that matter, can fully evaluate the impact or the accuracy of the study unless the data can stand the test of public eye scrutiny.

I think that is really the basic issue that we have here.

Admiral RICKOVER. Yes, sir.

I believe that his study, which was mainly conclusions with no supporting data, was published in the *Lancet* magazine. That is a medical magazine that is published in England.

I mentioned earlier the British National Radiological Protection Board found a great deal of fault with it.

I do not know that the *Lancet* is his report official study. All the data has never been subjected to scrutiny in the United States.

Now, you recall that earlier I said in my testimony, a man who claims to be a scientist must live and abide by the scientist's creed which is, when a man makes a statement or develops a hypothesis, his data shall be open to anyone to question.

For example, when Einstein came out with his relativity theory, he published how he got it and everyone was entitled to look at it and question his theory as to relativity.

And the onus was put squarely on Einstein to prove it.

What has happened in the Najarian case is that he has put the onus on others to prove that he is wrong. He has not accepted the onus to prove that he is right in what he has said.

This is a trap that this committee and many other groups are falling into. It is the onus of the man who formulates a hypothesis to be able to prove it against all outside questions.

Mr. Emery, that is the scientific method, to have the scientist prove his theory.

That is what has brought about all our improvements and advances in industry.

Again, I strongly urge that you make an issue of this or else he should be discredited as a scientist in this instance.

Now, there is another aspect of this thing, too, which relates to what you say.

Dr. Najarian is quoted as belonging to certain institutes, just as another doctor is quoted as being employed by Pittsburgh University. Therefore the implication is that these organizations back him up. They should be asked whether the man is talking for himself or whether he is also representing the institution. Do you understand my point? In other words, they are making unsupported statements and putting the onus of proving them on the other side which is absolutely the wrong way to go at it.

Mr. EMERY. The bottom line, then, Admiral, is that any scientific study whether it is favorable or unfavorable, must withstand scrutiny by anyone who cares to analyze it, and let the chips fall where they may?

Admiral RICKOVER. That is what brands Dr. Najarian as a propagandist, pure and simple.

[The following questions were submitted to the witness to be answered for the record:]

The CHAIRMAN. The press has quoted some individuals as claiming that the Government is trying to cover up any investigation into radiation effects and activities. In your view, is there a foundation for such accusations?

Admiral RICKOVER. I can only speak for my own involvement with investigations being done relative to shipyard workers in the naval nuclear propulsion program. I have fully cooperated with the investigations being done by the Center for Disease Control, the staff of the House Armed Services Committee, and the Johns Hopkins University which is doing an epidemiological study under Department of Energy auspices. I certainly know of no coverup.

I discussed in my opening statement a recent issue with union access to a CDC conference held at the Portsmouth Naval Shipyard. Because union representatives were not included by CDC on their team and thus could not be present at all times, a union representative charged there was a coverup. Of course whenever a person doesn't get his way immediately he can always charge there is a coverup and the press religiously publishes the charge. Government people who are trying to do a thorough job and comply with the laws and regulations of the land are at the mercy of such people and their charges because they know our news media feed on this sort of thing and it is a way to influence public opinion. This has happened on radiation just as it has in many other cases. From my vantage point there is no coverup, and I will certainly continue to cooperate with the Government investigations into the potential health effects of exposure to low-level radiation.

The CHAIRMAN. You have testified that radiation exposure was reduced in 1978 even though there are more nuclear ships. Does this

mean the Navy waited until the radiation controversy started before it took action to reduce exposures?

Admiral RICKOVER. No, sir. Ever since I was assigned to Oak Ridge in 1946 to study nuclear power, one of my major concerns has been the health effects of radiation. I was determined to so design atomic-powered naval ships that the crews would be adequately safeguarded. An example of my concern in this subject was the design of the shielding for our naval reactor plants. I designed this shielding to be many times more stringent than was required by the standards then in effect. Even though the standards have been reduced considerably since then, the design of the shielding in the late 1940's of even the first ship, the *Nautilus*, was so conservative that today it is still more than adequate for what is needed to meet the present considerably lower levels permitted.

In the early years of the program personnel radiation exposures increased with increasing numbers of nuclear ships. By 1962 four submarine reactor plants had been overhauled and major efforts were underway to reduce radiation exposure. By 1966 the number of ships in overhaul had quadrupled as indicated by the buildup to the peak in total man-rem. Subsequently, as the number of nuclear-powered ships continued to increase, the number of ships in overhaul more than doubled again. However, by 1967 the ongoing major efforts to reduce radiation exposure were taking effect. Decreases in total annual exposures, decreases in numbers of personnel monitored, and decreases in numbers of personnel with annual exposures over 3 rem resulted in the following years such that the trend of total personnel radiation exposure has been downward since 1966.

The CHAIRMAN. Tell us something about Navy radiological control recordkeeping.

Admiral RICKOVER. A typical shipyard generates almost 1,000 pages of radiological control records each day. These include survey records for direct radiation, for radioactive particles on surfaces, for airborne radioactivity and for radioactivity in water samples. Audit and inspection reports, records of training performed, shipping documents for radioactive material, records of medical examinations and inventories of radioactive material are parts of these many records.

Probably the most extensive records are personnel radiation exposure records. In shipyards the daily dosimetry measurements for each worker are entered into a computer. From the computer this information is printed out in a number of formats. Twice each day a complete list of all workers' exposures is printed and distributed to work sites so each worker can know his up-to-date exposure. This information is then used by the worker to minimize his own exposure and by radiological control personnel to control exposures to administrative levels. Data printed includes radiation exposure by worker's name, exposure accumulated for the week, quarter-year and year, exposure used on specific jobs, and number of individuals who have received exposure in various exposure groupings.

Keeping these records accurate requires many checks and double-checks. Records are audited by a group of people independent of the personnel making the record entries. My representative in the ship-

yard checks these records. In addition, the Navy inspection team from my office inspects these records.

The CHAIRMAN. Is there any difference in the way in which military and civilian workers are treated with respect to radiation exposure, recordkeeping, medical diagnostic or basic training procedures at shipyards engaged in Navy nuclear work?

Admiral RICKOVER. No. Military and civilian shipyard employees are treated the same way. The number of military personnel attached to the shipyard who receive radiation exposure is very small; for example at one shipyard only 2 percent (37 out of 1,537) of the number of shipyard personnel monitored for radiation exposure are military personnel. The amount of exposure these military personnel receive is small since they are primarily in supervisory positions. This does not include Navy ship crews whose exposures are reported separately from shipyard personnel.

The CHAIRMAN. Both Navy personnel and civilian workers participate in shipyard overhaul procedures. What number in each group engages in those activities which result in exposure to nuclear radiation? Please state your response in absolute numbers and relative percentages.

Admiral RICKOVER. In 1978, 14,984 shipyard personnel were monitored for radiation exposure associated with naval nuclear propulsion plant work. About 2 percent of these are military personnel assigned at the shipyards. About 1,500 crewmembers of nuclear-powered ships were involved in radioactive work in shipyards. Therefore the total of both shipyard and ship personnel is about 16,500, and ship personnel were almost 10 percent of this total. Nuclear-powered ships which were in shipyards for short availabilities are not included in these numbers since the work performed in availabilities is less extensive than in overhaul.

The CHAIRMAN. Individuals from which group generally receive higher exposures? Which occupational specialties were involved in the higher doses?

Admiral RICKOVER. The personnel who receive the highest radiation exposures work on radioactive piping and components inside the reactor compartments of nuclear-powered ships. These included pipefitters, machinists, cleaners, inspectors, riggers, ladders, and shipfitters.

The CHAIRMAN. Is there a training, information program for those not involved in nuclear work or potential nuclear hazards in the shipyard?

Admiral RICKOVER. Each shipyard employee not involved in radioactive work and each person assigned to a nuclear-powered ship or a support facility, is required to receive basic radiological training, which is to insure that personnel understand how radiation areas are marked, how to identify radioactive materials, and not to cross radiation barriers. This instruction also explains that the radiation environment of personnel outside radiation areas and outside the ship or shipyard is not significantly affected by nuclear propulsion plant work. A typical shipyard spends about 50,000 man-hours each year to provide nonnuclear workers radiation training.

The CHAIRMAN. According to news reports, experts outside the Navy have rated the radiation control at Portsmouth "excellent." But what

about the early days when controls were not as stringent as they are today?

Admiral RICKOVER. Questions concerning controls in the past are basically asking if workers received more radiation exposure than was recorded in their records.

In each case where a worker implies or indicates he may have received more radiation exposure than was recorded, shipyards do a detailed evaluation of the situation. Shipyards have kept many records of what has happened in the early days and use these records in their evaluations. There have not been many cases where it was found that a record needed to be changed because of one of these evaluations.

The early days of the naval nuclear propulsion program occurred after shipyards had been handling radioactive sources for a number of years for industrial nondestructive testing purposes. Thus, a wide base of technical knowledge already existed on how to control personnel radiation exposures. In 1959, when Portsmouth performed their first overhaul of a nuclear ship, most of the basic concepts of radiological control used today in shipyards had already been formulated.

Th major changes in the last 20 years have been in improving work methods to reduce personnel radiation exposure. As new instrumentation has been used, it has confirmed that the earlier practices were effective in determining radiation exposure of personnel.

One example is the replacement of film badges with thermoluminescent dosimeters to measure personnel radiation exposure. As I discussed earlier, the use of this new type of dosimeter showed we had been recording radiation exposure about 15 percent higher than workers actually received. Thus, the actual radiation exposures in the early days were generally lower than what was recorded.

The CHAIRMAN. Each year since records have been kept, some number of shipyard workers and naval personnel exceed the established occupational radiation dose. What efforts have been made to observe the health and well-being of these personnel? Have there been any definitely established cases of any form of cancer among those personnel who reached or exceeded established exposure limits? If so, what were their exposures, the latent periods from exposure to diagnosis, the types of cancer? Have any former or current shipyard or shipyard personnel claimed that they have a cancer condition due solely to occupational exposure regardless of recorded doses? Some older naval nuclear weapons are known to have measurable levels of intrinsic (or background) radiation. Has this caused any problems?

Admiral RICKOVER. In no case have personnel in the naval nuclear propulsion program exceeded the lifetime limit of 5 rem accumulated dose for each year beyond the age of 18. Since 1967, no personnel have exceeded the quarterly limit of 3 rem per quarter year. The total number of persons in the naval nuclear propulsion program who have exceeded the quarterly limit since the limit was imposed in 1959 is 36. Most of these cases have been only slightly above the quarterly limit. For example, the Portsmouth Naval Shipyard experienced 14 cases in which individuals exceeded their quarterly limit from 1959 to 1962. The lowest value of exposure was less than 1 percent over the quarterly limit, and the highest value was 14 percent over the quarterly limit. Therefore, personnel who exceed limits by small amounts were not treated differently from a medical standpoint than other workers

who received exposures just under limits. In a report issued by the National Council on Radiation Protection and Measurements, they stated that they do not consider an established limit marks the difference between safe and unsafe amounts of radiation exposure. Of course, workers who exceeded limits will be included in the low level radiation studies conducted by CDC and Johns Hopkins.

There have been 19 shipyard workers who have claimed their radiation exposure caused the cancer or leukemia they had. Ten cases have been denied, 1 leukemia case just this month; 8 cases are under evaluation by the Labor Department, and 1 leukemia case was awarded. I disagree with this award in this case because this worker also had hundreds of rem in medical radiation exposure in addition to his 5 rem of occupational radiation exposure. If a radiation exposure were the cause of his leukemia, his occupational exposure could not have been more than a tiny fraction of his total radiation exposure.

Radiation exposure associated with nuclear weapons is not the responsibility of the naval nuclear propulsion program.

The CHAIRMAN. Radiation control criteria at Kittery-Portsmouth Naval Shipyard are much stricter than Federal standards. I understand that at Portsmouth the radiation exposure criteria were 1 rem/quarter and 2 rem/year per person in 1978, and 0.5 rem/quarter and 1 rem/year for 1979. That appears to be a clear intent of management to keep exposures of workers down.

Since the Federal standards are 3 rem/quarter and 5 rem/year, how do you explain to the workers the seriousness, or lack thereof, of receiving a radiation dose that exceeds the administrative criteria set up at Portsmouth Naval Shipyard?

Admiral RICKOVER. The managers and supervisors make it clear to their workers that these administrative levels have to be met and that management takes this requirement seriously. In their training sessions, explanations are given that the purpose of these lower administrative levels is to help reduce total radiation exposure. Workers also have training on understanding the risks of radiation. The records show that the shipyards have been successful in getting the message across to the workers, since radiation exposure has been decreasing. As I noted earlier, there was only one person over 3 rem in 1978.

Management is evaluated on how well their subordinates meet the administrative levels. They are evaluated on minimizing the number of workers exposed, and keeping cumulative radiation exposure for each major job, the entire overhaul period, and the calendar year below levels set in advance.

The CHAIRMAN. The Navy form, "Occupational Ionizing Radiation Exposure," contains the caveat: This document contains information subject to the Privacy Act of 1974. What information in the document is subject to the Privacy Act of 1974? Prior to 1974, were there statutory provisions to restrict the release of comparable information? Does an individual have complete freedom to release his personal records to whomever he wishes? Is there validity to the media charges that the Navy suppresses derogatory information on the exposure of personnel to ionizing radiation?

Admiral RICKOVER. This particular form is kept in medical records. The Navy Bureau of Medicine and Surgery considers all information

contained in personnel medical records to be subject to restrictions under the Privacy Act. Specifically, how much radiation exposure an individual received is considered subject to restrictions of the Privacy Act. This is not something I determine.

Prior to the Privacy Act it was a BuMed policy to restrict release of this information unless the individual authorized it. Restrictions on release of personnel radiation exposure information were not new with the Privacy Act. The Navy, the predecessors of the Department of Energy, and the Labor Department have had such restrictions for many years.

An important feature of these restrictions both then and now was that the individual had to authorize release of his exposure information. He was permitted to release it to anyone, his doctor, employer, or lawyer.

Last year and again this year the Navy has made available to the media detailed reports on occupational radiation exposure in the naval nuclear propulsion program. These reports go into detail on overall occupational radiation exposures and identify such information as past overexposures, injury claims filed by workers, and internal radiation exposures. There is no information withheld other than identifying names of individuals with their exposures which cannot be released because of Privacy Act considerations.

The CHAIRMAN. I understand that Dr. Najarian complained that he was denied access to the Navy's official radiological records. What is the situation with respect to his having access to Navy's records?

Admiral RICKOVER. Personnel radiation exposure records are covered by the Privacy Act of 1974 and as such, the Navy cannot release this information unless it is for a purpose directly related to the official basis for the Government holding the information. Since Dr. Najarian was conducting his own, private study, a basis did not exist for giving him personnel radiation records without violating the Privacy Act.

It was determined that such information on deceased persons was no longer private information and thus not covered by the Privacy Act. Personnel radiation exposure information for deceased persons has been released to Dr. Najarian.

The CHAIRMAN. Numerous demands have been made that the Federal Government should reduce radiation exposure limits. Do you think the Navy should reduce its own radiation exposure limits? What would be the impact on your program of reduced exposure limits?

Admiral RICKOVER. I don't have anything to do with setting U.S. radiation exposure limits. I will continue to follow whatever limits the Federal Government sets.

However, radiation exposure limits should not be changed solely at the demand of a few very vocal scientists who disagree with the majority of their peers. Disagreements on the scientific basis for the limits should be resolved by careful scientific analysis and judgment and not by the newspapers. I get suspicious of the motives of a scientist who uses the media to gain support for his ideas.

The most frequent demand has been to lower radiation levels by a factor of 10, to 0.5 rem per year. Lowering limits to this level would not stop the operation of naval nuclear-powered ships, since operating crews do not exceed this exposure at sea. However, it would make

repair of the nuclear propulsion plants much more difficult. It would increase costs. And, surprisingly to many proponents of lowering limits, it would increase the total occupational radiation exposure for the shipyard work force. Total exposure increases because with lower individual exposure limits more workers would be needed to perform a given job. When workers are changed in the middle of a job, the total amount of exposure to do the job increases. Also, when the limits are reduced you will not always be able to use your most expert people who can do the job as quickly as possible with minimum exposure.

The CHAIRMAN. I'd like to discuss the general subject of public information regarding radiological controls and their meaning. It seems to me that open communications with workers engaged in radiological activities and the general public would go a long way toward curbing an alarmist approach to these activities.

What are your recommendations on how these communications might best be provided?

Admiral RICKOVER. I have addressed this question somewhat in my opening statement. In my program the workers are given training in radiation and radiological control and I think that is a key element in the general sense of well being workers have in the naval nuclear propulsion program. When people operate from a well founded basis of information they can separate the facts from the rhetoric.

I certainly agree that more can be done regarding better information to the public. The Navy can do little in this area since Navy pronouncements are viewed as self-serving and biased. However, the interagency radiation task force reports just released by Secretary Califano can be of great help in getting the public a more balanced view on radiation.

Unfortunately the public receives its information from the news media. Yesterday's coverage on one newspaper front page headlined "job dangers of radiation emphasized." In contrast, Secretary Califano made a balanced presentation which did not emphasize job dangers of radiation. Apparently it is difficult for those who compose headlines to make the tone of the headline match the story. There is a tendency to put the word "deadly" in front of "radiation" in headlines, for example.

As I discussed in my opening statement, the most important thing we need is for information to be issued that puts occupational radiation exposure into proper perspective with natural and medical sources of radiation and compares risks from radiation exposure to other everyday risks. This is not happening now and it is resulting in unnecessary fear that could lead to a loss of the many benefits we can realize from proper use and control of activities involving manmade radiation.

The CHAIRMAN. Are the authorities of the communities near shipyards doing nuclear vessel overhaul acquainted with shipyard procedure to handle emergencies and what the communities response should be?

Admiral RICKOVER. State radiological emergency response plans provide the basis for State and local government response to radiological emergencies whether occurring at a naval shipyard or some other facility in the State. The Navy cooperates with State radiological health and emergency preparedness officials. We have met with these officials in all States where shipyards are located. They are aware

of shipyard procedures and have copies of the Navy's emergency plan. Coordination of local authorities and their response is handled primarily through the State. Shipyard officials have also had discussions with local authorities around the shipyards.

The shipyard officials are authorized and required to notify State or local authorities immediately when preliminary assessment indicates a situation has or may have potential for radiological effects outside the shipyard boundaries. This notification would include recommended action for consideration by these authorities based on the Environmental Protection Agency's protective action guides for radiological emergencies. State authorities know what these notification levels are and what actions would be recommended.

The CHAIRMAN. Are nuclear accident, incident safety drills conducted which involve personnel not engaged in nuclear related jobs?

Admiral RICKOVER. Yes. At least one of the quarterly drills each year typically will involve large numbers of personnel throughout the shipyard. Many of these would not be engaged in nuclear related jobs.

These training exercises also include personnel outside the shipyard. For example, State officials are notified during the exercise and there is a station for a representative from the State inside the shipyard's emergency control center. As another example, these exercises regularly involve local hospital personnel.

The CHAIRMAN. Are there teams and, or security forces trained to cope with nuclear emergencies which might occur on or outside the shipyard?

Admiral RICKOVER. The shipyards have radiological emergency and security teams capable of responding to emergencies inside or outside the shipyard. Response outside the shipyard is to assist appropriate State and local authorities. These teams are trained and drilled regularly.

The CHAIRMAN. The major justification for the naval reactors development program is that it: "Provides for the design, development, and testing of improved naval nuclear propulsion plants and reactor cores having long fuel life, increased reliability, improved performance and simplified operation, and maintenance requirement." How many new reactor designs will be incorporated in vessels that are in for overhaul? How many new core designs will be incorporated in vessels that are being refueled or overhauled?

Admiral RICKOVER. The naval nuclear propulsion program is a continuing effort which is improving existing and developing new reactor plant components, systems, and cores, and verifying operating reactor plant performance. This ongoing effort combines technological advances, designs, and characteristics to evolve new and improved components, cores, and systems capable of withstanding harsh operating conditions over extended lifetimes. Combining operational and developmental responsibility in one organization has allowed operating reactor plant data to be incorporated in the continuing developmental effort. This overall responsibility has been fundamental to the significant technical advances achieved over the last 25 years.

Improvements to components, cores, and systems have extended the time between overhauls and lengthened reactor plant design life.

To use core endurance as an example of these improvements, the first core for the U.S.S. *Nautilus* propelled the submarine 2 years and 62,000 miles, while new long life cores are capable of propelling nuclear ships for 10 to 15 years and over 400,000 miles. As a result, the number of refuelings has been significantly reduced, and is expected to be reduced further as longer lived cores become available, thereby substantially reducing costs, increasing operational readiness, and minimizing radiation exposure and radioactive wastes.

Nuclear propulsion plants are the longest lead items for nuclear warships. The extensive design, development, and test work associated with reactor plant components, systems, and cores requires many years of effort prior to being ready for shipboard use. Therefore, the ongoing naval reactors developmental effort for the design of various new cores, components, and systems aids in reducing the long lead time required to put a new or improved ship class into the operating fleet. As an example, the nuclear propulsion plant for the Trident class ballistic missile submarine would have taken years longer if developmental work on various core, system, and component improvements had not already been ongoing.

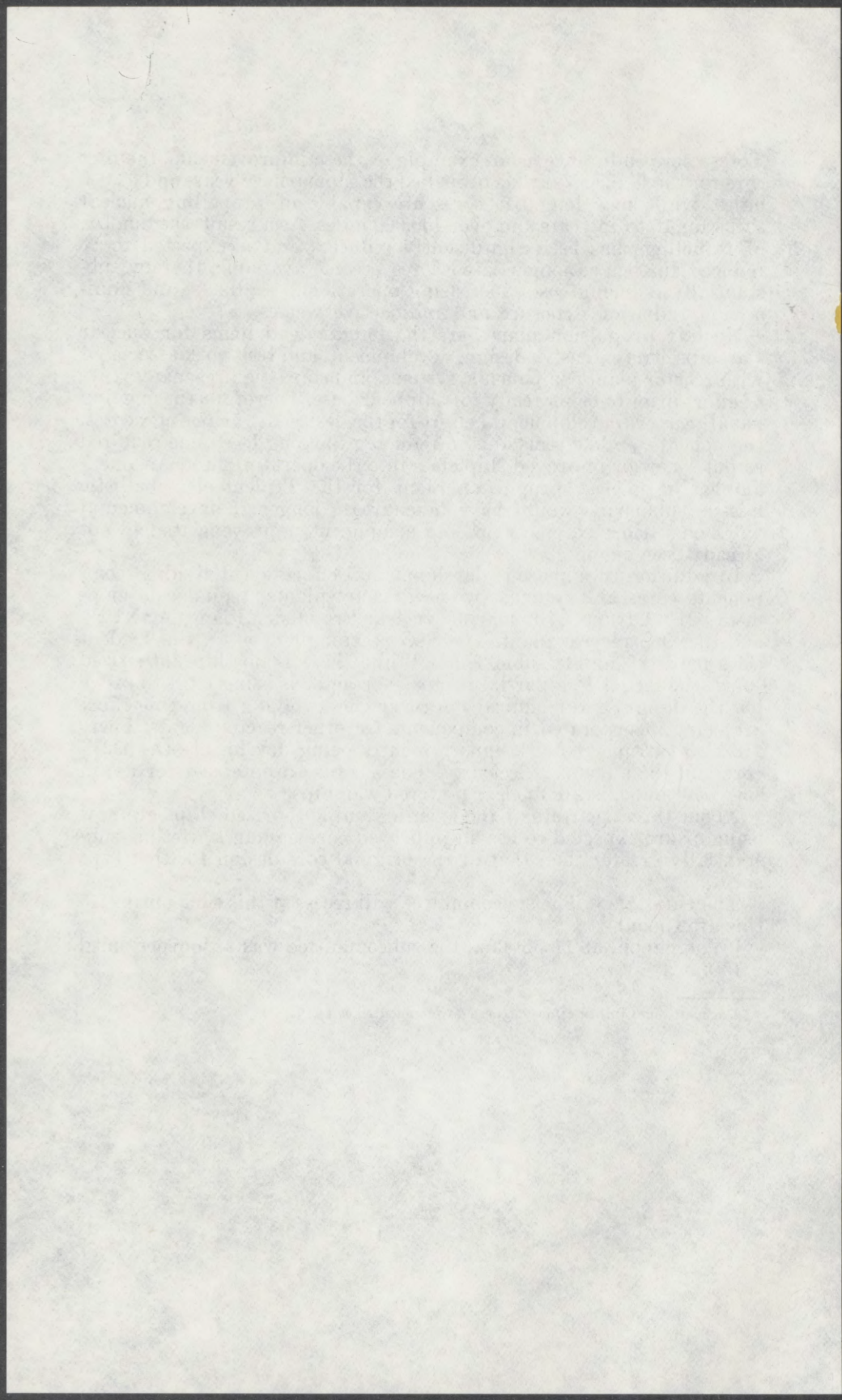
In addition to numerous developmental efforts on individual components, cores, and systems, two new reactor plants are under development—the Advanced Submarine Nuclear Propulsion Plant (ASNPP) and the S8G reactor plant. The S8G reactor plant is for the Trident class ballistic missile submarines. While there is no ship authorized to use the ASNPP, a partial prototype reactor is being built to prove out the design, and technical improvements evolving from this effort are being incorporated in components for other reactor plants. There are also two new core designs presently being developed—the D2W core and the advanced fleet core. These cores are intended for use in both new and existing nuclear powered warships.³

About three quarters of the existing and authorized ships are now using or are expected to use an improved core having a lifetime substantially greater than that of the original core design for that type ship.

The CHAIRMAN. The subcommittee will recess at this time until 2:15 this afternoon.

[Whereupon, at 11:56 a.m., the subcommittee was adjourned until 2:15 p.m.]

³ For additional information on these developments see pp. 91–96.



AFTERNOON SESSION

The CHAIRMAN. The committee will be in order.

Admiral, I think we ought to go to the next part of your briefing now, on the defense item that you want to bring to the attention of the committee. Did you have a separate presentation you wanted to make this afternoon?

Admiral RICKOVER. Yes, sir, I have.

The CHAIRMAN. Why don't you go ahead with that.

STATEMENT OF ADM. H. G. RICKOVER—CONTINUED

Admiral RICKOVER. Mr. Chairman, before I start I would appreciate it if I could have your permission to revise and extend the statement I made this morning, and also the one for this afternoon.

The CHAIRMAN. You certainly may, Admiral.

Admiral RICKOVER. Thank you, sir. I deeply appreciate this opportunity to state my views concerning the naval shipbuilding program as it affects the naval nuclear propulsion program.

If you approve, sir, I will submit my full statement for the record and only read parts of it, because it is pretty long.

The CHAIRMAN. Yes, sir.

INTRODUCTION

Admiral RICKOVER. In some of my remarks I may express views contrary to those of some of my superiors.

You are aware that since the inception of the naval nuclear propulsion program there have been basic differences between my opinions and those of many of my superiors.

My superiors have more responsibilities and problems different and more onerous than mine, and these responsibilities and problems may require different solutions than I propose.

I claim no superior wisdom. I make no claim that my views are right and theirs are wrong. As I have in the past, I will give you my personal and professional views based on the information available to me and leave it to you to make your judgments as you see fit.

Now, as I go along, Mr. Chairman, I am going to skip parts of it, because it is too long to take up your time in this hearing.¹

The CHAIRMAN. You may summarize it at any point you care to.

Admiral RICKOVER. Yes, sir.

And certainly, any time you care to, any member can interrupt me and I will answer at that time.

NAVAL NUCLEAR PROPULSION PROGRAM

The combination of the responsibilities of the Departments of Energy and Navy for naval nuclear propulsion under one organization

¹ For Admiral Rickover's complete prepared statement see appendix 3, pp. 206-239.

eliminates duplication of programs and resources and provides close coordination of technical work.

DIVISION OF RESPONSIBILITIES BETWEEN NAVY AND ENERGY DEPARTMENTS

The naval nuclear propulsion work funded by the Department of Energy provides for the research and development of nuclear reactors for warships.²

In this regard, I am responsible for reactor plant research, design, development, construction, operation and health matters pertaining to naval nuclear propulsion plants and for all related safety aspects.

Furthermore, my responsibilities also include, selection, training, and qualification of personnel for operating and maintaining these plants. Within the Department of Energy, I am also responsible for the water-cooled breeder program, a civilian reactor development program which is not under the cognizance of the Armed Services Committee.

The Department of the Navy is responsible for the military application of nuclear propulsion including constructing, operating, and maintaining nuclear-powered ships, and for developing the nonreactor portions of the nuclear propulsion plants.

NAVAL REACTORS DEVELOPMENT PROGRAM

The joint naval nuclear propulsion program involves many activities, including two Department of Energy-owned, contractor-operated laboratories where research and development work is performed; a number of land prototypes owned by the Department of Energy; reactor component manufacturing plants owned by the private sector; also shipyards, private and Navy, where nuclear ships are designed, built, and overhauled.

LAND PROTOTYPES

Seven land prototype propulsion plants are now in operation; these are used to test and evaluate reactor and propulsion plant designs, and to train and qualify Navy personnel for operating and maintaining naval nuclear propulsion plants.

In addition, the propulsion plant prototype for the Trident ballistic missile firing submarine will commence operation at West Milton, N.Y., this year. In fact, I expect this plant to be operating some time in May. I know Mr. Stratton is particularly interested in this.

NUCLEAR WARSHIPS

In the quarter century since 1953, when the *Nautilus* land prototype first operated, the number of nuclear-powered warships has grown to a present total of 125 warships.

These represent more than 40 percent of the Navy's combatant ships. This figure includes 41 ballistic missile submarines, 73 attack submarines, 3 aircraft carriers, and 8 cruisers. We also have one nuclear-powered deep submergence research vehicle, the NR-1.

These ships have steamed a total of more than 40 million miles; yet there has never been an accident involving a reactor nor has there

² See pp. 91-96 for a summary of the Department of Energy FY 1980 budget request for naval reactors development.

been any release of radioactivity which has had a significant effect on the environment. This ties in with my testimony this morning.

In addition to the ships in operation, 7 Trident ballistic missile submarines, 24 *Los Angeles*-class high-speed attack submarines, 1 *Nimitz*-class carrier, and 1 *Virginia*-class cruiser have been authorized by Congress or are under construction.

The naval nuclear propulsion program is responsible for more operating reactors than the combined total of all U.S. civilian power reactors. Altogether, there are 152 reactors in operation, which have accumulated over 1,700 reactor-years of operating experience.

I think, Mr. Chairman, this gives you a pretty good idea of what a vast program this is, and how much experience we have had, not only in the plants themselves but in the training of personnel to operate the reactor plants of these ships and prototypes. And as you know, information is made available to the civilian power industry.

LONG LIFE REACTOR CORES

Particular emphasis is placed on obtaining advanced long life cores necessary for increased ship performance and availability.

Extending the operating lives of these cores will materially benefit the Navy from the standpoint of both cost and operations. A longer nuclear core operating life will increase the percentage of time the nuclear fleet units are able to undertake operational duties.

This will allow greater operational flexibility and provide additional assurance of availability and endurance to fight a war.

This is a most important consideration, because any future naval war will have to be fought with the ships available at the start of hostilities.

I will say another thing. Nuclear ships, although they are far more complex than oil-fired ships are available to be on the line more than the conventional ships.

Furthermore, when we started the naval nuclear propulsion program, diesel submarines used to go in for a complete overhaul every 2½ years. Our nuclear ships only require a complete overhaul every 6 to 9 years. That gives you a measure of the greater additional time they are available for operations.

An additional benefit of developing long-life cores is that as core lives increase the number of refuelings will be reduced.

Refueling is a complicated and costly operation. As we go up to 15 years of operation before refueling from the 2 years we started with, you can see that also means saving of time and money and minimizes the radiation exposure and volume of radioactive waste.

As an example, the first core for the U.S.S. *Nautilus* propelled the submarine 2 years and 62,000 miles, while a modern core is capable of propelling nuclear ships for 10 to 15 years and over 400,000 miles.

SSN-688 CLASS SUBMARINES

The shipbuilding program proposed by the Department of Defense for fiscal year 1980 includes funds for the 34th high-speed *Los Angeles*-class submarine.

Nine have already been delivered to the Navy; 14 more are being built at Electric Boat and 8 at Newport News. The contract for the

remaining two already authorized is expected to be awarded in a few weeks.³

These high-speed nuclear submarines, whose principal mission is antisubmarine warfare, are meant to counter the rapid increase in both the quantity and speed capability of the Soviet nuclear submarine fleet.

The high speed capability in the 688 class permits them to be used in direct support of high-speed surface task forces in an escort role.

High speed also provides tactical advantage over previous, slower classes of U.S. submarines. Ships of the SSN-688 class are currently participating in a tactical development and assessment program which is designed to determine the best tactics to employ in the various missions which this ship will perform.

The program is only partly completed; but it has already shown that the high speed of the SSN 688 class considerably expands the tactical options and capabilities available to attack submarines.

Mr. Chairman, I suggest that later today you go, if you can, into executive session so that I can give you some specifics on the outstanding performance demonstrated by this new class of submarines.

TRIDENT SUBMARINES

The shipbuilding program proposed by the Department of Defense for fiscal year 1980 includes funds for the eighth Trident submarine.

The Trident submarines will have increased survivability compared to our existing Polaris and Poseidon submarines because they are being built with all the latest technology.

They will be more difficult to detect than existing Polaris and Poseidon submarines because the Trident submarines will be quieter and their longer range missiles will give the submarines 10 to 20 times more ocean area in which to hide.

Our existing Polaris and Poseidon submarines are noisy compared to current standards.

They were all built with the technology of the 1950's. Quieter submarines are necessary to decrease the probability of detection and to insure the survivability of our seaborne strategic deterrent.

Our current force of 41 ballistic missile submarines was commissioned during the 7-year period from 1959 to 1967, and were built to specifications based on a 20-year life.

These ships have been operated hard, with two crews, to allow them to be on station the maximum possible time. It is unreasonable to expect them to operate for more than 20 years without the possibility of breakdowns.

The long range of the Trident missiles will permit basing our ballistic missile submarines in the United States—no foreign basing will be required.

This will eliminate the vulnerability of our ballistic missile submarine force to international political action that could deny us the use of foreign bases. This is extremely important because we are always in danger of losing our foreign bases.

³ On April 16, 1979 the Navy placed a contract with Electric Boat to build these two submarines.

The events in Iran are some indication of this.
Aside from submarines——

FOREIGN BASES

The CHAIRMAN. I would like for you to get in there a little detail on our foreign bases and tell us what the situation is. We are getting into worse shape year by year in foreign bases. And will you give us some idea what the latest is on Rota.

Admiral RICKOVER. On Rota, I can tell you specifically that we will be out of there by July 1.

The CHAIRMAN. What will we have left in that area?

Admiral RICKOVER. The nuclear Navy will not have anything left. The rest of the Navy is still there, but squadron 16, which is our Polaris nuclear-powered submarines, will put out by July 1.

They are going to be based in the southern part of the United States at a base near Georgia.

The CHAIRMAN. That is a pretty good long cruise from Georgia to some of our present foreign bases.

Admiral RICKOVER. We can make out.

The CHAIRMAN. Make out?

Admiral RICKOVER. From a targeting standpoint it is obviously better to have foreign bases. But there is a price we have to pay for that, too. We have to pay for it. I think we will make out all right.

The CHAIRMAN. I guess we have to make out.

Admiral RICKOVER. Well, you know, you don't get anything for nothing, and you have to pay a price.

The CHAIRMAN. Of course we never have, even with the bases we don't get them for nothing.

Admiral RICKOVER. Someday Heaven will prevail on Earth and we will get those things free. But not today.

The CHAIRMAN. Proceed with your statement.

Admiral RICKOVER. Aside from submarines, the only warships I have recommended to be provided nuclear propulsion are aircraft carriers and guided-missile firing ships. These are large ships.

SOVIET NAVAL THREAT

I will address my views on nuclear propulsion for surface warships shortly, but first I want to summarize the growing Soviet Naval threat.

Since 1958 the Soviet Navy has taken delivery of at least 1,800 new ships and combatant craft in 137 different classes, a program of naval expansion that surpasses the efforts of any other naval power.

From a defensive posture in World War II, the Soviet fleet has evolved into a major blue-water navy that today can challenge the United States for control of the seas.

More important, the Soviet momentum for superiority in all phases of naval warfare continues while U.S. naval plans are far from certain and fluctuate every year. There has never in peacetime been anything comparable to the current growth of Russian naval power.

From 1969 through today the Soviet Navy has increased in numbers of ships and in capability. For example, the nuclear submarines in the Soviet fleet increased from 69 in 1969 to about 155 today, surpassing us in this area in 1970.

During this time period, the number of Soviet surface combatants and aircraft carriers have increased from 220 to 272 while the number of U.S. major surface combatants and aircraft carriers fell from 301 to 174. While their numbers have continued to increase, ours have continued to decline.

SOVIET SUBMARINES

Looking at the submarine situation specifically, the comparison is particularly ominous. Currently the Soviets have a total of about 355 submarines, consisting of about 155 nuclear-powered and 200 diesel-powered ships, all of which have been built since World War II.

The total U.S. force is 122 submarines with 114 nuclear powered and 8 diesel powered. You have a table before you that shows the comparison. [See p. 216.] By 1985 the 7 Trident and 24 *Los Angeles*-class nuclear attack submarines already authorized are expected to be delivered, averaging about 5 new nuclear submarines a year.

The current Department of Defense plan is to authorize only two additional nuclear submarines a year.

Thus, after 1985 our deliveries will drop to that rate. If the Soviets continue delivering at the rate of 10 nuclear submarines a year, as they have averaged for the past 4 years, the nuclear submarine gap will continue to widen rapidly.

Now, you must not take this, Mr. Chairman, as an advocacy on my part that we build up to the number the Soviets have. I am not advocating that, nor do I think it is necessary.

I think we can make up to some extent what their national motives are by trying to have better ships with better crews. I think if we are supported to that extent we can do well even with a reduced number of ships.

Now, this may sound unusual, coming from a military man. But this is what I believe.

SOVIET BALLISTIC MISSILE SUBMARINES

In the critical area of strategic submarines the Soviets have built about 71 nuclear powered ballistic missile submarines compared to our 41. They have 34 *Yankee*-class submarines which are equivalent to our Polaris and Poseidon submarines, but their submarines are all newer than ours.

The Soviets also have at sea 29 ships of their *Delta*-class ballistic missile submarines, with more under construction. These ships carry missiles with a 4,200-mile range.

This means that from their operating areas in the Barents Sea and northern waters they can cover the entire United States, Canada, and most of Mexico.

In total, the Soviets have almost twice as many nuclear-powered ballistic missile submarines as we, and they are continuing to build

new ones. Our first Trident submarine will not be delivered until 1980. Even then our building rate will only be about one a year.

SOVIET ATTACK AND CRUISE MISSILE SUBMARINES

In attack and cruise missile submarines the Soviets have a total of 260 units to our 81. Of their total, about 84 are nuclear powered, while the United States has 73 nuclear-powered attack submarines.

We do not have any submarines capable of firing cruise missiles, although the Navy is developing a version of the Harpoon missile which will be capable of being fired from submarine torpedo tubes.

The Soviets have the largest and most modern submarine yards in the world. They are credited with a nuclear submarine production capability of 20 ships a year on a single shift basis. While not fully utilizing this vast building capacity, they have since 1974 completed 40 submarines.

As late as 1966, the Russians had only two new construction yards for building nuclear submarines; today they have four with this capability, and further expansion of such facilities is currently in progress.

At present, the maximum U.S. capacity to build nuclear submarines is less than half that of the Soviets.

Of greater concern than total numbers is the fact that since 1968 the Soviets have introduced over nine new submarine designs, or major modifications in design, besides converting older submarines to improve their capabilities. They have introduced significantly improved versions of their attack, cruise missile, and ballistic missile nuclear submarines.

In the last 10 years, they have introduced more new submarine designs than have ever been put to sea, during a comparable period, in all of naval history. The United States, on the other hand, has introduced only two new submarine designs in this period.

SOVIET SURFACE WARSHIPS

The trends in the surface navy are also of concern.

Today, the Soviets have more major surface combatants than we, and many of their ships carry surface-to-surface missiles, which our ships do not yet have.

They presently have 272 surface combatants and aircraft carriers compared to our 174. Since 1969, the Soviets have built over 800 major and minor surface combatants, mine warfare, and amphibious ships, while the United States has built 85, or about one-tenth as many.

The Soviets have recently shown that they have a place in their navy for aircraft carriers. The recent operation of the *Kiev* and *Minsk* along with construction of a sister ship shows that the Soviets intend to enter into the area of naval aviation capability which has been the major strength of the U.S. Navy.

SOVIET CRUISER PROBABLY NUCLEAR POWERED

The Soviets have begun construction of a new class of cruiser, which will probably be nuclear powered and which, at an estimated 25,000 tons would be the world's largest nuclear-powered cruiser.

Our largest nuclear-powered cruiser, the U.S.S. *Long Beach*, is about 700 feet long and displaces 17,000 tons.

The new Soviet cruiser will be larger than the nuclear-powered strike cruiser (CSGN) that was proposed for construction by the Ford administration.

SURFACE WARSHIPS

The table that follows compares the Soviet and United States surface fleets. You have that, and I am not going to take your time to repeat it. You have the tables in front of you. [See p. 217.]

Overall, I believe that in a nonnuclear war, our Navy still has a slight edge over the Soviet Navy because of our aircraft carriers, listed in the second table. [See p. 218.]

However, even this is not reassuring since, as a land power, the Soviets do not have to depend on sea lines of communication to conduct military operations.

Further, the number of deployable carriers in our fleet continues to decline, and no new carrier has been authorized since the *Carl Vinson* 6 years ago. This is the longest gap in carrier authorization at any time in the past 25 years.

Apparently, it is now planned that one more carrier will be built in the foreseeable future. Even so, the ship included in the budget this year is substantially inferior in almost every respect to any carrier, nuclear or conventional, authorized in the past 25 years. That is progress.

DIFFERENT MISSIONS OF SOVIET AND UNITED STATES NAVIES

The mission assigned to our Navy is a far more difficult task than the Soviet Navy mission of denying us free use of the seas.

The United States has long since given up any chance of matching the Soviet Navy in number of ships. Therefore, the quality of our ships must be superior, if we are to be able to withstand their attacks and protect the sea lines of communication.

It is axiomatic in war that a nation dependent on the quality of its weapons to prevail over numerically superior forces must design its forces around an offensive strategy.

A nation whose forces are outnumbered cannot afford to fight a defensive war of attrition. If we expect to be able to prevent defeat in a nonnuclear conflict, then we must be able to penetrate the opposing forces and strike their bases and sources of supply.

FISCAL YEAR 1980 BUDGET PROPOSES NONNUCLEAR CARRIER AND "AEGIS" SHIP

As you know, the fiscal year 1980 shipbuilding program includes a medium size, oil-fired aircraft carrier known as the CVV; also, the second ship of the DDG-47 class *Aegis* fleet air defense ships, the DDG-48, which is an oil-fired, gas turbine-powered ship.

Aircraft carriers and *Aegis* fleet air defense ships will form the backbone of our firstline naval strike forces. Thus they will have to be capable of fighting in the areas of highest threat.

Considering the difficulties of providing logistic support in such areas, in my view it is essential that our firstline warships be given the mobility and flexibility that only nuclear propulsion can provide.

In my opinion, in the 1980's and beyond, in any area where the Soviets challenge us, we will need all-nuclear carrier task forces if we are to be able to keep our sea lines of communication open.

The decisions you reach this year concerning whether you authorize these nonnuclear ships, or decide to take on the uphill fight to reestablish the nuclear-powered ships the Congress and the Department of Defense once agreed upon—the nuclear carrier CVN-71 and the nuclear *Aegis* cruiser CGN-42—are of fundamental importance to the future of the U.S. Navy.

In this connection I advise any members who haven't been reading the newspapers in the last 3 weeks to see what has happened to our supply of oil from Iran, and not only the Iran situation, but the dwindling amount of oil, and what that portends in the future.

We are talking about ships that are going to be operating in the 21st century.

I would hate, if I were a descendant of any of the people in this room, to be faced with what they will say: You had all that information and you still authorized oil-fired ships that had to fight great distances from the United States, and you still did that?

How would any of us answer that question? They will think we are nuts.

By the way, it was this idea which impelled Congress way back 20 years ago to authorize nuclear surface ships. It was at this very concern over the availability of oil, which has now happened.

And now when it happens we renege on what we saw clearly 20 years ago. I would just like someone to explain that all to me, because I admit my mind is not capable of comprehending it.

The justification for providing nuclear propulsion for major combatants has been documented in detail through analysis, the military judgment of senior naval commanders, and experience in the fleet.⁴

I have seen nothing in recent world events which diminishes the need for the mobility in our naval strike forces which only nuclear propulsion can provide.

OPPOSITION TO NUCLEAR PROPULSION BY SYSTEMS ANALYSTS

The Defense Department systems analysts in opposing nuclear propulsion have relied on the argument that since nuclear propulsion costs more, conventional ships should be built instead.

The analysts include the cost of nuclear fuel in the acquisition cost of nuclear warships, but ignore the cost of buying and delivering oil to the conventional ships, assuming it is available.

Nowhere in their arguments do they address the difficulty the Navy can expect to encounter in providing and delivering oil to its major combatants in high threat areas where there are going to be submarines around.

⁴ See pp. 70-72 for some recent examples of experience in the fleet which demonstrated advantages of nuclear propulsion in surface warships.

In their analyses they study the effects to be expected when combatant ships are attacked by aircraft, missiles, and torpedoes.

But in the same analyses they assume that the much more vulnerable logistic support forces will not be attacked, and that the combatants will be supplied propulsion fuel whenever and wherever they need it.

Even then, the studies show that on a lifecycle cost basis a nuclear task force costs about the same as an oil-fired task force, when all the costs are considered.⁵

ROLE OF CONGRESS IN CREATING NUCLEAR NAVY

Three decades ago it was the Congress that overrode the cost analysts' arguments against the nuclear submarine, to get the program established.

Your chairman, Melvin Price, is the only Member of Congress today who was a charter member of the Joint Committee on Atomic Energy (JCAE).

He has pointed out many times that it was the JCAE that authorized the Atomic Energy Commission to buy and pay for the nuclear propulsion plants for our first two nuclear submarines, the *Nautilus* and the *Seawolf*, because the Department of Defense could not envision the worth of nuclear propulsion.

He must remind you of this, because history repeats itself. And this is what the function of Congress is. The function of Congress is to judge the executive branch. You are all elected by your constituents. I am sure this is not because you are atomic experts or experts in anything else, but because they think you have ordinary common-sense, and that you have an awareness of what is good for the people of your State, your district, and the United States.

If you can't do that, then you have no business being in this room. I hope no one attacks me on that subject.

Congress has had to step in many times since, to keep the nuclear submarine program going.

Even so, the nuclear submarine building program has now been slowed to a trickle. And the talk of reverting to diesel submarines grows louder every day in the Defense Department.

The *Nimitz*-class nuclear carriers and the *Truxtun*, *California*, and *Virginia* classes of nuclear cruisers evolved from similar arguments between Congress and the Department of Defense. This shows that history repeats itself, that is all I am really saying.

This argument led to enactment by Congress, 5 years ago, of title VIII of the Department of Defense Appropriations Authorization Act, 1975, which established as a matter of law that the policy of the United States is to provide nuclear propulsion for major combatants built for naval strike forces.

The systems analysts did not accept that policy and worked to circumvent it; this culminated last year in the repeal of title VIII.

No nuclear-powered surface warship has been authorized for construction since title VIII became law.

The closest was the CVN-71 last year, but this ship was removed from the Authorization Act consequent to the President's veto.

Also, Congress authorized advance procurement funds 2 years ago for a nuclear-powered *Aegis* cruiser, the CGN-42, with four such

⁵ See pp. 78-79 and pp. 226-227 for a comparison of 30-year lifecycle costs for nuclear and oil-fired aircraft carriers.

ships included in the Department of Defense plan at that time. However, that program now appears to have been shelved by the Department of Defense.

CREDIBILITY OF NONNUCLEAR WAR

Perhaps the opposition to nuclear propulsion is based on the assumption that we do not need to be prepared to fight a nonnuclear war against a technologically sophisticated enemy. But if that is so, why do we need another carrier at all? Or why do we need *Aegis* ships designed to counter sophisticated air attack?

If a confrontation between United States and Soviet naval forces is not credible, why are the Soviets embarked on such a major upgrading of their naval capability?

Furthermore, all we would need then is a few ships, they might be wooden, that look like aircraft carriers. We could send them around to two or three trouble spots to show our presence.

We wouldn't need any real ships.

It takes many years to build a warship. What if we miscalculate and do not build ships adequate to meet the threats we can expect to face?

What alternative will we then face—giving in on all issues for which we are not willing to resort to nuclear war?

The price of investing in adequate strength to insure peace may appear high, but it is small compared to the cost of a real war.

AIRCRAFT CARRIERS

For the foreseeable future, the aircraft carrier will continue to be the principal offensive striking arm of the Navy in a nonnuclear war.

But without the tactical airpower provided by carriers, all of our other surface forces would have greatly increased vulnerability.

How many carriers the Navy must have is not my responsibility to determine. However, I note that the number of overseas airbases available to us continues to decline, and political considerations can prevent us from using some of those we retain. Our need for carriers appears to me to be increasing rather than decreasing.

AIRCRAFT CARRIER IN FISCAL YEAR 1980 PROGRAM

The Department of Defense fiscal year 1980 shipbuilding program includes a request for \$1.617 billion for an oil-fired aircraft carrier with a full load displacement of about 62,500 tons, called the CVV.

It is planned to build this ship in lieu of the fourth carrier of the *Nimitz* class, for which \$268 million was appropriated in fiscal year 1977 for advance procurement of nuclear propulsion plant components.

CVV VERSUS CVN-71

The CVV will be about two-thirds the size of the CVN-71; it will be able to operate and service an air wing about two-thirds as large; it will carry about 40 percent of the aircraft fuel and about two-thirds the aircraft ammunition; it will have one-half the number of aircraft elevators, catapults, and propulsion shafts; it will be about 5 knots slower; and it will require refueling every few days.

The acquisition cost of the CVV without fuel will be about two-thirds the \$2.403 billion acquisition cost of the CVN-71, but whose cost includes the initial nuclear reactor cores which would provide for about 15 years of fuel for operation.

That is never included in the comparison and neither is the cost of delivering all that oil, assuming it is available, and that you can get it where you need it.

When all costs over a 30-year life cycle are considered, the cost per aircraft is expected to be about the same for the CVV as for the CVN-71, and the CVN-71 would be much more effective.⁶

SEA-BASED AIR PLATFORMS PROJECT REPORT

Last year I summarized to the committee the results of the Assessment of Sea-Based Air Platforms Project Report issued in February 1978 by the Secretary of the Navy. I pointed out that the study showed that, overall, the *Nimitz*-class carrier would be more cost effective than the CVV even though:

First. The costs of nuclear power were included in the analysis but the advantages of nuclear power were omitted. Incidentally, that is a frequent way the studies are made. When people have a predetermined mind as to the way they want it and make a comparison, it is always one-sided. They give you a cheaper cost for the oil-fired ships, but they don't include the advantages on the other side. That has happened all these years.

Second. The engagement analyses were performed on the basis that all carrier forces were deployed on station, and fully replenished at the time the postulated attacks started.

You notice, that is a very cushy situation where the enemy advised you ahead of time where they will be so that you can be there in time to take advantage of it.

Thus, the capability of nuclear-powered ships to transit long distances at higher speed, arriving in the trouble area earlier, ready to enter combat without replenishment, was given no consideration in the analyses. Nor was consideration given to the ability to reposition nuclear-powered ships rapidly and without concern for logistic support; this ability greatly reduces vulnerability to preemptive attack and could be decisive in many actual combat situations.

Third. The analysis assumed that replenishment groups were available whenever and wherever needed, and that replenishment forces would not be attacked.

Thus, the nuclear carrier's advantage of requiring less frequent replenishment, and its ability to steam at high speed to rendezvous with replenishment forces in safer areas without concern for propulsion fuel, were not considered.

Fourth. The scenarios postulated in the analyses called for ship speeds within the capability of all ships studied. Therefore the higher top speed of the nuclear carrier was not considered in the analyses.

Fifth. Nor was weather considered in the analyses. Thus, the greater seakeeping capability of the *Nimitz*-class carrier was not considered. In this regard, carrier studies furnished to Congress in 1974 by the

⁶ See pp. 78-79 and pp. 226-227 for comparisons of costs and military characteristics of carriers.

Chief of Naval Operations showed that sea conditions in the North Atlantic are such that a carrier of CVV size would not be able to operate aircraft about 21 percent of the time in winter, as compared to about 12 percent for a *Nimitz*-size carrier—a factor of nearly two in favor of the larger carrier. [For an example, see p. 71.]

Further an advantage of nuclear surface warships is their ability to take circuitous routes and use high speed to avoid storm areas during transits. This is possible because of their freedom from propulsion fuel constraints. [For an actual example, see p. 70.]

Overall, the engagement and cost analyses showed the *Nimitz*-class nuclear carrier to be the most cost-effective carrier. When all the advantages of the nuclear carrier that were omitted from the study are actually considered, it seems to me that the nuclear carrier is overwhelmingly superior to the conventional carrier on a cost-effective—or on any other basis.

IMPORTANCE OF CARRIER PLATFORM

A smaller conventional carrier such as the CVV costs less to procure on a ship-for-ship basis than a CVN. However, it would be short-sighted to base the decision on the type carrier to be built entirely on initial procurement cost. The Navy study showed that the initial procurement cost of the carrier is only about 10 percent of the total life-cycle cost of buying and operating aircraft at sea. However, the survivability of aircraft and their effectiveness in combat are heavily dependent upon the platform from which they operate.

The study showed that, even without considering the advantages of nuclear propulsion, the nuclear carrier is the most survivable platform. This is so even when the dispersal of forces through building larger numbers of cheaper ships is considered in the analyses.

Further, the greater mobility, tactical flexibility, and capacity for combat consumables of the nuclear carrier makes its relative survivability even greater than calculated in the analysis.

Now, these are not my figures that I am quoting, the members must realize, I am just taking the results of analyses made by another group. We had very little to do with it. I am just pointing out the results of the analyses show that we should have a nuclear carrier.

NUMBERS OF CARRIERS

It is frequently argued that by buying smaller conventional carriers, like the 62,500-ton conventional CVV, the Navy could have more ships in more places for the same cost.

In this regard, it should be noted that if three conventional CVV's and their air wings were procured in lieu of two *Nimitz*-class carriers and their larger air wings, the Navy would get the same number of aircraft and one more ship. But the study also showed that even without considering the advantages of nuclear propulsion, the three conventional ships would cost more, be more vulnerable, and provide less military effectiveness.

Further, it would require an additional investment in more carrier escorts and replenishment forces before the three CVV's could be operated in more places at one time than the two nuclear carriers.

Besides, the present plan is to build only one more carrier in the foreseeable future. Therefore, the real choice that faces you is what type of ship that one carrier should be.

COMPARISON OF CVV AND CVN-71 MILITARY CHARACTERISTICS

A comparison of CVV and CVN-71 military characteristics and life-cycle costs is summarized in the following chart which is an update of the chart I furnished to your Committee last year to show the latest information about both ships. [See p. 226.] You have that chart, and you can see the various ratios. There should be no question as to which is superior for the money you invest.

MODIFIED JOHN F. KENNEDY CLASS CARRIER

I note that some are recommending a compromise position of building a carrier like the *John F. Kennedy*, CV-67, which was the last oil-fired carrier built.

The proponents of this compromise point out that the *Kennedy* can operate and support an air wing the same size as the *Nimitz*-class carrier air wing, and that it has the same maximum speed and redundancy of aircraft elevators and catapults as the *Nimitz*-class carrier. An oil-fired modified *Kennedy* is estimated to cost \$1.76 billion in the fiscal year 1980 program, \$143 million more than the CVV.

The *Kennedy* was authorized in 1962 for the fiscal year 1963 ship-building program. At that time the first nuclear surface warships, the cruiser *Long Beach*, CGN 9, and the carrier *Enterprise*, CVN 65, had been commissioned only a few months. The Navy had originally recommended that both the *America*, CV-66, and the *Kennedy* be nuclear-powered, but the Secretary of Defense "persuaded" the Navy to change its recommendations from nuclear to conventional.

His persuasion was very simple. He said, in effect, "If you don't do what I want, you won't get any."

By late 1962 the *Enterprise* had proved her worth in the Cuban missile crisis. Many in Congress considered it a mistake for the *Kennedy* to be oil-fired and tried to get Secretary McNamara to change his mind.

In 1963 the Joint Committee on Atomic Energy held extensive hearings on the subject of "Nuclear Propulsion for Naval Surface Vessels." The Chairman of the Atomic Energy Commission, Dr. Glenn T. Seaborg; the Chief of Naval Operations, Adm. David L. McDonald; Secretary of the Navy Fred Korth; and the Director, Defense Research and Engineering, Dr. Harold Brown, testified that they favored making the *Kennedy* nuclear.

Just let that sink in.

Secretary of Defense Robert S. McNamara testified against it.

The Joint Committee analyzed the testimony and all the classified studies of the matter furnished by the Department of Defense. The Joint Committee issued a report setting forth their analysis and the basis for their recommendations:

"1. That the decision to install conventional propulsion in the new aircraft carrier, CVA-67, should be set aside and plans made to install nuclear propulsion in this ship; and

"2. That the United States adopt the policy of utilizing nuclear propulsion in all future major surface warships; and

"3. That a vigorous research and development program for surface warship nuclear propulsion be continued."

I recommend that the Joint Committee hearing record and the December 1963 report be read by anyone who is interested in building an oil-fired *Kennedy*-class carrier. The arguments we hear today are the same ones made then.

The difference is that now we have 15 years more experience with successful operation of nuclear warships in the fleet where the advantages of nuclear propulsion have been demonstrated over and over again, and the potential vulnerability of oil supplies has become increasingly evident to everyone.

ORIGIN OF THE NIMITZ CLASS

Following the joint committee's December 1963 report, Secretary McNamara had the Navy make an extensive cost-effectiveness study entitled: "Nuclear Power for Surface Warships, Naval Warfare Analysis Group Study No. 33."

For the first time—and as far as I know the only time—the war-gaming analyses took into consideration the effects of attack on logistic support forces. The study showed that the peacetime costs of a *Nimitz*-class carrier over its life would be essentially the same as a *Kennedy*-class carrier, and that the nuclear ship would be more effective.⁷ The study also showed that when attacks on logistic support forces were considered, losses could be expected to be less if the carrier were nuclear powered.

Following this study and additional successful operational experience with nuclear ships, Secretary McNamara in 1966 changed the three additional carriers planned at that time to nuclear propulsion.

Just imagine that; even he did that. It would take one awful lot of convincing to get him to do it. As far as I know that is the only time he has ever changed his mind.

That was the origin of the *Nimitz*, the *Dwight D. Eisenhower*, and the *Carl Vinson*.

When I testified before the House Armed Services Committee in May 1966 in support of the authorization of the *Nimitz* in the fiscal year 1967 shipbuilding program, I said:

"When the Navy changed their recommendation from nuclear to conventional propulsion in the two aircraft carriers following the *Enterprise*, I know that a major concern was that they felt they wouldn't get these carriers if they asked for nuclear. So they asked for conventional. I think they would have asked for an aircraft carrier with sails, if they hadn't been able to get any other. After all, a Navy without ships is not a Navy at all. * * *"

I don't want to blame the senior naval officers, because they have to have carriers. They want nuclear, they have said this time and again to your committee, but if they can't get nuclear they have to have something. That is why they will go along for a conventional carrier. And I don't blame them. As I said in May 1966:

⁷ See p. 78 for current cost comparison which shows that total 30-year lifecycle cost of the CVN 71 nuclear carrier and air wing is expected to be about 1 percent more than the oil-fired *Kennedy* class carrier and air wing. Both have the same weapons systems and aircraft, but the nuclear carrier has capacity for about 50 percent more ammunition and about twice as much aircraft fuel as well as all the advantages of nuclear propulsion.

"In order to carry out his responsibilities, the Chief of Naval Operations certainly must have real ships, not paper ships. In order to get real ships, he must ask for ships that he thinks he can get."

I can see how today some who believe another carrier is needed, but do not see any point in building the CVV, could turn to a *Kennedy*-class ship as a compromise. There is no question that the superiority of a *Kennedy* over a CVV is worth the increase in cost involved.

But, it is important to remember that study after study made by the Navy over the past 15 years shows that the overall cost of a *Nimitz* is essentially the same as the overall cost of a *Kennedy*, while the nuclear ship is markedly superior. It should be borne in mind that a *Nimitz*-class carrier, with the same overall cost, carries almost twice as much aviation fuel and 50-percent more aircraft ammunition than a *Kennedy*-class carrier, as well as having all the advantages of nuclear propulsion.

These features increase the fighting capability of the ship and the air wing it operates and supports. They also reduce the vulnerability of the ship and air wing as a weapon system because they reduce dependence on highly vulnerable logistic support forces.

When all is said and done, it must be remembered that the cost of the carrier is only a small fraction of the total cost of operating sea-based aircraft. Yet the capability, availability, and survivability of those aircraft are directly dependent upon the characteristics of the carrier platform from which they operate.

TURNING THE CLOCK BACK

In my view, to build an oil-fired *Kennedy* would be turning the clock of carrier technology back over 15 years. To build a CVV would be turning the clock back over 30 years.

I suggest, Mr. Chairman, that you ask the Navy to consider building wooden warships. They are cheaper. Why not? That would be a good idea. As far as Congress is concerned, if what they want is the cheapest things, how about going back to wooden ships and smoothbore cannon?

[The following information was received for the record:]

There are two basic, and separable, issues involved in deciding on what carrier to build. The first is what size aircraft carrier is needed for our firstline naval strike forces. The second is the need for nuclear propulsion independent of the size of the carrier.

EVOLUTION OF AIRCRAFT CARRIER DESIGN

Over the past half century I have followed with great interest the evolution of the aircraft carrier into the Navy's principal offensive weapon system for nonnuclear war. When I graduated from the Naval Academy in 1922, the Navy's first carrier, the U.S.S. *Langley*, CV-1, a converted collier, had just been completed. This was the same year the United States ratified a treaty between the United States of America, the British Empire, France, Italy, and Japan limiting naval armament. The treaty, which resulted from the Washington Naval Conference of 1921, set forth limitations on naval armament in two major categories: Capital ships and aircraft carriers. The term

"capital ship" was defined in the treaty as a vessel of war, not an aircraft carrier, whose displacement exceeds 10,000 tons or which carries a gun with a caliber exceeding 8 inches. The United States was allowed to retain 18 existing capital ships, all of which were battleships, for a total tonnage of 500,650 tons. Capital ships could be replaced when they reached 20 years of age except no new capital ships were to be laid down for 10 years after November 12, 1921, with certain minor exceptions specified in the treaty. The total capital ship replacement tonnage of the United States was agreed not to exceed 525,000 tons. It was also provided that no capital ship exceeding 35,000 tons standard displacement would be acquired or constructed by any of the powers. Standard displacement was defined in the treaty as:

The displacement of the ship complete, fully manned, engined, and equipped ready for sea, including all armament and ammunition, equipment, outfit, provisions, and fresh water for crew, miscellaneous stores and implements of every description that are intended to be carried in war, but without fuel or reserve feed water on board.

The treaty stipulated that all existing aircraft carrier tonnage should be considered experimental and therefore aircraft carriers could be replaced without regard for age. The powers also agreed that the total tonnage for aircraft carriers for the United States would not exceed 135,000 tons in standard displacement. An aircraft carrier was defined as a vessel of war with a displacement exceeding 10,000 tons and designed for the specific and exclusive purpose of carrying, launching, and landing aircraft.

It was also provided that no more than two aircraft carriers exceeding 27,000 tons standard displacement would be acquired by or constructed by any of the powers. Two carriers could be of a tonnage of not more than 33,000 tons standard displacement and had to be accounted for within the total tonnage allowances for aircraft carriers. For economy these two carriers could be converted from any two ships whether constructed or in the course of construction which would otherwise be scrapped under the provisions of the treaty. The United States utilized this provision to convert the battle cruisers *Lexington* and *Saratoga* which were under construction to aircraft carriers; otherwise, they would have been scrapped.

A little arithmetic will show that the total aircraft carrier tonnage allotted to the United States under the terms of the treaty could have provided as few as 4 or as many as 13 aircraft carriers depending on their displacement, in addition to the 18 battleships. Under the terms of the treaty, the *Langley* was considered experimental and did not count against the aircraft carrier tonnage allotment. The United States actually used its allotment of 135,000 tons to build the six aircraft carriers *Lexington*, *Saratoga*, *Ranger*, *Yorktown*, *Enterprise*, and *Wasp*, which were all completed or under construction before the treaty was terminated on December 31, 1936.

In view of the current great interest in disarmament talks, I think it would be worthwhile if more people read the Senate Report on the 1921 Disarmament Conference. (Senate Report on Conference on the Limitation of Armament, February 3 (calendar day, February 10), 1922, document No. 126 67-2).

On December 7, 1941, when the Japanese attacked Pearl Harbor, the United States had in commission 17 battleships and seven aircraft carriers in addition to one escort carrier, the *Long Island*, which had been converted from a C-3 type cargo ship. In addition, eight battleships and the first five aircraft carriers of the *Essex*-class had been laid down. The *Essex*-class carriers, all of which are now retired, had a standard displacement of about 33,000 tons and a combat load displacement of about 43,000 tons.

LESSONS OF WORLD WAR II

During World War II, the aircraft carrier came into its own as the heart of our naval strike forces. The need for increasing the size of carriers in order to provide adequate combat capabilities of individual units became evident. Before the war was over, construction started on the three carriers of the *Midway*-class with a combat load displacement over 60,000 tons each.

Based on the lessons learned during the war and the evolution of higher performance aircraft, the need for even larger carriers became evident. In order to accommodate an air wing with sufficient variety and numbers of aircraft to handle the missions of a first-line carrier, and to provide sufficient ammunition, aircraft fuel, maintenance shops, spare parts, and personnel accommodations, the large-deck carriers of the *Forrestal*-class were developed in the decade following World War II. Eight were built between 1955 and 1968, the *Forrestal*, *Saratoga*, *Ranger*, *Independence*, *Kitty Hawk*, *Constellation*, *America*, and *John F. Kennedy*. These 80,000-ton ships and the nuclear carriers *Enterprise*, *Nimitz*, and *Dwight D. Eisenhower* are the backbone of our present Navy for nonnuclear war. The *Midway* and *Coral Sea* are also still in commission, but are over 30 years old.

The *Nimitz*-class carriers are slightly larger than the large-deck non-nuclear carriers, but since they carry much more aircraft fuel and ammunition they have about a 10-percent greater displacement.

ADDED REQUIREMENTS PLACED ON CARRIERS

Over the past 10 years the total number of carriers in the fleet has been reduced from 24 to 13 as the older and smaller *Essex*-class carriers, and now a *Midway*-class carrier—the *Franklin D. Roosevelt*—have been retired. The antisubmarine warfare functions previously assigned to our smaller carriers have now been added to the attack missions assigned to our large-deck carriers. As the Soviet naval threat has expanded, the need for a large, versatile air wing on each carrier has increased. The increase in the variety of aircraft on an individual carrier needed to carry out multiple missions has increased the space required for maintenance shops, spare parts, and specialized personnel associated with each type of aircraft.

Throughout this half century the performance of individual aircraft has increased markedly. However the demands placed on them have also increased as the threat which they must penetrate has be-

come more sophisticated. The aviation community predicts that the combat aircraft of the future will be a vertical short takeoff and landing (V/STOL) type aircraft. Predictions of when high performance combat aircraft of this type will be developed range from the late 1980's to the turn of the century. Of course much of the new technology could also be used to improve the performance of catapult launched aircraft.

EFFECT OF V/STOL PLANES ON CARRIER SIZE

Some people seem to think that the development of V/STOL aircraft will eliminate the need to build large-deck carriers for our first line naval strike forces. This appears to me to be a *non sequitur*. Even though the Navy may be able to develop high-performance V/STOL aircraft over the next 15 years I do not see what that has got to do with the size of the aircraft carrier.

I have seen nothing predicted about V/STOL technology that will make the aircraft smaller or reduce the number needed in an air wing. There is nothing about the V/STOL concept that will reduce ammunition and aircraft fuel requirements. There is nothing in the V/STOL concept that will reduce the maintenance shops, spare parts, and personnel needed in a carrier. There is nothing about V/STOL that will make a smaller carrier more seaworthy.

The takeoff space required for a fully loaded combat V/STOL aircraft is expected to be about the same as that now required for catapults. It is true that the need for arresting wires will be eliminated by V/STOL. However our present carriers already utilize the landing area for parking aircraft during air wing launch operations. Thus a V/STOL air wing with the same number of aircraft will probably require essentially as much flight deck space as is required for catapult-launched aircraft.

Therefore, it appears to me that it will require just as large a carrier to support an adequate air wing of V/STOL aircraft as is required to support an adequate air wing of catapult aircraft.

STUDIES OF CARRIER SIZE

How large an aircraft carrier should be has been studied many times over the past 15 years. The construction of the last conventional carrier, the *John F. Kennedy*, was held up for over a year while the Navy studied this issue in response to the request of Carl Vinson when he was chairman of the House Armed Services Committee. When Admiral McDonald became Chief of Naval Operations in 1963, one of the first things he did was have the Navy make a new study of how big an attack carrier should be. He had commanded the smaller carrier *Coral Sea*, and only became convinced after extensive studies that construction of large-deck carriers should be continued.

The sea-based platforms study performed last year at the direction of the Secretary of the Navy showed that the large-deck carrier is more cost-effective than the smaller CVV proposed in this year's budget for both V/STOL aircraft and conventional aircraft.

As I noted previously, in 1964, Secretary of Defense McNamara accepted the policy recommended by the Navy that all aircraft carriers to be authorized in the future would be nuclear powered. But, it was only after additional studies of alternative size carriers that he agreed that the *Nimitz*-class carriers would be larger than the *Kennedy*; he had thought they should be about *Midway* size. [End of insert.]

DECISION ON CARRIER RESPONSIBILITY OF CONGRESS

Admiral RICKOVER. If we are to have another carrier, we must use the best technology we have. The *Enterprise*, the *Nimitz*, and the *Dwight D. Eisenhower* have proven their capabilities in operation. They are clearly superior to any oil-fired carrier. Whatever carrier we build will not join the fleet until 1987 and will have to operate at least 30 years after that. If we are to spend the money it takes to provide and operate an air wing at sea, it makes absolutely no sense not to provide the best platform. I do not understand the arguments that have been presented for canceling the CVN-71 and substituting either a CVV or a *Kennedy*-class carrier in its place.

Of course, the decision is not mine to make, so it is not necessary that I understand the basis for it. On the other hand, under our Constitution the decision is yours to make. Therefore, I urge that you find an explanation that makes sense to you for whatever decision you make in this matter.

NEED FOR NUCLEAR-POWERED GUIDED MISSILE SHIPS

Some argue that we should not build another nuclear carrier because to do so would require providing nuclear power for the guided-missile firing ships which accompany it. I do not consider that argument valid. Studies furnished to your committee have shown that each time a nuclear ship is substituted for a nonnuclear ship in a carrier task group, the capability of the force as a whole will improve, even if all the other ships are oil fired.

However, it is also true that there is an incentive to provide nuclear propulsion in missile-firing ships, whether or not the carrier they accompany is nuclear powered. Further, a nuclear-powered guided-missile ship has a unique capability for independent operations not available to oil-fired ships.

Of course, the greatest gain is made when all the ships in a task group are nuclear. The all-nuclear carrier task group has greater capability to penetrate and counter the projected Soviet naval threat than any other naval surface force we know how to build.

When a nuclear carrier is substituted for a conventional carrier, the range of a carrier task group, with four conventional escorts, is doubled. When two of the four escorts with the nuclear carrier are nuclear, the range of the carrier task group is doubled again. When all the escorts are nuclear, the range of the carrier task group is essentially unlimited.

Each nuclear escort substituted for a conventional escort also increases task force flexibility and mobility through advantages which are difficult to describe in numerical form.

VULNERABILITY OF REPLENISHMENT SHIPS

For example, none of the comparisons of the relative effectiveness and cost of the nuclear and conventional escorts cited in current Navy cost studies take into consideration losses due to enemy action. One older Navy study, "Nuclear Power for Surface Warships," to which I referred earlier, showed that:

One, losses of underway replenishment ships can be expected to be greater when supporting conventional than when supporting nuclear warships;

Two, under several of the threat conditions studied, the number of replenishment ships lost supporting conventional warships was more than twice the number lost supporting nuclear warships; and

Three, the greater the threat to the underway replenishment ships, the larger is the loss differential to be expected—owing to the larger replenishment force required for the conventional warships.

If we are concerned that the expanding Soviet naval capability will increase the vulnerability of our first-line strike forces, then it is not reasonable to assume that our underway replenishment groups can be operated with impunity. The all-nuclear carrier task group, having essentially unlimited high-speed endurance, carrying more combat consumables which permits longer periods between replenishments, and with the capability to retire at high speed for replenishment in low-threat areas, has far greater capability to conduct sustained combat operations than any other surface naval forces we know how to build.

Against a sophisticated naval threat, it could quickly turn out that our ability to conduct sustained combat operations would be controlled by the logistic support available. Under such circumstances, each ship with nuclear propulsion improves the capability of the entire force. The all-nuclear task group has far greater striking capability than a conventional group.

When logistic supply lines are attacked during a real war, the decrease in the requirement for ships' fuel for the strike forces will have a compounding beneficial effect. The surviving fuel transportation and storage facilities can then all be concentrated on getting fuel for aircraft and other military vehicles to the forward areas. The escorts that would otherwise be required for the tankers which carry ships' fuel could then be assigned to assuring the safety of other supplies.

FIFTEEN YEARS WITHOUT REFUELING

With existing designs of naval nuclear propulsion plants it is possible to provide enough energy for 15 years of warship operation without need to refuel. In contrast, oil-fired naval warships must be refueled every few days. Of what value is an oil-fired warship if it is unable to get oil when and where it needs it?

STUDIES OF NUCLEAR PROPULSION FOR SURFACE WARSHIPS

The studies that have been made of the issue of nuclear propulsion for surface warships have cost millions of dollars and countless man-years of effort, including that of many high-level people. Every aspect

of the advantages and cost of nuclear surface warships has been exhaustively studied in minute detail over a period of many years by numerous analysts, civilian and military.

These studies have brought out time and again that a nuclear surface warship has a higher initial investment cost than its conventional counterpart, but that when overall costs are taken into consideration the nuclear ships are not much more expensive, yet provide greatly increased military capabilities.⁸

ADVANTAGES OF NUCLEAR PROPULSION DEMONSTRATED IN FLEET

Further, operation of nuclear-powered surface warships in the fleet continues to demonstrate the significant military advantages derived from nuclear propulsion. In the past, I have provided the committee with letters I have received from commanding officers which gave specific examples where nuclear propulsion had enhanced the ability of the ships to carry out their military missions. I have here extracts from several such letters I have received since I testified last year. I will be glad to furnish these extracts for the record.

[The following information was received for the record:]

EXCERPT FROM LETTER TO ADMIRAL RICKOVER FROM CAPTAIN ALMSTEDT, COMMANDING OFFICER, U.S.S. BAINBRIDGE (CGN 25) DATED JULY 2, 1978

"Operations during the past three months with the Seventh Fleet have continued to demonstrate the importance of freedom from the logistic constraints of refueling.

"During a port visit, it became necessary to proceed to sea in order to avoid a threatening typhoon. The only route to safety was to "Cross the Tee" of the typhoon. The resulting high speed transit was no problem for *Bainbridge*, but was a concern for the fossil fuel ship in company since arrangements had to be made to refuel her after the high-speed transit. It is conceivable that at times such an escape route would not be available due to the inability to rendezvous with a ship capable of providing fuel.

"Another benefit, that freedom from refueling has demonstrated, is added time and additional opportunity to conduct training evolutions which can better prepare a ship for combat. Recent examples:

a. Because an oiler was unable to make the rendezvous point desired, the only ship available to participate in a joint air/ship/submarine ASW operation was *Bainbridge*. This happened on several occasions.

b. While transiting between two points the ship was able to participate in a missile shoot, which a fossil fuel ship would have missed due to fuel constraints.

c. On one occasion *Bainbridge* was detached to render assistance to a fishing boat in distress. *Bainbridge* was the only ship available which could make the high speed transit, and return in time without refueling to participate in the next phase of the exercise. After *Bainbridge* was detached, the other ships moved off in a different direction to rendezvous and refuel.

"The adjunct corollary in war to the above peacetime examples would be lost opportunities to inflict damage or engage the enemy due to the necessity to refuel."

EXCERPT FROM LETTER OF OCTOBER 18, 1978, FROM CAPT. E. B. BOSSART, JR., COMMANDING OFFICER U.S.S. LONG BEACH (CGN 9)

Indian Ocean operations in company with U.S.S. *Enterprise* and U.S.S. *Truxtun* again demonstrated the superior mobility and flexibility of nuclear powered surface combatants. Under deteriorating weather conditions and heavy seas, the nuclear powered task group was able to sustain a high speed of advance (SOA) and full readiness for multithreat combat operations. Had the task group been composed of conventionally powered ships, the necessity to conduct

⁸ See pp. 78-79 and pp. 225-227.

underway refueling would have seriously degraded task force flexibility and may have resulted in significantly reduced SOA's to conserve fuel when replenishment was impossible due to inclement weather.

CAPTAIN WILLIAM E. RAMSEY, USN, COMMANDING OFFICER U.S.S. DWIGHT D. EISENHOWER (CVN69), MEDITERRANEAN

FEBRUARY 3, 1979.

Adm. H. G. RICKOVER, USN,
NAVSEA 08,
Washington, D.C.

DEAR ADMIRAL RICKOVER, This is a special letter.

Dwight D. Eisenhower (CVN 69) departed Norfolk on January 16 for an extended deployment with the Sixth Fleet. The projected transit route was along the 30th parallel to avoid the major storm high probability area located further to the north. As it happened, on the 18th an intensive low pressure area developed rapidly which affected our weather and sea conditions dramatically.

For the remainder of the entire transit *IKE* was subjected to winds ranging from 25-45 kts and seas and swells 18-24 feet. *IKE* experienced rolls up to 15 degrees and pitching deck motion up to 11 degrees. Under these conditions flight operations would have been impossible on any other class of aircraft carrier. However, the capabilities designed into the NIMITZ class carrier permitted flight operations everyday except one.

Two methods were employed to provide a relatively stable flight deck for operations. The first method was to utilize the advantages of a nuclear powered propulsion plant to run downwind at high speed with the stern into the swell. Although this resulted in at times only 5-10 kts of positive wind over the deck the high energy arresting gear systems built into the ship were able to accommodate all the high performance aircraft aboard. The second method employed was to put the bow into the wind and sea and then back down at a high bell. In this manner wind over the deck was maintained at about 25-30 kts and the deck was steady. Flight operations were conducted an entire day utilizing this technique with only a slight loss of speed along PIM.

The marriage of catapult and arresting gear technology with the obvious advantages of nuclear power continue to impress and amaze me as to the broad spectrum of tactical flexibility I have at my disposal. In essence, *IKE* is not a slave to wind conditions; instead, with a well trained air wing, almost any course is available in response to the existing tactical situation. The significance of this to an embarked tactical commander is of course obvious and greatly expands the boundaries for operational planning.

WILLIAM E. RAMSEY.

CAPTAIN WILLIAM E. RAMSEY, USN, COMMANDING OFFICER U.S.S. DWIGHT D. EISENHOWER (CVN69), MEDITERRANEAN

FEBRUARY 4, 1979.

Adm. H. G. RICKOVER, USN,
NAVSEA 08,
Washington, D.C.

DEAR ADMIRAL RICKOVER, This is a special letter.

During the period November 16 through December 4, 1978 *Dwight D. Eisenhower* (CVN 69) participated in a major joint exercise in the Gulf of Mexico called Gulfex 79. Additional participating forces were units of the U.S. Navy, the Royal Navy and tactical squadrons from the USAF. In addition the nuclear cruisers, U.S.S. *Virginia* (CGN 38), U.S.S. *California* (CGN 36), and the U.S.S. *South Carolina* (CGN 37) joined with *IKE* to form the Nuclear Power Task Group (NPTG) element of naval forces. *IKE* was the Flagship for the exercise with COMCRUDESGRU EIGHT embarked.

The exercise was one of the most complex and intensive conducted in recent times. The opposition was highly sophisticated—two nuclear submarines, the RN *Conqueror* and *Batfish*—and approximately 600 strike sorties flown against the task force by USAF units.

In the face of such opposition the tactical flexibility designed into *IKE* enabled us to conduct operations with very few engagements with aggressor forces. In situations where a submarine datum was established flight operations were conducted away from the datum unconstrained by wind over the deck

requirements. This was possible by utilizing the high speed capability provided by our nuclear powered propulsion plants combined with the installed high energy catapult and arresting gear systems and a well trained air wing used to operating in cross wind and low winds over the deck. Rather than being constrained to setting a course into the wind we maneuvered as necessary to avoid coming under attack.

The same capabilities were utilized to negate the effectiveness of the high density raids flown against the task force by USAF tactical aircraft. Complementing tactical measures were taken such as dispersion of forces, deception and emission control to confuse the tactical picture which successfully reduced the numbers of aircraft penetrating to the carriers. Those aircraft which did locate *IKE* were all detected and engaged by missile ships and CAP.

The Gulfex 79 scenario contained a high speed transit to the Western Gulf 100NM off the coast of Mexico and thence southward through the Yucatan straits. This high speed transit was conducted by the NPTG under emission control to determine the effectiveness of Cuban forces in maintaining track of the force. On arriving at a position 100NM southwest of the Western tip of Cuba, flight operations were conducted for a day [deleted].

Subsequently another high speed transit was conducted south of the Florida Keys to homeports. During this transit Cuban air activity was noted which monitored the force movement until east of Key Largo at which time they broke contact.

During the entire 17 day period of high speed and intensive flight operations *IKE* only refueled from an oiler once and still returned to homeport with over-[deleted] gallons of JP-5 aboard [deleted]. The exercise demonstrated dramatically the expanded tactical options available to an embarked commander employing the capabilities designed into the *NIMITZ* class carrier.

WILLIAM E. RAMSEY.

NO NUCLEAR CRUISERS AUTHORIZED SINCE FISCAL YEAR 1975

Admiral RICKOVER. The last nuclear cruiser authorized was the *Arkansas*, CGN 41, in the fiscal year 1975 program, which followed by 3 years the authorization of the *Mississippi*, CGN 40.

NEED FOR NUCLEAR-POWERED AEGIS CRUISERS

Navy witnesses have testified for the past several years that the Aegis system is needed to protect our surface ships against the projected Soviet air threat in the 1980's. Aegis ships are needed in the areas of highest threat, the same areas where our nuclear carrier task forces will be most needed, and where the military advantages of nuclear power may be essential to their mission.

Unfortunately, repeated reductions in the planned program have raised the question of whether our nuclear carrier task groups will ever have the nuclear-powered Aegis ships they need.

In January 1977, President Ford submitted a 5-year shipbuilding program from fiscal year 1978 through fiscal year 1982, which included two nuclear-powered strike cruisers, CSGN's, and 10 DDG-47-class conventionally powered Aegis ships. The Ford administration's fiscal year 1978 budget request included funds for the lead DDG-47-class ship and long-lead funds for the first CSGN planned to be authorized in fiscal year 1979.

The new administration subsequently canceled the nuclear strike cruiser program entirely and directed that instead the Navy adopt an alternative of putting Aegis in a smaller ship of the *Virginia*-class size.

Funds were authorized and appropriated in fiscal year 1978 to buy long-lead material needed to support the new administration's stated plans to request authorization for construction of the first of four ships, the CGN 42, in the fiscal year 1979 program.

However, in December 1977, the Navy budget request for construction of CGN 42 in fiscal year 1979 was disapproved in favor of slipping the ship authorization 1 year to the fiscal year 1980 program. The DOD subsequently slipped the CGN 42 to the fiscal year 1983 program. A few months ago, the DOD deleted any ships of this class from the current 5-year shipbuilding program.

The issue is whether nuclear-powered Aegis ships are needed to counter the Soviet threat. Aegis is planned as our most capable AAW weapons system. Because Aegis ships will be expensive, regardless of their means of propulsion, there will never be a large number.

In a naval war against an enemy employing sophisticated weapon systems, all strike force Aegis ships will be needed in the areas of highest threat. It is under just such circumstances that the advantages of nuclear propulsion are most urgently needed to maximize mobility and minimize logistic support. It is into such high-threat areas that the nuclear carrier task forces will be sent in time of war, and they will need nuclear-powered Aegis ships to accompany them. The Aegis ships should be nuclear for the same reasons that carriers should be nuclear.

In areas where the threat is great enough to require nuclear carriers and Aegis ships—our firstline naval strike forces—it is highly unlikely that others can survive. When a nonnuclear Aegis ship runs low on fuel, it will be necessary to remove the Aegis ship to an area of lower threat to meet the oiler, losing the Aegis protection just when it is most needed.

NEED FOR MORE NUCLEAR CRUISERS

Another consideration is that to have a credible nuclear-powered guided-missile ship capability in both the Atlantic and Pacific Fleets, it is necessary to build a reasonable number of nuclear ships so that some ships are available for immediate deployment at all times. Only nine nuclear cruisers have been authorized over the past 23 years, and none of these has Aegis.

Unless nuclear-powered Aegis cruisers are built, our nuclear carriers will have to be accompanied by DDG-47 class Aegis ships when they enter the highest threat areas, thus giving up the significant military advantages of the all-nuclear carrier task force in the very areas where nuclear propulsion is most needed. Study after study has shown that the small additional life-cycle cost of the all-nuclear-powered carrier task group is more than justified by the added military capability it would provide.

The decisions you make this year on the naval shipbuilding program will not affect the fleet until a decade from now. It is always tempting not to make investments for the future when today's problems are so pressing. But where would we be today, if Congress had refused to take the long-range view in the past? Our forefathers were wise to put the decisionmaking authority in the hands of Congress. That is the only body in Government where the leaders stay in office long enough to face personally the long-range results of their decisions.

PREPARED STATEMENT

Mr. Chairman, the remainder of my statement addressed the nuclear industrial base and also shipbuilding claims. Rather than reading it I think it would be better to spend your time in my answering your questions.

[The full statement of Admiral Rickover is included in Appendix 3, p. 206.]

SIZE VERSUS NUMBER OF SHIPS

The CHAIRMAN. Admiral, one of the things that struck me in your statement, you refer to those who argue that with a smaller ship they can have more of them, more ships, and more places for the same cost.

Well, that argument falls flat on its face in the last year or so. And the indications are that this is a growing thing. We are losing more and more places where we can put ships.

Admiral RICKOVER. I agree with you, sir. Naval history supports what you say, not only in recent years, but in the years gone past. I think when you were small boys you read about the British Fleet. They had large numbers of small sailing ships, and when a large 74 gun ship of the line would come along, they all had to scatter. You don't make out with only small cheap ships.

The best example of that in American history was Thomas Jefferson's idea of having a cheap navy which also was made up of small ships. He had small wooden ships built and had one put in each harbor, so that in theory, they would be available where needed. But when a big British ship came along the small ships could not get out of the harbor. That is an analogy that I can make for the present-day situations.

If you have a boxer like John Johnson or the latest champion, if you put him in the notion that somewhere there are a lot of poor fighters, he will lick them one at a time.

CAPABILITY OF CVV

The CHAIRMAN. Forgetting just the nuclear part of the question, would the CVV be a good warship in itself, the CVV?

What kind of a warship would it be?

Admiral RICKOVER. Yes, it would be about the same as the ships we had 30 years ago; yes, they were good warships for the time, but not for today. I pointed out what they lack as compared to the modern aircraft carrier.

First, they don't carry as many planes.

Second, they don't carry as much ammunition.

And third, they can only stay at sea a few days without refueling.

The CHAIRMAN. Mr. Bennett?

KENNEDY-CLASS CARRIER VERSUS NO CARRIER

Mr. BENNETT. Of course, the issue brings up the question of what kind of a carrier is the one that is uppermost in our mind. We tried real hard last time to get a nuclear carrier, and we were defeated on the floor of the House. The problem now is, I guess, partly a political problem, because I and everybody that knows anything about the

Navy can realize that the nuclear carrier is certainly superior dollar-wise and every other way. We do get down to the question, however, of not getting any carrier at all.

It seems to me that it would be better to have a *Kennedy* type than no carrier, don't you?

Admiral RICKOVER. Yes, I agree with that. I have to take the Chief of Naval Operations' view. But I would rather see fewer ships and better ones. If I were limited in the amount of money we had, I would put that up to the Chief of Naval Operations and let him decide what ships to build for a sum of money.

I think if we haven't got the money there has to be a compromise somewhere. But I would have the senior military man discuss that with the congressional committee and come to some conclusion. There you have to take the representatives of the people, the representatives of the Government agency directly involved, and come to some solution there, if that is the problem.

Obviously, if we don't have money we can't build the ship. And we may get to that point. But the overall cost of a *Kennedy*-class carrier is essentially the same as that of a *Nimitz*-class carrier.⁹

Is that a fair statement?

Mr. BENNETT. I think it is a very fair statement. There are elements, of course, three elements that I can think that are worth thinking about on the question of whether we can get a nuclear carrier from Congress or not.

One of them is that the time that they voted down the carrier, or sustained the President's veto, was at a time when a very important, dramatic event was occurring in Camp David and there was a feeling in Congress that they wanted to sustain the President at that time in history.

And another thing is that we have a lot of new carriers. Whether that is good or bad I don't know. I guess in one respect it is bad, because if the Members had not heard the knowledge about nuclear carriers there would be less knowledge on their part.

Admiral RICKOVER. Mr. Bennett, that is why I went at length into the history of nuclear surface warships, because I know that there are now members on your committee who have not been here and are not familiar with the whole history of this problem.

Mr. BENNETT. A lot of people think that people like myself and Mr. Stratton and others want a carrier because it is just like having a Cadillac or something like that. But what we really want to do is use the dollar more effectively so that we could win a war; that is really what we are trying to do.

Admiral RICKOVER. I am sorry many of the new members are not here. If you consider it worthwhile at any time I would be glad to repeat the discussion to any new members.

Naturally many of them can't be here at one time. But I think it would be worthwhile to hear the statement.

PERFORMANCE OF SSN-688 CLASS

Mr. BENNETT. How does the performance of the SSN-688 compare to the 637?

⁹ See pp. 78-79 for 30-year lifecycle cost comparison.

Admiral RICKOVER. I can't discuss that in open session. I would like to tell you about it, but I cannot, for obvious reasons, discuss that.

Mr. BENNETT. We will try to get you back some other time.

Admiral RICKOVER. I can supply it for the record if you wish.

The CHAIRMAN. Why don't you supply that for the record.

Admiral RICKOVER. Well, it will have to be a classified part of the record. I would be very happy to send you over the information as a classified document.

The CHAIRMAN. Fine.

[The information was provided to the subcommittee.]

Mr. BENNETT. That is all.

WHY NOT THE BEST?

The CHAIRMAN. Mr. Spence.

Mr. SPENCE. Yes, Mr. Chairman, thank you.

Admiral, thank you, too.

Not long ago someone used the term, or the phrase, "Why not the best?" And in that connection I think we have agreed that the nuclear carrier is the best.

My problem is, Why can't we convince the person that used that term that the nuclear carrier is the best? I imagine you have tried, haven't you?

Admiral RICKOVER. Mr. Spence, the President has his own problems. I think he has more problems than I have. And I think he has even more problems than you have.

Mr. SPENCE. He has more problems than a cat in a room full of rocking chairs; I know that.

Admiral RICKOVER. Obviously, in my position—and as I said in the beginning, I am not privy to all the information and the entire situation, I can only talk about it from my worm's eye view.

Mr. SPENCE. Just for what it is worth, I will take your view.

NAVAL REACTORS DOE BUDGET

I notice that the fiscal year 1980 budget was reduced by \$18 million in the last year. And the question I have is, Is the amount requested in this budget for naval reactors sufficient to do the job?

Admiral RICKOVER. Yes, sir, it is sufficient. I realize that no one can have all the money he wants. If you would let me have my druthers, I would like to have all the money in the Treasury, just like the people putting in claims, and let me decide how to spend it. I assure you I wouldn't take any for myself.

Mr. SPENCE. I just want to thank you for what you have done for this Navy of ours and this country of ours. I appreciate it.

Admiral RICKOVER. Thank you, sir.

And I appreciate your support, too.

Mr. BENNETT. Would the gentleman yield?

Since you might not come back before the Seapower Subcommittee again this year, I just want to express my deep appreciation for your magnificent service to this country, the Navy, and in regard to your basic Americanism.

Admiral RICKOVER. Mr. Bennett, no appreciation is required for somebody who has had the opportunity, the great honor and pleasure of dealing with people such as are on this committee. Don't forget, all of you act as an inspiration, too, and cause one to do his very best. Don't think it would happen without you.

Now, I don't give you credit for that, I give credit to your parents. Is that all right?

Mr. BENNETT. That is all right.

AVAILABILITY OF OIL

The CHAIRMAN. Mr. Dan Daniel.

Mr. DAN DANIEL. Thank you, Mr. Chairman.

Admiral Rickover, the statement you made on page 36, 15 years without refueling, is one that has great appeal to me. That is particularly true when we take into account that Russia today is engaged in what I believe is a resource war, which means that the availability of energy is perhaps going to be one of the most important factors in our military decisions in the years ahead.

So that is a point that I think that we do not give enough attention to. And I am glad that you highlighted it in this statement.

LIFECYCLE COSTS

You made another statement, that nuclear ships are not that much more expensive over a 30-year life cycle cost.

Elaborate on that for the committee, if you will.

Admiral RICKOVER. Yes, sir.

You can accept my word as a fact, but I will prove it. I will elaborate on that in the record. Do you want it now?

Mr. DAN DANIEL. Give me a brief elaboration now and a more expansive one for the record.

Admiral RICKOVER. When you talk about the full lifetime costs, in the first place the nuclear ship carries its own fuel. It doesn't have to be refueled. You don't have to pay for tankers and escort ships to carry the fuel to where you need it. And the cost of fuel is becoming more expensive all the time.

So when you take all of these things and add them up, you come up with new lifetime costs, call it 30 years, if you wish, and they are about the same, they are not much different. And this is not my analysis, this is an analysis that has been made for the Navy.

That is, supposing there were two different houses and one was far superior to the other, but the superior house was lots more expensive, you could make a 30-year analysis, and you could find out that it pays you to buy the more expensive house.

That is the sort of analysis the Navy went through. If you care to have it in more detail, I will be glad to do that.

Is that what you would like, sir?

Mr. DAN DANIEL. Yes, sir. Not only would I like it, but I think we need it.

Admiral RICKOVER. Yes, sir; I will do that.

[The following information was received for the record:]

THIRTY-YEAR LIFECYCLE COMPARISON, CVV/CV 71 (MODIFIED REPEAT KENNEDY)/CVN 71 (FISCAL YEAR 1979 PROGRAM YEAR DOLLARS)

The latest comparative carrier cost information in fiscal year 1979 program year dollars prepared by the Navy Sea Systems Command can be summarized as follows:

[In millions]

	CVV	CV 71 (modified repeat Kennedy) (Opt. D)	CVN 71 (Opt. D)
R.D.T. & E. cost.....	\$35.7	\$9.9	\$5.9
Procurement (SCN) less nuclear fuel costs.....	1,500.0	1,670.0	1,200.5
Postdelivery and outfitting.....	45.0	50.9	58.0
Midlife conversion (SCN).....	334.0	308.0	308.0
30-yr operations and support costs (O. & M.N.) other than propulsion fuel.....	2,037.3	2,655.0	2,826.5
30-yr SCN, OPN and O. & M.N. cost for nuclear fuel including installation, removal and reprocessing (2 sets of cores).....			1,390.0
30-yr peacetime propulsion fuel oil requirement (millions of barrels).....	14.4	15.0	
Fiscal year 1979 cost to buy and store 30-yr oil supply at \$19.58 per barrel.....	282.0	293.7	
Cost to deliver 30-yr supply of oil at fiscal year 1979 average cost of \$32.27 per barrel.....	464.7	484.0	
30-yr peacetime life cycle cost of ship without air wing costs.....	4,698.7	5,471.5	5,678.9

CVN 71 = 5,678.9M

CVN 71 = 5,678.9M

CV 71 = 5,471.5M

CVV = 4,698.7M = 1.209

* Includes \$268,000,000 appropriated in fiscal year 1977 for long lead nuclear components and nuclear fuel for CVN 71.

The Assessment of Sea-Based Air Platforms Project Report of February 1978, prepared by the Office of the Secretary of the Navy at the request of Congress, estimated the 30-year life cycle cost in fiscal year 1979 dollars of a CV/CVN air wing using current types of aircraft, to be about \$11.2 billion; and the 30-year life cycle cost of the smaller, less capable CVV air wing using current types of aircraft, to be about \$7.5 billion. Adding these costs to the NAVSEA ship costs summarized above yields:

	CVV	CV 71 (Kennedy class)	CVN 71
Billions:			
Ship cost.....	\$4.7	\$5.5	\$5.7
Air wing cost.....	7.5	11.2	11.2
Total.....	12.2	16.7	16.9
Number of CTOL aircraft.....	67	97	97
Cost/aircraft (millions).....	\$182	\$172	\$174

CVN 71 = \$16.9B

CVN 71 = \$16.9B

CV 71 = 16.7B = 1.01

CVV = 12.2B = 1.385

Total peacetime life cycle cost of the CVN 71 nuclear carrier and air wing is about 1 percent more than the conventional *Kennedy*-class carrier and air wing; both have the same weapons systems and aircraft.

Total peacetime life cycle cost of the CVN 71 nuclear carrier and air wing is only 38.5 percent more than the conventional CVV and

air wing; the CVN 71 has 45 percent more aircraft than the CVV. The life cycle cost per aircraft for the conventional CVV is 4.5 percent more than for the nuclear CVN 71.

Cost comparison does not consider advantages of nuclear propulsion. The nuclear carrier has far greater mobility and tactical flexibility, which increases survivability and attack effectiveness.

CVN 71 has capacity for 50 percent more aircraft ammunition and almost twice as much aircraft fuel as *Kennedy*-class conventional carrier, and 1.5 times as much aircraft ammunition and 2.5 times as much aircraft fuel as the CVV. This increased capacity for combat consumables, combined with high speed endurance, greatly reduces need for logistic support even in sustained combat operations.

Cost comparison assumes replenishment in operations area and does not account for wartime attrition. Nuclear carrier has capability to steam at high speed to and from replenishment in low threat areas. Attrition of Underway Replenishment Group ships supporting conventional ships is expected to be greater in war due to greater logistic support required.

In war, the combat effectiveness of naval strike forces will be controlled by the availability of logistic support. Nuclear-powered warships can provide far greater attack capability for a given amount of logistic support.

NUCLEAR VERSUS OIL-FIRED WARSHIP FUEL COST COMPARISON (EQUIVALENT ENERGY BASIS)

For long-life reactor cores containing large amounts of fissionable material, such as cores for nuclear-powered aircraft carriers (CVN's) or guided missile ships (CGN's), the operational life of the cores may be limited by the length of time the core materials will hold up in the hostile environment to which they are subjected. Based on the technical information available to date, it is expected that cores being built today will provide for 15 years of satisfactory operation. As additional data is accumulated, it is expected that it will prove feasible to assure satisfactory core life for longer periods for future cores and possibly for present cores.

A set of reactor cores for a *Nimitz*-class carrier or a new construction nuclear cruiser contains much more energy than would be expended during a 15-year period if the nuclear ships were steamed at the same low, peacetime steaming rates for which oil-fired ship fuel costs are computed by the systems analysts when they make cost comparisons between nuclear and oil-fired surface warships. The result is that the two sets of cores costed for each nuclear ship over the 30-year ship life assumed in DOD cost studies could propel the nuclear ships substantially farther or at higher speeds than the amount of oil costed in these studies for comparable oil-fired ships would propel the oil-fired ships. Thus, for the total fuel cost for two sets of reactor cores, the nuclear ships could be operated at a much higher tempo than that assumed by the analysts in the cost estimates for the oil-fired ships; or alternately, it may prove possible to operate the nuclear ships much longer on two sets of cores than the assumed 30 years.

One approach to account for the nuclear ship's core energy is to compare the nuclear fuel cost with the cost of the fuel that would be

required to operate the comparable oil-fired ship as much as the nuclear ship could operate using two sets of cores. This comparison is made below for nuclear cruisers and *Nimitz*-class carriers.

The fuel oil equivalent in each set of new construction cruiser cores (starting with initial installation in CGN 42 and in first refueling of CGN 36 and later cruisers) is 3 million barrels and in each set of *Nimitz*-class carrier cores is 11 million barrels. Thus, the total oil equivalence in the initial and one replacement set of cores is 6 million barrels for new construction nuclear cruisers and 22 million barrels of fuel oil for *Nimitz*-class carriers. The total equivalent cost of this fuel can be estimated by using the current purchase cost, storage, and handling cost and average Navy peacetime fuel delivery cost.

However, as explained below, using current average costs for purchase and delivery of propulsion fuel oil can only approximate the relative cost of nuclear and conventional fuel; the actual relative cost is dependent on indeterminate future events.

For example, using today's purchase prices for oil and nuclear fuel results in an underestimation of the relative cost of oil, since it is expected that the cost of oil will rise much faster than the increase in general inflation affecting the cost of nuclear fuel. In this regard, it should be noted that the oil for a new oil-fired aircraft carrier or guided-missile ship would be purchased in the 1987-2017 period. Oil is expected to become increasingly scarce, and its cost can be expected to rise rapidly during this period. Since most of the cost of naval nuclear fuel is independent of the cost of uranium or the cost of energy, the cost of naval nuclear fuel is not expected to increase nearly as rapidly as the cost of oil.

The average Navy peacetime fuel delivery cost has been calculated by the Naval Sea Systems Command to be \$32.27 per barrel. This was computed using current ship values amortized over 30 years, current operating costs, and actual amounts of ship propulsion fuel oil delivered in a period of a year and takes into account the portion of fuel oil delivered to ships in port. If the tempo of operations of the oil-fired ships were increased, the average delivery cost per barrel would probably be different than the current peacetime average cost. If the tempo were increased by more operations close to U.S. shores in the 2d and 3d Fleets, the average cost of delivery would probably decrease. However, if the tempo were increased by added operations away from U.S. shores such as 6th Fleet or 7th Fleet operations or addition of a 5th Fleet in the Indian Ocean, the average cost of propulsion fuel oil delivery might actually increase as existing assets become overloaded requiring additional underway replenishment forces and associated escorts. This would also result if our foreign sources of fuel oil were reduced requiring more fuel to be transported from the United States.

There are many factors affecting the tempo of operations that can be expected to change over the next 40 years, even without a war. For example, as the size of the fleet decreases without a commensurate reduction in naval commitments, or these commitments increase, the tendency will be to require an increase in operating tempo of major combatants.

On the other hand, as the availability of propulsion fuel oil decreases, there will be a tendency to limit operations of oil-fired ships to minimize oil consumption. This will have an adverse impact on training and readiness for combat. Nuclear ships are not subject to the same constraint.

The total cost of buying, installing, removing, and reprocessing the initial fuel for a new nuclear cruiser, in fiscal year 1979 dollars is estimated to be \$55.6 million, broken down as follows:

	<i>Millions</i>
Procurement of initial reactor cores (SCN budget)-----	\$31.8
Fuel installation (SCN budget)-----	1.0
Uranium burnup charge (OMN budget)-----	2.7
Defueling cost (OMN budget)-----	14.0
Fuel reprocessing (OMN budget)-----	6.1
Total -----	55.6

The total cost of buying, installing, removing, and reprocessing each set of replacement fuel for a new nuclear cruiser in fiscal year 1979 dollars is estimated to be \$64.6 million, broken down as follows:

	<i>Millions</i>
Procurement of replacement reactor cores (OPN budget)-----	\$31.8
Fuel installation (OMN budget)-----	10.0
Uranium burnup charge (OMN budget)-----	2.7
Fuel removal (OMN budget)-----	14.0
Fuel reprocessing (OMN budget)-----	6.1
Total -----	64.6

Thus, the total fuel-related costs for two sets of cores in fiscal year 1979 dollars is estimated to be \$120.2 million. A DDG 47-class ship would require about 6 million barrels of oil to travel the same distance as a new nuclear cruiser could travel with two sets of cores. It should be noted that to consume this much oil would require more than twice as much travel over the useful life of a DDG 47-class ship than the 94,000 barrels per year assumed by the analysts for cost comparisons would provide.

The total equivalent cost of 6 million barrels of fuel oil in fiscal year 1979 dollars using the current purchase cost, storage, and handling cost, and the NAVSEA estimate of the average delivery cost of oil delivered to Navy ships, is:

	<i>Per barrel</i>
Storage and terminal facilities-----	\$0.72
Fuel procurement-----	18.86
Average delivery cost of oil delivered to Navy ships (NAVSEA estimate)-----	32.27
Total -----	51.85
$\$51.85/\text{bbl} \times 6 \text{ million bbl.} = \311.2M.	

The total cost of buying, installing, removing, and reprocessing the initial fuel for a *Nimitz*-class carrier in fiscal year 1979 dollars is estimated to be \$196.5 million, broken down as follows:

	<i>Millions</i>
Procurement of initial reactor cores (SCN budget)-----	\$113.9
Fuel installation (SCN budget)-----	30.6
Uranium burnup charge (OMN budget)-----	10.8
Defueling cost (OMN budget)-----	19.8
Fuel reprocessing (OMN budget)-----	21.4
Total -----	196.5

The total cost of buying, installing, removing and reprocessing each set of replacement fuel for a *Nimitz*-class carrier in fiscal year 1979 dollars is estimated to be \$193.5 million, broken down as follows:

	<i>Millions</i>
Procurement of replacement reactor cores (OPN budget) -----	\$95.9
Fuel installation (OMN budget) -----	45.6
Uranium burnup charge (OMN budget) -----	10.8
Fuel removal (OMN budget) -----	19.8
Fuel reprocessing (OMN budget) -----	21.4
 Total -----	 193.5

Thus, the total fuel-related costs for two sets of cores in fiscal year 1979 dollars is estimated to be \$390 million. An oil-fired carrier would require about 22 million barrels of oil to steam the same amount as a *Nimitz*-class carrier could steam with two sets of cores. The total equivalent cost of 22 million barrels of fuel oil in fiscal year 1979 dollars using the current cost factors cited above is: $\$51.85/\text{bbl} \times 22 \text{ million barrels} = \$1,140\text{M}$.

It should be noted that to consume this much oil would require the nonnuclear carrier to steam at a 47-percent higher tempo or for a 47-percent longer period than would be provided by the 500,000 barrels per year assumed by the analysts for cost comparisons. In this regard it should be further noted that the actual miles steamed per year in recent years for individual oil-fired carriers varied from a low of about 22,500 for one Atlantic Fleet carrier to a high of about 65,700 miles averaged over the last five years for a Pacific Fleet carrier. The average per oil-fired carrier has been about 38,800 miles per year in recent years. If a new *Kennedy*-class carrier were assigned tasks which required steaming 65,700 miles per year, it would use about 640,000 barrels of fuel oil per year for propulsion, or about 19.2 million barrels of fuel over a 30-year life.

Thus, using the current propulsion fuel oil purchase, storage, and handling costs and average Navy peacetime fuel delivery cost, it is estimated that the cost of buying and delivering propulsion fuel oil equivalent to two sets of reactor cores would be on the order of 2.5 to 3 times as much as the cost of the nuclear fuel for new nuclear cruisers or *Nimitz*-class carriers. This is much more than the propulsion fuel oil cost typically allocated to oil-fired ships by cost analysts because those costs are calculated on the basis of current average peacetime fuel usage rates applied over 30 years and do not take into consideration the much greater energy available in two sets of nuclear cores. [End of insert.]

Mr. DAN DANIEL. Thank you, Mr. Chairman.

PETROLEUM SHORTAGE

The CHAIRMAN. Mrs. Byron.

Mrs. BYRON. One very brief question and one statement.

I am a new member on the committee, and I am delighted today to have the opportunity to hear your testimony.

There is one area that I feel very strongly about, and that is your correlation to the fuel crisis that we seem to be heading toward. If I am correct, by reading in the newspapers, we are talking about 2 gallons per day per person. By that formula I will be able to come to work 2 days a week and maybe part of the third day. So, I think that

is something that we are going to have to take under grave consideration when we discuss this before the committee and in the future.

So thank you for coming once again today. And I am sorry my other new colleagues were not here to hear your testimony.

Admiral RICKOVER. Of course you are raising the issue of nuclear power here indirectly. But I think inevitably the time is coming when people will ask for it. As I mentioned this morning, in an official referendum in California the people voted for nuclear power.

Mrs. BYRON. Thank you.

Admiral RICKOVER. Thank you. I appreciate being able to talk with you, and I hope if you have any questions that you will feel free to ask them now or at any other time, because ultimately I must depend on committees such as this. This is the only place I can talk. I am not listened to anywhere else, certainly not in the Defense Department, because I don't say what they want.

CONVENTIONAL CARRIER OR NO CARRIER

The CHAIRMAN. Mr. Bob Daniel.

Mr. ROBERT DANIEL. Thank you, Mr. Chairman.

Admiral, as Mr. Bennett pointed out, we may again be confronted this year with the question of a conventional carrier or no carrier at all. And I would say it is among the more distressing things I have experienced in my 7 years here that we are given that choice for reasons so specious.

If there were some genuine foundation that this was the choice we had to make, I suppose I could reconcile myself to it. But the reasons are not persuasive as you have abundantly developed here today.

NUCLEAR VERSUS CONVENTIONALLY POWERED SUBMARINES

I would like to ask about the question of conventionally powered submarines. You touched on that in your testimony. You say this is being considered again in the Defense Department. I am an advocate of course of continuing production of only nuclear-powered submarines. But what arguments are being made for conventional submarines, the resumption of the production of them.

Admiral RICKOVER. They are cheaper.

Mr. ROBERT DANIEL. Well, if I may be the devil's advocate just a moment, what are we going to say if debate develops on this subject in this committee or on the House floor?

You say—this is somebody talking to me now—you say the Soviets are doing everything so well, and you are apprehensive about their developing capability, as indeed I am. And they are still producing conventional submarines.

Why are they doing that?

Admiral RICKOVER. Well, this issue has arisen—it arises all the time. The thought behind it is that nuclear-powered ships are too expensive, and there must be an easier way. We can make cheaper nuclear ships, too. We can just leave out military characteristics. We can reduce the speed. And this is what we think the recommendation will be, to reduce the military characteristics and get a cheaper ship. And perhaps make it diesel. We can do that, too. What

they don't take into account from a monetary standpoint is this. I believe the costs at the end of the war when we were turning out large quantities of diesel submarines were \$7 or \$8 million each. Those that are advocating that we build diesel submarines today think they are going to cost about \$80 million. Actually, the estimates that have been made are running about \$150 million each.

And your question was also, why are the Soviets building some diesel submarines?

Now, they want some for coastal defense. That is all right. So are European nations building some diesel submarines, but not for offensive purposes in defending the sea lanes. They want them for nearby coastal use.

Mr. ROBERT DANIEL. If you were to compare the cost of a nuclear versus a conventional submarine in the two ships of which all the characteristics would be the same—and I realize it might not be possible to have the same—what sort of cost factors are we talking about?

Admiral RICKOVER. The defense minister of a certain country—and I can't tell you what country, but it is an important country—was asked, "What would you rather have, three diesel submarines or one nuclear?" And he immediately said, "One nuclear."

And that was a view that was not advocated, but it was his instantaneous reaction. So would I.

Mr. ROBERT DANIEL. What were the cost factors of a similar size submarine?

Admiral RICKOVER. Sir?

Mr. ROBERT DANIEL. By what factor would we multiply the cost of a conventional submarine.

Mr. LEIGHTON. We have a problem of classification here, Mr. Daniel. All of the figures in the table the Admiral has in front of him are classified. We are having a hard time giving you an unclassified answer that is meaningful.

Mr. ROBERT DANIEL. I would change the question to say, if we are buying 688 conventional power.

Admiral RICKOVER. I can touch on this after the session is over. If you want to look at the chart I will show it to you. But I can tell you some rough figures.

The SSN-688 class now costs \$381 million per ship. We can build a diesel submarine for \$150 million, but it doesn't have the characteristics of the 688 by a long shot. And that is in addition to more than 10 years of operation for the 688 because it does not require refueling. The diesel version doesn't have the endurance, speed capability, and weapons and a lot of other things.

Mr. ROBERT DANIEL. Thank you.

Admiral RICKOVER. I would like to show you that in detail in classified form if you are interested. We have that.

Mr. ROBERT DANIEL. Thank you.

[The following information was received for the record:]

SUBMARINE ALTERNATIVES STUDY

The CHAIRMAN. Admiral, I understand that the Secretary of the Navy, as a result of requests by Congress, has initiated a study of alternatives to the large, expensive Trident and *Los Angeles* class

submarines now being built. Could you tell us what you know about this study and give your opinions regarding its results.

Admiral RICKOVER. Yes, sir, I am aware of such a study. As a matter of fact you might be interested to know that, to my knowledge, at least six studies are being conducted by various groups, agencies, and so forth, on how the Navy should design and build cheaper submarines.

There are several issues involved in this area that need to be discussed and understood. I would like to address each of them.

First, the Navy is perfectly capable of designing and building a cheaper submarine. It doesn't need any help. It is just as easy for them to do that as it is for Detroit to design and build cheaper automobiles; for the aerospace industry to design and build cheaper commercial passenger aircraft; or for the Army to build cheaper tanks. The question which must be answered is, Will these cheaper versions serve the purpose for which they are intended? If Detroit builds a cheap automobile and nobody buys it, then the effort was a failure. However, in the automobile business you are dealing with a product that is produced by the millions and if a mistake is made on a given model, the company changes or drops that particular model and comes up with a new one. With submarines we are dealing with a small number of inherently expensive items that must last for 20 to 30 years. So the question boils down to, What do you want the submarine to do? This is a question the Congress must be in a position to answer, because it is not certain that you will receive a clear, well-reasoned recommendation from the Department of Defense.

You should recall that it is Congress that can take the credit for the existence of the 688 class high-speed submarine we now have and we are continuing to build. The DOD fought the 688 class design all the way for years. Yet today it represents probably the most capable attack submarine in the world and operational results prove it is the only submarine that can carry out many of the missions required of a modern attack submarine.

REDUCED COST REQUIRES REDUCED CAPABILITY

To make a submarine cheaper all you need to do is tell the designer to remove certain capabilities. Each capability that is deleted or reduced, makes the submarine smaller, lighter, and thus cheaper. If you decide you don't want a certain speed capability, a certain quietness capability, a certain shock capability, a certain weapon capability, or a certain depth capability, you can reduce them and the submarine will get cheaper. Where all of these so-called studies fall flat, is when they try to prove that by reducing one or all of these capabilities, you can end with a submarine that is just as effective for a cheaper price. By doing this, the study becomes a fraud. You do not get something for nothing.

I have watched the current submarine study you asked about since its inception almost a year ago. I have provided technical answers to specific questions asked of me relative to design features of the nuclear propulsion plant. However, I have also watched this study group try to prove the impossible and I have seen them flounder in their attempt. I have seen some of the people resort to questionable analyses

in order to make preconceived results come out right, only to be caught up when reviewed by knowledgeable persons. There is no panacea and the sooner those in charge recognize this the better.

In my opinion this entire issue could be settled in a relatively short period of time and without a lot of useless studies. Again, the burden will fall on the Congress, as it always has.

As I have said many times before, in peacetime we should build the best and most capable weapon systems we can. In a real wartime situation we will not have the time to build these complex ships such as was possible in past wars. The judgment as to what and how many we should build in peacetime is obviously a question involving many elements, not the least being, how much money the administration and Congress is willing to provide in competition with other national programs. But to build less capable submarines in peacetime, in my opinion would be a grievous error. As Winston Churchill said, "it is like breeding slow racehorses."

NEED TO PLAN FOR FUTURE THREAT

Another factor which I do not believe is given serious enough attention is a realization of just what the threat will be in say 10, 20, or 30 years. Remember, a new submarine designed today will take at least 8 years before it goes to sea and will have to last well into the 21st century. The studies being conducted today assume today's capability for the enemy. No one knows what the enemy will have in 10 or 20 years. How can you even guess? How can you guess what missions will be demanded of our attack submarines? We have not fought an at-sea war since 1945 and, if and when we do, a responsible official must assume that there will be many changes in strategies and tactics of naval warfare. We have never faced an enemy at war using nuclear submarines nor have we ever used our nuclear submarines in a real war situation.

Knowing this, how can anyone, regardless of how smart he may be, come up with calculations that prove, in a mathematical sense, just what our submarines should be capable of? Yet this is what is going on. Soon you will be getting a 12-inch thick "study" on what kind of submarine we should be building. At this time I do not know what that study will recommend because it changes every week. The problem is that the people doing the study know what some Members of Congress or their staff want the answer to be. So the studiers keep juggling the calculations to try to prove that even a diesel submarine is just as effective as a nuclear-powered one. It is quite possible they will arrive at that absurdity. Using the same logic I guess they could just as easily conclude that we should decommission all of our nuclear-powered submarines. You may recall that several years ago the DOD system analysts recommended that we sink 10 of our Polaris submarines as a cost-saving measure.

Again, let me say, if the Congress and the administration want the Navy to build cheaper submarines, diesels included, all they have to say is "do it." But the Navy should not be asked to prove that they are just as effective as the 688 class nor should they make the Navy say that is what the Navy wants instead of the 688 class.

PROGRAM FLUCTUATIONS AFFECT COST

There is another important factor that affects the cost of submarines which the Congress should consider if you really want to reduce ship-building cost and that is the constantly changing submarine construction program.

A few years ago the SSN 688 class program was planned to include five submarines per year. The Trident submarine program was planned to include three submarines per year. Both these programs are now down to about one per year after several changes in Defense Department planning. The lack of firm programs discourages potential suppliers and results in increased costs.

Back in the 1960's the Department of Defense announced a policy of stopping all submarine construction after fiscal year 1970 on the basis that we would have enough submarines to handle the potential threats. Fortunately, Congress took the initiative to continue submarine construction; but the Defense Department planning caused the loss of many suppliers and competitive vendors with the result of higher costs.

I am not in a position to evaluate how many submarines we should ultimately build. However, every time there is a stretchout in building ships, costs go up. The Congress can help avoid this waste by insisting on firm planning from the Department of Defense.

LACK OF RECOGNITION OF IMPORTANCE OF SUBMARINES

I would like to repeat another point I have made before. In my opinion, I do not think that many in the DOD or the Navy, particularly those with the power to control money, appreciate the value or significance of the submarine—either as a weapon we may have to face, or as a weapon within our own arsenal. The top leaders within the DOD and the Navy tend to think largely in terms of air warfare. The aero-space industry has a tremendous influence on how defense dollars are spent. I think it would be interesting for this committee to find out how much money is spent in the Navy in each of the three basic areas of air, surface, and submarine, including research and development. I do not mean to imply that naval air is not important, but I do say that the division of money leans too heavily in that direction.

In this same vein, while the nuclear submarine and surface ship programs are struggling to maintain the barest level of officer manning, midshipmen from the Naval Academy are being allowed to go into flight training in unlimited numbers. The Navy does need candidates for flight training, but right now they are so heavily backlogged that these young, newly commissioned officers are being forced to wait around 6 to 12 months until the training command can handle them. The Navy is also permitting up to 50 graduating USNA midshipmen to go into the nonflying officer program (NFO). This, to me is a travesty. Here, we train and educate young men for 4 years at the Naval Academy at great expense to the taxpayer, and then allow 50 to enter a program which can only lead to their loss at the end of their obligated service. Why do we need to train naval officers at the Naval

Academy so that they can become passengers in our naval aircraft? There are few things I can think of that are as much a waste of taxpayer's money. You would do well to look into this.

Insofar as submarines are concerned let me give you my recommendation, and I can assure you it is not based on systems analysis, computer studies, or war game scenarios. It is based on intuition, knowledge of history, and just plain commonsense. I am sure that, for this reason alone, the DOD "studiers" will reject it.

RECOMMENDATIONS FOR SUBMARINE CONSTRUCTION

First let me address the Trident submarine. I would continue building the Trident submarine to its present design. You should recognize that at the time this ship was under consideration, over 3 years of studies had been conducted by practically every group who could be assembled. Detailed consideration was given to its speed, depth, quietness, number and size of missiles, mode of operation, and so forth.

What was finally agreed upon was the culmination of all of these factors, including debates between the Navy, DOD, the National Security Council, the White House, and the Congress. Finally a decision was made and the design features were settled. It has taken us 8 years to get where we are and, as you know, the first Trident has yet to be completed. To change the design at this point would not only take years to accomplish but would be extremely costly. As far as I know, the only objection to the presently designed Trident is its cost. I have not heard anyone say that there is anything wrong with its design in that it can not perform the mission as intended.

One element of the Trident design which was the subject of extensive debate was the number of missile tubes. Twenty-four tubes were selected. If, for reasons unrelated to mission capability, it were decided to change the number of tubes to say 20 or 16, that change could be made on Trident's further down the line and it could be done without massive change in the ship's design features. However, the number of tubes is not within my area of expertise.

Insofar as attack submarines are concerned, I would continue building the 688 class. Today, it represents the best we know how to do. In addition, I would continue reviewing the design of the 688 class to see what improvements can be made. This so-called reengineered 688 might come out smaller but then again, it might not. Remember, the 688 was designed over 10 years ago and since that time we have learned more about its operation. These lessons need to be incorporated into later designs. To go back to 637 class with its reduced speed capability would be sheer nonsense. Recall, it was Congress that forced the Navy to build the 688 in the first place because of our continuing loss of speed capability in comparison to what was seen in Soviet nuclear submarines. The idea of intentionally building a slow submarine just to save money strikes at the core of absurdity.

In my opinion we would be better off having no additional submarines in the shipbuilding program than to revert to 20-year-old designs. [End of insert.]

ADMIRAL RICKOVER'S RETENTION ON ACTIVE DUTY

The CHAIRMAN. Mr. Stratton?

Mr. STRATTON. Thank you, Mr. Chairman.

Admiral, I too wanted to join in the accolades that were extended to you. But I was a little disturbed because there appears to be a kind of a farewell. And I certainly would be disturbed if I thought that your service was going to terminate at any time in the immediate future.

It is my understanding that you are serving on a 2-year hitch. But I haven't found any witness in my long experience on this committee who is so willing to testify as to his own views and to testify so knowledgeably.

And I trust that this committee will exert its influence—and it does have some influence once in a while—to make sure that you stay on the job at least for another 2 years.

You are a young man, and you have got a lot of things to contribute to the country.

NUCLEAR VERSUS OIL-FIRED CARRIER

I share your view completely with respect to the nuclear carrier. And I was impressed by your reference in your testimony to the leadership that Congress has taken in the past, particularly the leadership of our distinguished chairman, when the chips were down, on insisting that we get started on a nuclear navy.

And I think that instead of us sitting up here and figuring on what the freshmen are going to vote for, we ought to do a little exercising of leadership ourselves. That is what the American people want.

I think we have seen too little of it in the Government. And if it doesn't come from the other end of Pennsylvania Avenue it ought to come from this end.

And I think Mr. Bennett has put his finger on one thing. We had Camp David going a year ago. And Mr. Mahon, who certainly should have been on the other side, made a big pitch for not undercutting our President when he was negotiating, and so the nuclear carrier went down the drain.

Camp David appears to have evaporated, so we won't have that problem. But we have just three alternatives, as I see it.

AIRCRAFT FOR CVV

We have got the CVV, which is what the administration wants. We don't have the plans for that aircraft at the present time; do we, Admiral?

Admiral RICKOVER. Yes, we do, Mr. Leighton tells me. And he is the expert.

Mr. LEIGHTON. The CVV is being designed to handle any of today's aircraft, Mr. Stratton.

Mr. STRATTON. F-14?

Mr. LEIGHTON. Yes, sir, the F-14. The aircraft planned for it may include some F-14's, but it can't handle very many.

Mr. STRATTON. The CVV is primarily a vertical takeoff aircraft carrier, that is what the "V" stands for as I understand it. And we still don't have any "V" planes.

You have also, I think, done a remarkable job in demonstrating that if we go to the *Kennedy* carrier, it is going to be virtually the same cost as the *Nimitz*.

Admiral RICKOVER. That is right, sir.

Mr. STRATTON. And it is going to be half as effective, it is going to have to have the aircraft, or we are just throwing our money away, obviously.

INDIAN OCEAN OPERATIONS

It seems to me that there are two major reasons that we didn't have today for putting a nuclear carrier in the fleet.

The New York Times today has an article by Mr. Weinrod, "The Pentagon is urging an Indian Ocean fleet. It is going to be based at Diego Garcia." The Indian Ocean is a pretty large ocean, isn't it, Admiral, and if we are going to get around in the Indian Ocean, isn't it absolutely essential that the carrier we have be able to sustain high speed over an indefinite period of time and not have to be refueled every couple of days?

Admiral RICKOVER. I can answer your question indirectly. Several years ago there was a crisis, and it was necessary to send a carrier task force to the Indian Ocean. The carrier that was sent was a nuclear ship, the *Enterprise*. If the *Enterprise* had not been available, the Navy would have had to have two prepositioned tankers in the Indian Ocean ahead of time before knowing there was a crisis to support an oil-fired carrier, or tankers would have to be found and sent with the carrier, thus delaying its arrival. When the crisis developed there were no prepositioned tankers. Fortunately there was a nuclear-powered ship available that time.

That has happened time and again, that is, in time of an emergency, the nuclear ship has been able to respond quickly. At the time they want to save money they want the other kind of ships.

Mr. STRATTON. We have been trying to make the Indian Ocean an ocean of peace, but that seems to have dropped through the cracks.

And it seems to me that if we are going to utilize the Indian Ocean you ought to have a nuclear carrier.

Admiral RICKOVER. If you don't have a nuclear carrier, the Navy ought to start setting up a supply system with tankers to accompany the oil-fired carrier. And the tankers are more vulnerable than the carrier.

Mr. STRATTON. And you pointed out we lost the Iranian oil. I remember when our committee went to the Middle East in 1973, and we had to beg, borrow, and steal to get enough fuel to fly the plane back to the United States.

CONGRESS CONSTITUTIONAL RESPONSIBILITY

Admiral RICKOVER. Of course the thrust of my testimony was that ultimately and legally the decision should be made by Congress. That is what the Constitution provides. And that is what I talked at length about.

The men and women sitting right here are the ones who are ultimately responsible to the people for what is done, no one else.

Mr. STRATTON. And we are going to vote for it, I tell you that, and fight for it.

The CHAIRMAN. Admiral, if you have other matters in connection with your testimony this morning—

Admiral RICKOVER. Yes; we have an additional matter we need not take very long on.

It is the fiscal year 1980 Department of Energy budget for the naval reactors development program, the part that this committee is concerned with.

As you know, you are not concerned with our water-cooled breeder program. That comes under another committee.

But you are concerned with the naval reactors development program. I have a statement about that I would like to put in the record, if that is satisfactory to you, Mr. Chairman.

The CHAIRMAN. We would like you to put it in the record.

[The following information was received for the record:]

NAVAL REACTORS FY 1980 DOE BUDGET REQUEST

Admiral RICKOVER. Mr. Chairman, I would now like to discuss the naval reactors development program's budget request for fiscal year 1980 which is funded by the Department of Energy.

The fiscal year 1980 naval reactors development budget request is \$278.4 million. This is a decrease of \$18.4 million from the fiscal year 1979 authorized amount. The major areas of this budget request are as follow:

Operating funds

The fiscal year 1980 operating budget for the naval reactors development program is \$241.4, a decrease of \$30.4 million from fiscal year 1979. While funding needs decrease in fiscal year 1980, development efforts remain at a high level. Efforts for fiscal year 1980 include: studies to obtain a broader understanding of the response of reactor materials to various conditions; continuing efforts to design, develop and procure new prototype cores such as, the submarine test core and the advanced fleet core; upgrading fluids and corrosion test facilities; long term tests to identify predicted failure modes; improving techniques and equipment for monitoring and controlling new design and operating reactors; developing instrumentation and control equipment for both primary and secondary systems required to support installation of new long-life, high-performance reactor cores; preparing for fuel inspection and fuel test assembly removal from prototype plants; replacing and examining selected reactor control devices; irradiation testing of improved materials capable of longer core life and higher performance; improving analysis methods for accurately predicting nuclear performance of long-life cores; the continuing follow, testing, and operational support of the reactors in operating submarines and surface ships to improve operating techniques; continued operation and testing of eight land prototypes which are used to test and evaluate reactor and propulsion plant design; evaluating reactor plant equipment operating in land prototypes and test facilities; and examining reactor plant equipment removed from land prototypes in order to forecast operating lifetimes.

The breakdown of the fiscal year 1980 operating funds is:

	<i>Millions</i>
I. Submarine propulsion reactors.....	\$160.1
II. Surface ship propulsion reactors.....	55.6
III. Supporting research and development.....	16.9
IV. Personnel resources.....	8.8
Total, Operating Funds.....	241.4

I. Submarine propulsion reactors----- 160.1 million

The purpose of the submarine propulsion reactors program is to develop and support nuclear propulsion plants for submarines through the operation of 6 land prototypes and the continued engineering and physics design, follow, testing, and operational support of the reactors in 114 operating submarines and 31 submarines authorized by Congress or under construction. This work is accomplished through 6 ongoing programs. Submarine advanced, small submarine, attack submarine, improved submarine and deep submergence research vehicle nuclear propulsion plant programs and the S1W reactor facility. During fiscal year 1980, effort will continue in all programs. The major developmental areas in these ongoing programs and the work anticipated is summarized below.

1. *Advanced reactor concept*

The advanced reactor concept developmental effort consists of an advanced core designated the S7G. This concept has the potential of increasing on-line reliability. The concept is potentially applicable to future submarine and surface ship designs. This advanced reactor is currently in operation at the modifications and additions to reactor facilities in West Milton, N.Y. Work in fiscal year 1980 will include: evaluating S7G prototype reactor nuclear, thermal and mechanical performance; performing life testing of equipment for the S7G design for potential shipboard application; for post operations inspection of various equipment; and developing, qualifying and applying analysis methods and conducting test programs to determine various characteristics necessary to meet long life performance goals.

2. *Submarine test core*

The submarine test core is being developed and will be installed in a prototype reactor plant. The core will consist of modules containing advanced materials. These materials are expected to offer improved performance and increased lifetime. Efforts involving the submarine test core in fiscal year 1980 will include: continuing procurement of modules; conducting tests of module configurations; continuing nuclear design analysis to define parameters for reactor design and development work; and carrying out irradiation testing of improved materials.

3. *Nuclear propulsion plant for the "Los Angeles" class attack submarine*

Developmental efforts for the reactor plant used in the SSN-688 class submarines will continue in fiscal year 1980. This plant provides propulsion power approximately equivalent to that of earlier attack submarines. Included in this program are design and development efforts for a new core to extend fuel lifetime.

Work to be undertaken in this program for fiscal year 1980 will include: providing nuclear design lifetime performance information for advanced core ship application, conducting and evaluating periodic ship physics tests to insure that the reactor plant is operating within design limits; providing information to support reactor structural and

material evaluations; providing reactor plant analyses to assure adequacy of the reactor plant systems; and continuing development of an improved process for welding components using advanced welding techniques required to reduce the potential for contamination and fiber optic defects.

4. *Advanced design nuclear propulsion plant for future classes of submarines*

An advanced design reactor plant is being designed and developed to provide substantially higher performance than any other submarine propulsion plant now in use or being developed. This plant incorporates technological improvements and will provide the option of developing various improved submarine configurations, incorporating new weapon systems and advanced sonars. This will enable greater exploitation of the technical advantages of the modern submarine weapon system in either an offensive or defensive role. Efforts in fiscal year 1980 will include: designing and procuring prototype maintenance and refueling equipment to support servicing of the prototype reactor after startup and initiating design and procurement of equipment for a scale model test.

5. *Nuclear propulsion plant for the Trident strategic ballistic missile submarine*

Emphasis will continue to be placed on the design, development, test, and support of a nuclear propulsion plant for installation in the Trident strategic ballistic missile submarine. The Trident S8G design builds on advanced submarine technology and represents a major reactor plant advancement. The S8G highly instrumented prototype is being built to confirm the performance of the reactor plant for the Trident-class submarine.

In fiscal year 1980, operations and testing of the instrumented core installed in the new S8G prototype reactor plant located at West Milton, N. Y., will continue. This effort will include: initiating detailed planning for interim inspection of a reactor fuel assembly and control rod to verify design; completing nuclear and thermal/hydraulic evaluation of test results to confirm reactor design and operating procedures; and completing evaluation of the prototypical test to verify end-of-life effects. Further efforts will include developing inspection requirements and acceptance criteria for support adaptors and control rods and surveillance of core manufacturing and reactor equipment modifications.

II. Surface ship propulsion reactors..... \$55.6 million

The purpose of the surface ship propulsion reactor program is to support and develop nuclear propulsion plants for combatant surface ships, operate and test two land prototypes, and provide testing, engineering follow and operational support for the reactor plants in 11 operating ships and 2 ships under construction. This work is accomplished through three ongoing programs: Large ship, destroyer type dual, and aircraft carrier type dual nuclear propulsion plants. During fiscal year 1980, effort will continue in all programs. The major developmental areas and anticipated work in these ongoing programs are as follows:

1. *Nuclear propulsion plant for the Nimitz-class aircraft carrier*

The two-reactor nuclear propulsion plant for these carriers is capable of developing enough shaft horsepower to propel the ship at high speeds and supply adequate auxiliary power for operation of advanced weapons and electronics systems. The core, designated A1G, is the largest core yet developed for naval nuclear propulsion. Fuel life is expected to provide at least 13 years of normal ship operation. As part of this effort, a prototype reactor core has been installed and is operating in an existing prototype reactor plant. Efforts anticipated for fiscal year 1980 include: Following, operating and periodically testing the A1G prototype core installed in the A1W-B prototype plant, including designing, developing, and procuring equipment required for refueling the prototype and completing advanced planning for the prototype refueling; and designing and initiating procurement of a replacement core for the A1W-B prototype plant.

2. *D2W Reactor core for cruisers*

The D2W reactor core is operating in the D1G reactor plant at the K. A. Kesselring Site, West Milton, N.Y. Emphasis will continue to be placed on prototype testing of the D2W core, which incorporates the latest proven technological advances in nuclear system and component design.

Efforts in fiscal year 1980 include: monitoring the D1G prototype reactor for any changes in the characteristics of the D2W core; factoring the results of these evaluations into the design and operating procedures for follow shipboard cores; providing analysis necessary to support the establishment of plant operating restrictions; continuing redesign of structural components and evaluating potential modifications to support the shipboard core design.

3. *Advanced fleet core*

The advanced fleet is being designed to utilize new concepts in fuel element manufacture. This is expected to extend fuel element performance, resulting in a longer lifetime. Due to the extensive design, development, testing and manufacturing phases associated with this new core, efforts need to be initiated many years in advance of when the core will be available for shipboard use. Efforts involving the advanced fleet core in fiscal year 1980 will include: developing vendor equipment; initiating preproduction efforts to qualify the reactor core manufacturing equipment; continuing core design and procurement efforts; and initiating work on fuel and nuclear design justification to support procurement of the advanced fleet core.

III. Supporting research and development----- \$16.9 million

During fiscal year 1980 supporting research and development will continue to be provided in three areas: examination and analysis of expended cores and test reactor irradiation tests at the expended core facility, operation of a high-temperature test facility for obtaining reactor physics information, and development of advanced methods and techniques that can be used in the naval reactors programs.

The examination of expended cores and fuel element irradiation test samples and assemblies will continue at the expended core facility,

providing valuable technical data on fuel element performance and the long-term corrosion effects of irradiation on fuel-element cladding and core structural materials. Various ship cores will be analyzed to aid in confirmation of current core designs and form an essential part of the research and development effort necessary to develop longer lived naval reactor cores. Furnishing basic data on materials performance is also part of the effort. This will provide valuable support data for the design, fabrication, and operation of fuel systems and materials employed in current naval cores.

Operation of the high-temperature test facility will continue providing valuable data regarding physics characteristics being developed for use in naval nuclear propulsion plants, and providing data needed to design and analyze cores.

The Naval Reactors design studies effort is continuing development of extended analytical methods and models to improve predictions of material properties and structural response under steady-state temperature transient and cyclic use. Work will continue to improve naval fuel performance prediction capability through modification of the naval-fuel-element-performance computer program. This is required for design of longer lived and high performance cores. The development and application of improved methods of analysis will continue.

Irradiation experiments will be conducted in the advanced tests reactor including irradiation testing and evaluation which will provide data of value to operating ships as well as additional confirmation of the adequacy of core designs.

Personnel resources----- \$8.8 million

The 235 personnel requested for the Division of Naval Reactors, including the Pittsburgh Naval Reactors Office and the Schenectady Naval Reactors Office are necessary to meet anticipated programmatic requirements including support of the expanding Navy nuclear-powered fleet and the ongoing water-cooled-breeder effort.

Naval Reactors maintains a minimal personnel level and has been able to operate with austere staffing through careful management of personnel to meet work requirements. Existing personnel have been used to the greatest extent practicable in staffing new programs and expansions to existing programs. Improvements in work force productivity have been achieved over the years by maximum use of available staff to carry out increasing workloads. This approach has resulted in limited changes in the personnel level.

Naval Reactors' personnel maintain close program management and technical direction of the Bettis and Knolls Atomic Power Laboratories and associated facilities, with a combined employment in excess of 6,500. These laboratories are Government-owned, contractor-operated facilities solely devoted to the Naval Reactors program.

Plant and capital equipment funds

Capital equipment funds(\$15,800,000) are requested in fiscal year 1980 to support continuing research and development activities aimed toward producing technologically advanced nuclear propulsion plants and reactor cores having long fuel life, high reliability, improved performance, and simplified operating and maintenance requirements

necessary for enhanced ship lifetime performance. To accomplish these activities, the following types of capital equipment are necessary: quality assurance equipment, process development equipment, irradiation design engineering equipment, analytical, spectrochemical and other laboratory equipment; fabrication and inspection equipment; and radiation and other equipment such as survey meters, assay gages, and a tape spectra system. Equipment upgrading will continue to provide significant improvements in reliability and increase the efficiency of training naval personnel. Additional capital equipment is also needed to provide for the analysis and examination of spent fuel assemblies and other components operated in nuclear propulsion plants.

Major construction funds (\$17,900,000) are requested in fiscal year 1980 for the fluids and corrosion test facilities upgrading, project No. 80-AE-1. This project provides for the fabrication of two test loops, additions to and upgrading of corrosion laboratory equipment, the procurement of attendant supporting equipment, and modifications to existing buildings and facilities to accommodate these systems. One test loop will be used for testing small-scale components and the other test loop will be used for testing full-size reactor plant components. These test facilities are needed to develop design techniques used in naval reactor plants.

General plant project funds (\$3,300,000) provides for minor plant improvements, alterations, additions, and minor new construction at Naval Reactors' laboratories. In general, this project consists of performing land improvements, building alterations, utility improvements, additions to existing facilities and upgrading present facilities. The work contemplated under this project will provide continuity of present and planned operations, contribute to operating efficiencies, eliminate potential health, fire, and safety hazards, reduce maintenance and operating costs, and provide facilities to take full advantage of technological advances. [End of insert.]

The CHAIRMAN. Do you have any other matter that you want to bring to our attention?

Admiral RICKOVER. No, sir, we don't. And as far as the naval reactor development budget request, if it is satisfactory, we will take it up with your staff and work it out with them.

The CHAIRMAN. Fine. That will be satisfactory.

Admiral RICKOVER. Thank you, sir.

The CHAIRMAN. Thank you very much, Admiral.

Mrs. Holt, do you have a question?

INDUSTRIAL BASE

Mrs. HOLT. Thank you, Mr. Chairman.

I apologize for being in and out. I had a couple of other committees that I had to attend. I hated to miss your full testimony, Admiral Rickover, but I have read it.

I just want to ask one quick question. You emphasized the slipping away of our nuclear industrial base. How about the technological base? Are we losing a lot of engineers and scientific people, and is this eroding the technological base?

Admiral RICKOVER. We are losing some, but that is not the big issue. The big issue is losing the industrial base.

On the other hand, I cannot just sit here and justify a large industrial base when we don't have a large number of ships to build.

As you know, there is hardly a company in the nuclear business, including those that have built plants for the civilian industry, that was not started in the nuclear business to supply the naval program.

I determined at the very beginning to have at least three sources of supply for everything, so that we could have competition. But, I cannot argue that we should keep such a large industrial base for a few ships. If we get some regular authorizations and appropriations, even for a small number of ships, we will keep what we need going.

But if there are many years like this year, then it will take a great deal of money to start it up again if a nuclear shipbuilding program is needed in future years.

Mrs. HOLT. You don't feel that we are losing our technology, our lead in that?

Admiral RICKOVER. No, I don't think so.

This issue of technology is being raised today in a much broader sense. Arguments are being put forth which go much further, it is for the whole country, that we are not spending money on research and development, and therefore our ability as a country to invent is declining.

I think that is a questionable thesis. And in my opinion a great deal of that comes from people who are being supported by the Government. As you know, the Government supports a lot of those organizations.

Each year, particularly around appropriations time, you hear that story. I am not so sure that is a completely accurate story.

Are you kind of surprised to hear me say this?

Mrs. HOLT. Yes, I am, I am very surprised, because that was a fear that I had, and I think a lot of people have.

But I am glad to hear you say it, even though I am surprised.

Thank you very much.

Admiral RICKOVER. Thank you, Mrs. Holt. I have a short paper here which discusses the problems we face concerning the naval nuclear industrial base which I will submit for the record.

[The following information was received for the record:]

NAVAL NUCLEAR INDUSTRIAL BASE

Over a period of many years, a unique and highly specialized industrial base has been developed for the manufacture of reactor cores and components for the naval nuclear propulsion program. The continued existence of this industrial base has been threatened by recent reductions in Navy nuclear shipbuilding programs which have resulted in levels of new business in fiscal years 1978 and 1979 which are a significant underutilization of the annual capacity of the industrial base. Similar underutilization is forecast for fiscal years 1980 and 1981.

This paper outlines the history of the naval nuclear industrial base and its characteristics and describes its current status.

HISTORY OF THE NAVAL NUCLEAR INDUSTRIAL BASE

One of the principal goals of the naval nuclear propulsion program has been to develop and maintain within private industry the capability to manufacture and insofar as possible design the reactor cores and components required to build nuclear-powered ships.

Although the reactor core and certain major components for the first nuclear-powered submarine *Nautilus* were built in Government-owned, contractor-operated facilities, virtually all equipment for subsequent ships has been manufactured, and to a large extent designed, by private industry under fixed price type contracts with the Government or its prime contractors. As a result of this effort the naval nuclear propulsion program pioneered the development of nuclear power equipment suppliers in the United States. During the period 1955 through 1963 when the Navy was ordering as many as 15 reactor plants in a single year, and there was reason to expect a continuing naval nuclear shipbuilding program, a competitive market was established with at least three manufacturers—in most cases more than three—for most components used in naval nuclear reactor plants. It took an extremely arduous effort and many years to build up this industrial capacity for naval nuclear equipment.

Significant parts of the industrial base established by the early 1960's were lost in the period 1965-70 as the number of nuclear-powered ships authorized for construction was cut in half—from an average of about 10 ships per year in the period 1957-64 to an average of about 5 ships per year in the period 1965-70. The loss of industrial capacity was exacerbated by public statements by Department of Defense officials that after fiscal year 1969 no new nuclear submarines were planned to be built and that no new nuclear-powered fleet escorts would be built after DLGN-36 which was authorized in fiscal year 1967.

As a result, by the late 1960's the number of suppliers for the naval nuclear industrial base had been significantly reduced. For example, the number of suppliers of reactor cores had been reduced from five in 1963 to two in 1967 and one of these was limited in its qualification and capability. Also by 1967 there was only one active supplier of reactor vessels and closure heads. Similar losses of industrial capacity had been experienced for other types of reactor plant equipment.

The naval nuclear industrial base was seriously dissipated in this period because with the relatively small volume of naval nuclear work it was difficult to get competent suppliers to assign the necessary talent to naval nuclear propulsion work. The Navy had no leverage to require contractors to maintain, or reestablish in a short time, groups of qualified, experienced technical and production personnel capable of producing components meeting the rigorous standards required of Naval nuclear components. These groups take a long time to assemble; but because of their skill and experience, they are quickly reassigned to commercial work whenever they are no longer required for Navy work.

Contrary to the forecasts of a few years earlier, in the late 1960's and early 1970's it was necessary to rebuild the industrial base for

naval nuclear equipment in order to support an expanded shipbuilding program of SSN-688 class attack submarines, Trident ballistic missile submarines, nuclear powered cruisers and *Nimitz*-class aircraft carriers. Rebuilding this capability was costly and time-consuming due to the nature of naval nuclear work. Naval reactors must be designed to withstand combat shock, to continue operations following a partial casualty, to be compact to fit into a warship hull, and must be capable of being maintained by the ship's force while underway. Naval nuclear work must be performed under close scrutiny by the Government and its representatives to ensure the reactor will operate reliably and safely under combat conditions. Accordingly, naval nuclear work is very demanding on a supplier's engineering and quality control capabilities.

CURRENT STATUS OF THE NAVAL NUCLEAR INDUSTRIAL BASE

By 1977, after a major effort which had extended over almost 10 years, the naval nuclear industrial base had been substantially rebuilt to a level capable of supporting the shipbuilding programs developed through this period and forecast for the next several years. There were two suppliers of naval reactor cores both of whom are qualified to build the types of cores now in quantity production. In addition, there were four suppliers of heavy equipment such as reactor vessels, closure heads, steam generators and pressurizers. The industrial base for naval nuclear equipment is highly competitive in its major segments (reactor cores and heavy equipment). Prices for nuclear equipment in the last few years generally have increased at a rate less than price increases in the general economy due to the highly competitive marketplace that currently exists.

However, the level of new orders for naval nuclear equipment declined sharply in fiscal years 1978 and 1979 and the naval nuclear industrial base is being significantly underutilized as shown in the following table:

NEW ORDERS¹ FOR NAVAL NUCLEAR EQUIPMENT AS A PERCENT OF ANNUAL INDUSTRIAL CAPACITY

	Actual		Projected	
	1978	1979	1980	1981
Reactor cores.....	40	79	34	41
Major heavy equipment.....	25	27	16	26

¹ Includes orders for the new construction program funded in the Shipbuilding and conversion, Navy (SCN) appropriation as well as orders for replacement and spare cores and equipment funded in the Other Procurement, Navy (OPN) appropriation.

A major factor in the reduced utilization of the naval nuclear industrial base has been variations in the program for construction of naval vessels. For example, in the early 1970's the first 10 ships of the Trident submarine program initially, were planned to be authorized over a 4-year period fiscal year 1974-77; however, the program actually has been authorized at a much slower rate and current Department of Defense planning, is to request authorization of the tenth ship in fiscal year 1982—5 years later than originally planned.

The following table illustrates the stretchout of the Trident program:

AUTHORIZATION PLAN FOR THE FIRST 10 TRIDENT SUBMARINES BY FISCAL YEAR

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Original plan.....	1	3	3	3	-----	-----	-----	-----	-----
Actual and currently planned.....	1	2	1	1	2	-----	1	1	1

Similarly, the program for construction of SSN-668 class attack submarines has also been authorized at a much slower rate than initially was planned. For example, SSN-668 class submarines were authorized for construction at an average rate of five submarines per year during the period fiscal year 1971 through fiscal year 1974. In fiscal year 1975, however, the rate was reduced to five submarines every 2 years. Current Department of Defense plans for the period fiscal year 1978 through fiscal year 1984 are to authorize construction of only one SSN-688 class submarine per year.

There is evidence that the industrial base capacity developed over the past 10 years is now being lost. One of the two currently qualified suppliers of naval nuclear steam generators reduced manufacturing capacity by 50 percent in the mid-1970's and recently advised that the current forecasts of naval nuclear work would result in his leaving the business after current orders are completed. The number of suppliers who produce the fuel used by the reactor core suppliers in the manufacture of naval nuclear reactor cores has been reduced from two to one. Moreover, naval nuclear suppliers are declining to invest in needed new equipment or to upgrade manufacturing processes because of the current and projected low levels of new orders for naval nuclear equipment.

It is not prudent to risk the loss of the industrial base which has taken many years to build to gain a short-term deferral of funds so long as the Navy expects to build the ships for which the funds are requested. Once a supplier has left the naval nuclear business, the task of rebuilding the specialized production skills, quality control and engineering groups to meet naval warships requirements is similar in scope to starting over again. Moreover, loss of the industrial base would adversely affect options for future shipbuilding programs and the rebuilding of suppliers to support the nuclear Navy and future shipbuilding programs would be costly and time-consuming. In this connection the Senate Armed Service Committee in its report on the fiscal year 1979 Defense authorization bill [Report No. 95-826] directed the Navy to study alternative attack submarine shipbuilding programs and advise Congress by February 1, 1979, of its plans to maintain an attack submarine force level of not less than 90 submarines. It is anticipated that even with a 30-year life for attack submarines, future procurements of attack submarines beginning in the early to mid-1980's will be at a rate of approximately 3 submarines per year to maintain the force level of 90 attack submarines. With this building rate and with the anticipated continuation of construction of ballistic missile submarines it is important to maintain an industrial base capable of supporting these future shipbuilding programs [End of insert.]

PERSONAL VIEWS OF WITNESSES

Mr. DAN DANIEL. Mr. Chairman?

The CHAIRMAN. Mr. Daniel?

Mr. DAN DANIEL. May I make an observation and recommendation?

I was very much impressed with the approach that the admiral took to his testimony today, because many witnesses from DOD have been so reluctant to testify and give their own opinions.

I would like to quote two sentences from his introduction and recommend that you talk to the Secretary of Defense and see whether or not we can't get the other witnesses to use this same disclaimer to give us the information which they honestly believe to be true.

The admiral says, "In some of my remarks I may express views contrary to those of some of my superiors." And then he said, "I claim no superior wisdom. I make no claims that my views are right and theirs are wrong. As I have in the past, I will give you my personal and professional views based on the information available to me and leave it to you to make your judgments as you see fit."

It seems to me that we would be at a great advantage if we could get other witnesses from DOD to take that same approach.

Admiral RICKOVER. You will not, sir.

Mr. DAN DANIEL. We can request it, Admiral.

Admiral RICKOVER. You can request it, but you will not get it.

Mr. DAN DANIEL. I can't disagree with that. But at least we can go on record as saying that is the way it ought to be done.

Admiral RICKOVER. You are still young and hopeful, sir.

Mr. DAN DANIEL. We are going to keep trying.

The CHAIRMAN. Thank you very much, Admiral.

Mrs. Byron, anything further?

Mrs. BYRON. No.

The CHAIRMAN. Thank you very much.

And we certainly appreciate your cooperation.

Admiral RICKOVER. Mr. Chairman, I would like to say something, too.

One can talk about deep gratification, and so on, but I want to talk in a more heartfelt way, because I see so much going on in this country. I know that ultimately we have to depend on people like we have right in this room to protect this country, and the country needs protection. You are the only ones that can do it.

When you try you may not succeed, but it is the mark of a true man anywhere, regardless of whether he succeeds or not, he keeps on trying.

I hope that you will keep on trying. I am not sure that you are going to be successful. No man can do that. But if you try, then you can't blame yourselves.

If you value my advice, that is all I can tell you. That is how I operate. I don't make out—I try my best, and then I can't blame myself. Then I start in thinking hard, why didn't I get the thing, why?

I try philosophically to reason it out. Sometimes I can't blame myself, but I can't run this country. Neither can any of you run this country. But you can do your best. And that is adequate, when you do the very best you can.

[The following questions were submitted to the witness to be answered for the record:]

PROBLEMS IN GOVERNMENT

The CHAIRMAN. Admiral, you have commented in previous testimony on some of the problems you face in how the Government is run. Would you give us your current views?

Admiral RICKOVER. I have been involved in Government work in one capacity or another for over 55 years. In that time, I have been involved in literally thousands of battles, not of the warlike variety, but of the technical and bureaucratic kind. I have seen the evolution of our Nation for over a quarter of its existence and through a period where the Federal Government has become a dominant force in virtually every facet of national and personal life. I regretfully must say that I am pessimistic and deeply troubled over the state of the ability of our Government to function effectively.

I have testified on many occasions regarding the growth of management and systems analysis concepts within the executive branch. This approach to Government has now been institutionalized to the point of being pseudoreligious in nature, and you know how difficult it is to argue against religion. In the Department of Defense, the agency with which I am most familiar, we have an extensive hierarchy of practitioners of this cult. There is little that can be done without conforming to their systems, talking in their jargon, and being subject to their form of operation that anesthetizes all but the most determined individuals. In my organization I have people who must devote time to the problem, because to survive we have no choice. But for the technical work I am responsible for I ignore these system analysts and management fantasies, and deal in facts. I try to insulate my technical work from what the Government systems require, or it would not get done effectively, if at all.

The question of how Government is working internally is really connected to a much larger issue, and that is the creation of more and more laws that direct every facet of Government activity. When you take into account the kinds and numbers of laws that have been passed in the last several decades, and on top of that add the kind of bureaucratic implementation that results from people who are briefly in Government with no feeling of long-term responsibility, is it any wonder the public is disaffected with Government? How can you expect them to like something that is out of control. The burden on Government in trying to cope with this legislative deluge has reached crisis proportions. I do know that I and most of my people have little time any more to focus on our technical work. We are required to respond to an endless stream of demands stemming from poorly conceived laws and, even worse, their bureaucratic implementation.

Let me give some examples of what I am talking about. In 1969, the National Environmental Policy Act [NEPA] was passed which, among other things, established a requirement that any significant Federal action must be preceded by an environmental impact statement. The inclusion of this seemingly simple requirement has had a tremendous impact on the efficiency of Government. It has cost the

public many millions of dollars in administrative effort and greatly complicated Government actions. With interpretation rendered by Government administrators and the courts, the environmental impact statement provision has become unbelievably complex and onerous. It provides a means whereby small special interest groups can sharply curtail the ability of the Government to carry out productive work. It has also gone far beyond just the impact statement aspects, to the point where a multiplicity of other documents, plans, and systems have been created, further burdening the process of Government.

A project I am responsible for is the light water breeder reactor, a reactor that we are trying to show can produce more new nuclear fuel than it uses. We had designed a test core to put into the Shippingport Atomic Power Station, the Nation's first central station nuclear power station in operation since 1957. The purpose of the core was to see if this concept would work and thus possibly provide an energy resource which has heretofore not been available. We had prepared an environmental assessment that showed there was no significant impact, certainly none different than the proven record for cores operated there before.

Because of interpretations of court decisions by the Atomic Energy Commission, we were required to prepare an extensive environmental impact statement. The statement could not just deal with the test core alone; it had to address all aspects of the fuel cycle for such a reactor, and we had to predict into the 21st century applications of such a reactor industry. We had to do this even though the purpose of the test was merely to determine if a technical concept would work. As a result, we spent approximately \$2 million on this effort, conducted a public hearing, and produced a five-volume statement of something like 4,000 pages. All of this effort did not change the validity of the brief environmental assessment of the effect of what we planned to do. It only caused delay and cost a great deal. It also diverted many of my most talented people from their primary responsibilities, which hardly served the public good.

In contrast, the original Shippingport plant, the first plant in the world designed as a central station atomic powerplant, was operating in 4½ years. I chose the site and the utility to operate it; I built it and have been responsible for the operation of the reactor. It has been operating for 21 years with no real problems, and has certainly not been an environmental problem. Today, it would take about 12 years, involve many Federal and State regulatory bodies, tons of paperwork, and a huge organization to build this plant if it could be built at all.

In pointing this out, I am not saying I am opposed to taking environmental matters into account. I am concerned with the environment and have always incorporated such considerations into my work. That was why I did not need to alter the LWBR project just because we had to prepare an environmental impact statement.

Whenever we deal with what are essentially technical issues by creating a system that depends on paper and bureaucratic manipulation, and do not rely on the judgment of responsible people, effective government suffers. I take full responsibility for my work and expect to be held accountable for it. I don't need a bureaucratic system to

force me to meet my responsibilities. Government should not be predicated on this approach either. I can point to no useful effect in my work, of all this vast bureaucratic system that has become involved. It has resulted in delay and much added cost.

Another example of what I consider undesirable legislation is the Freedom of Information Act. This act was passed with the good intention of providing citizens with more direct access to Government information. Again, the result is reams of regulations, expenditure of a massive array of administrative and legal effort and less effective Government for the tax dollar. I believe an honest appraisal of the Freedom of Information Act would show that its primary effect is to serve business and private interests groups in obtaining information to serve their own purposes. Purposes, I might add, that are often contrary to the public good. For example, the act is being used by companies to obtain information when they are involved in litigation with the Government. This allows the company to avoid normal court discovery procedures—an opportunity not available to the Government.

As another example, a company that is being investigated by a grand jury for potential fraud has submitted a sweeping Freedom of Information Act request in an attempt to obtain documents that may be the basis for the grand jury's deliberation. The cost to the Government to locate, review, and release the requested records will be much higher than can ever be recovered and will divert senior people from other important technical duties. Yet, because of the law, the Government has no choice but to respond to this request. That this law is onerous is evident, I think, in the fact that the Congress did not choose to apply its provisions to the legislative or the judicial branch. If such a law is needed, I find it hard to reconcile that it should apply only to the executive branch of the Government.

When Congress decided in 1970 that additional Department of Labor involvement in the occupational safety and health field was needed in the private sector, it recognized that most Federal agencies already had occupational safety and health programs for their own employees. To avoid unnecessary duplication and the bureaucratic haggling which would result if one Federal agency, the Department of Labor, was given control over programs in other agencies, the Occupational Safety and Health Act was written to specifically exclude Federal employees from most of the Department of Labor regulations under the act. Instead, the Federal agencies are required by the law to have their own safety and health programs. In recent years, however, the Department of Labor has been attempting to expand its influence over the programs of other Federal agencies. In recent months this has reached the point that the Department of Labor is pressing for a new Executive order to give itself virtually the same control over Federal agency safety and health programs that it exercises in the private sector.

A final example of a law that has been administered beyond recognition is the workmen's compensation provisions of the Federal Employees Compensation Act. Certainly Congress never intended to pay compensation for injuries sustained by Federal employees engaged in recreational activities on their lunch hour. Nor can I believe that Con-

gress intended to prohibit Federal agencies from appealing compensation decisions, made by the Department of Labor, which they consider wrong or to allow an employee to refuse to be examined by a Government doctor and still be paid compensation. But the way the law is being administered each of the things I have just cited is happening.

I could go on with other examples where we are trying to solve our problems with laws. Is it any wonder the courts are ruling on issues never before dealt with by the legal system? The result is a proliferation of requirements, regulations, agencies, and layers of bureaucrats that are destroying effective Government as certainly as an avalanche destroys everything in its path.

The advent of laws has been a crucial factor in the creation of our Western culture and a significant step forward from barbarism. But the use of laws to control our society cannot be limitless without creating an anarchy of its own. It is that anarchy that we are rapidly approaching. Soon the only useful profession will be as a lawyer.

I realize I am addressing a very broad subject and that solutions to such complex matters are not easy. However I have two suggestions:

1. Congress should stop passing so many new laws, particularly if they establish entirely new areas of legislation, create broad new Government programs, or deal in special interests. If such laws are passed they should include a self-canceling provision so that Congress would be forced to reevaluate and reenact them periodically.

2. Rather than passing more laws, Congress should use its oversight function to focus on how well existing laws are being implemented and how well Government officials are carrying out their responsibilities. If it finds that laws are not effective or not needed they should be repealed. If they find, as indeed they will, that Government officials are not carrying out their responsibilities, they should require replacement with someone who can do the job. The solution should not be to pass more laws, establish new agencies, or add more layers of managers, systems analysts, and lawyers.

EXCESS FLAG OFFICERS

The CHAIRMAN. Admiral, in testimony before the Senate, I believe you expressed a view that there are too many general, flag officers in the military and that a reduction is necessary. The Congress took some action in this regard by asking the Department of Defense to submit a report to Congress. Can you provide an update on what is happening on this subject?

Admiral RICKOVER. Yes, sir. In April 1977, I testified before Senator Nunn, who is chairman of the Senate Subcommittee on Manpower and Personnel of the Committee on Armed Services. At that time, I recommended a reduction in the overall flag, general officer strength of 10 percent per year for the next 5 years. I also identified the methods that could be used for reduction and recommended a realignment of the number of officers in the various services so they would be proportional to the overall military strength of that service.

As a result of the actions of that committee, the Defense Department Authorization Appropriation Act of 1978 contained a require-

ment to reduce the number of flag, general officers from the fiscal year 1978 total of 1,141, to 1,073 by October 1, 1980. In addition, the following was included in the DOD Appropriation Authorization Act of 1978 conference report:

The conferees agree on the need for a process to enable Congress and the Department of Defense to develop criteria for an ongoing review of the number of general officers and directs the Secretary of Defense to submit a report with the fiscal year 1979 military authorization request on the required numbers of general officers as well as any justification for deferring the proposed military and civilian reduction in whole or part.

Last year a report entitled "Secretary of Defense Report of General and Flag Officer Requirements—April 1978" was prepared and, as best I can tell, sent to the Senate Armed Services Committee. I really do not know what has happened since then. You might have Mr. Ford or someone else check with the staff of the Senate Armed Services Committee to find out what they have done. I would be interested in knowing myself, because I have not heard of any sizable reductions in flag/general officers under consideration within the Navy.

PROBLEMS IN RECRUITMENT AND RETENTION

The CHAIRMAN. All the services are having problems meeting their recruiting and retention goals. I would assume this would be an even greater problem for the nuclear Navy because your standards must be higher. Can you tell us how you are doing and what needs to be done?

Admiral RICKOVER. Yes; we are having a problem not only in recruiting, but in retention. I will discuss recruiting first.

It must be recognized that the nuclear field program is the No. 1 priority Navy recruiting program; however, in spite of this priority, nuclear recruiting attainment has fallen successively further below requirements over the past 3 years. In fiscal year 1978, we attained 95.4 percent of our goal. This same level or higher must be attained for fiscal year 1979 if fleet manning reductions are to be avoided in 1980 and 1981. Early indicators for fiscal year 1979 are not a cause for optimism as only 76.9 percent of the goal to date has been achieved. Every possible initiative I can give to the recruiting program is being provided.

In September 1978, the Navy proposed to the Department of Defense an enlistment bonus program which included recruits in 17 ratings and in the nuclear field. This program will provide a \$2,000 bonus upon enlistment for most of the 17 ratings and will pay the \$2,000 to nuclear field personnel upon completion of 1 year of nuclear training. I discussed the enlistment bonus plan with Mr. Duncan, the Deputy Secretary of Defense, and, at his request, provided him my comments in writing. This came as the result of one element of the Department of Defense stating its intentions to approve the Navy enlistment bonus program, with the nuclear field personnel excluded. This would have had only one effect, a bad one, on recruiting of people for the nuclear program. I understand that now Mr. Duncan has approved the enlistment bonus plan to include the nuclear field. This is the correct approach and hopefully one which will result in some improved ability to recruit people for the nuclear program as well as the 17 other ratings.

I am not in a position to claim the enlistment bonus will or will not work. I do know that we must do whatever we can to attract good people into the nuclear Navy. If this takes an enlistment bonus, then we should do it. The cost, about \$4.4 million annually, is insignificant when compared with the consequences of not having enough qualified people.

Our recruiting goals are determined by a combination of many factors. One of the most significant factors in this calculation is the retention rate of our experienced personnel. In this area as well as recruiting, we have a problem.

To provide a proper sea-shore rotation plan for nuclear enlisted personnel, we need to reenlist 55 percent of our trained personnel at the earliest opportunity and we must retain 65 percent of these men when they become eligible for a second reenlistment. Despite the implementation of several reenlistment incentives in recent years, we have only succeeded in stabilizing our retention rates at approximately 45 percent for first and second term reenlistments. With your help, the incentives of selective reenlistment bonuses have prevented lower reenlistment rates from occurring. As I have testified previously, a nuclear trained person, whether he is an officer or a sailor, can leave the Navy and get more salary, either in commercial powerplants or in nuclear-related industries. I would like to emphasize the fact that few young people actually enlist into the nuclear field with a Navy career in mind. Therefore, it is imperative that we maintain financial incentives for our nuclear trained operators in order to retain these men that the country has invested so much in and expects so much of.

At present, our most serious retention problem exists with those men who are reaching the end of their obligated service having spent 10 to 14 years in the Navy. As recently as 1975, we were retaining more than 80 percent of these men. A steady and dramatic decline in the reenlistment rate of these men has occurred in subsequent years. Specifically, only 33 percent of these highly trained and experienced operators reenlisted in 1978. One of the major causes for this low reenlistment rate is obvious, and it is financial in nature. These men are faced with a pay inversion as they complete their second reenlistment, since financial incentives terminate at that point in their careers. To put it into financial terms, each man takes a pay cut of \$3,750 annually. It would take this individual in excess of 5 years of service before he could regain the standard of living to which he had become accustomed while receiving his reenlistment bonus.

For this reason, a Chief of Naval Personnel initiative was proposed in June 1978 to create a third selective reenlistment bonus [SRB] eligibility zone to help stem the declining reenlistment rate of career nuclear petty officers. This proposed zone "C" SRB will be applicable navywide, but initial eligibility is programed for nuclear enlisted personnel only. The Chief of Naval Operations favorably endorsed this proposal in December 1978 and has recommended submission to the 96th Congress. I cannot stress enough how important this proposal is. To underline this requirement, one must realize that at current nuclear training attrition rates and retention rates, the loss of each potential zone "C" reenlistment requires an additional 20 recruits to fill the vacancy. By this I mean that of 20 nuclear field recruits today, only

1 will remain in the Navy as a nuclear operator beyond 12 years of service. Passage of zone "C" selective reenlistment bonus legislation by Congress is an essential requirement if we are to continue to properly man our nuclear-powered ships.

RETENTION OF NUCLEAR-TRAINED OFFICERS

The CHAIRMAN. I understand that both the Navy and Air Force are having difficulty in retaining aviators. I'm sure that your nuclear-trained officers have an equally marketable skill in the civilian business world. Would you provide us your comments in regard to the retention of nuclear-trained naval officers?

Admiral RICKOVER. As you know, the Congress passed the nuclear bonus legislation in 1976. Although there has been a slight improvement in the retention of nuclear-trained officers, it has not yet accomplished what we hoped. Currently, 81 percent of all nuclear-trained officers are at sea. This is a reduction of 4 percent from last year. In fiscal year 1978, the retention of junior officers was 38 percent, an increase of 2 percent over retention of junior officers in fiscal years 1976 and 1977. A minimum retention of 40 percent is necessary to reduce to an acceptable level the arduous sea-duty cycle.

In 1978, the 95th Congress approved legislation to continue spot-promotion authority for line officers serving in lieutenant commander billets as engineer officers and in certain other key engineering billets onboard nuclear ships. The spot-promotion program is a low-cost retention incentive (about \$1,000 annually for each officer) which justifiably recognizes these selected high-performing young officers who are serving in our more difficult and responsible jobs.

When spot-promotion authority was discontinued in 1972, it was followed by a decline in retention of nuclear-trained officers. We cannot afford to have this happen again. The inherent responsibility in these selected engineering billets, the training required, and the number of officers and men working in the engineering department warrant lieutenant commander seniority for officers in these billets, but there just are not enough lieutenant commanders available. For example, in the nuclear submarine community, there are 104 of 164 engineer officer billets currently being filled by spot-promoted lieutenant commanders. A similar situation exists in nuclear surface ships. The current spot-promotion legislation expires on September 30, 1979. Legislation has been prepared to extend this spot-promotion authority through fiscal year 1981. Adoption of this legislation is essential to retain sufficient high quality officers to fill these demanding billets.

Current nuclear officer bonus legislation (nuclear officer incentive pay) expires on September 30, 1981. As I have already stated, the requested extension of spot-promotion legislation also terminates at the end of fiscal year 1981. This situation will provide an opportunity to review the entire program of nuclear officer incentives. There is a need to increase the amount of the nuclear officer bonus to offset inflation during the 5-year period between its adoption in 1976 and its renewal in 1981. The annual incentive bonus should be increased if it is to continue to be a viable alternative to civilian nuclear salaries. You have understood the necessity for these nuclear officer incentive pro-

grams in the past and have provided the support we have needed. Your assistance will again be needed during the next 2 years to gain congressional approval of an updated incentive package. As I have said before, if we decided it is important to keep the nuclear ships operating, we should pay what it takes.

I am also very concerned with our chronic inability to bring adequate numbers of officers into the nuclear program. The total number of volunteers has increased annually but still remains below our needs. In fiscal year 1978, for example, the accession goal for officers into the nuclear program was 781, and we only achieved about 75 percent of this goal. As you know, we get our officers from three sources: U.S. Naval Academy, NROTC, and the Officer Candidate School (OCS). In order to have a viable program such that there is a reasonable sea-shore rotation, we need about 830 officers going into nuclear training. Last year, the Navy procured 6,314 officers, which means we need about 13 percent of them in the nuclear program. While there are concerted efforts within the Navy to meet these goals, I find it difficult to understand why officer accession programs do not reflect this need. In my opinion, the Naval Academy and NROTC programs must be geared to meet the needs of the Navy first, with other considerations following. Ever since the nuclear program came into existence, we have fallen short of our needs. Yet each year, I see actions proposed and taken, that impede our ability to meet these needs. For example, there is a current effort underway to do away with the requirement for 80 percent of NROTC students to take their majors in either engineering, science, or math. While it is possible to train an NROTC graduate who has majored in liberal arts, the likelihood that he will volunteer and then successfully pass our course is much reduced from that of the engineering/science/math major. I have more to say on this subject; however, it again represents a situation where people in newly acquired positions of authority, use that authority to force their own ideas onto the Navy without understanding the impact.

In the long run, it may take action by the Congress to force the Navy to put its resources where they are needed. It does not give me much satisfaction to make such a recommendation, but it may be the only recourse.

The one area in which I think Congress should be firm is in not allowing the standards of acceptance to be lowered. I am constantly chided that we could meet our officer and enlisted goals if I would just lower the standards.

I cannot do that, and I am sure you would not want me to.

WOMEN IN THE NUCLEAR PROGRAM

The CHAIRMAN. I have seen newspaper accounts on the Navy using enlisted women in the nuclear program. Could you tell the committee how that is going and how the Navy intends to use these women?

Admiral RICKOVER. Women are a personnel resource that we should use, where we can, to improve the Navy's ability to meet manning requirements. This must be done with care to avoid the undesirable situation in which men, after having spent years at sea, find they

have no place to go ashore because all of the shore jobs are filled by women. We must guard against even the perception that this could occur because of its possible effect on recruiting and retention of our nuclear-trained men which we must have to man our ships at sea.

The Navy began enlisting women into the nuclear field effective January 1, 1979, and approximately 75 women have been recruited for the nuclear program as of the end of February 1979. The fiscal year 1979 recruiting goal for women in the nuclear field is 225 compared to the total fiscal year 1979 nuclear field recruiting goal of 5,820. Women for the nuclear program are currently being enlisted into the electronics technician [ET], electrician's mate [EM], and interior communications [IC] ratings. The Chief of Naval Operations has directed that no women are to be recruited into the machinist mate [MM] rating Navy-wide until the issue of sea-shore rotation is resolved. Approval by the CNO to extend nuclear field enlistments to machinist mates is anticipated.

The nuclear field enlistment standards for women applicants are the same as those for men. Also, nuclear power program training and qualification requirements for women and men are the same. Upon graduation from Nuclear Power School and qualification as a nuclear propulsion plant operator at one of the nuclear power training units, women nuclear operators will be assigned to operational nuclear billets at one of our three prototype sites, one of several nuclear capable submarine or surface ship tenders, or at a nuclear shore support facility. Consideration is also being given to the possibility of using some women nuclear operators in nuclear ships that are in shipyards for long overhauls.

I do not know how well women will do in the nuclear program. I don't have any doubt that they can do as well as the men in handling the academics. I also think they can do as well in operating the plants. However, I do have concern in their ability to handle the maintenance and repair aspects which involve many long and hard hours of work. That type of work is not very appealing and we'll just have to see how it goes. I do intend that women be introduced into the nuclear program in a sensible manner and that every reasonable effort be made to realize the benefits from this new source.

NAVAL OFFICER EDUCATION

The CHAIRMAN. Admiral, I know that you are very concerned about education in general and in particular, the state of education in the Navy. Could you give us your views on where the Navy stands in regard to naval officer education?

Admiral RICKOVER. I would like to address several aspects of naval officer education because of their importance in relation to the Navy's ability to operate the ships. To start with, there is a need to review the entire subject of naval officer education in order to establish a coordinated and cohesive program that will provide the Navy with what it needs to carry out its assigned missions. Such a review program does not exist today.

The Navy will be facing a situation over the next decade or so where the number of ships and personnel will continue to decline while

its commitments will either remain constant or possibly increase. Fiscal restraints will be forcing the Navy to extend the useful life of its ships. Acquisition and retention of its personnel show no signs of improving, while the tempo of fleet operations continues at a steady pace. All of these factors put an increasing burden on the officer corps of the Navy. The question is, is the Navy doing what it needs to do with its officers in order to handle this situation? In my opinion, the answer is, no.

The naval officer education aspect of this problem encompasses pre-commissioning education such as Naval Academy and NROTC, post-commissioning education such as PG School and the Naval War College, and all other elements relating to professional education and training of naval officers.

There is a tendency within the Department of Defense, Office of Management and Budget, and Congress, in their attempts to review this matter, to compare how each of the three services, Army, Navy, and Air Force, handle their programs. Such comparisons are not meaningful especially where the Navy is concerned. Ships are required to deploy in peacetime as well as during wartime. Maintenance of ships and their equipment presents a far greater task than for the other services. Naval officers must be able to operate and maintain their equipment (ships) for longer periods of time in an unfriendly saltwater environment. The Navy's education and training program must be geared to that situation. In peacetime, the Army has a completely different problem and can afford the luxury of having large numbers of officers detailed into various educational programs. This is also true of the Air Force. The Navy, in order to meet its deployment commitments, must have more of its officers educated and trained to handle technical problems than the other services. Maintaining ships and ship's equipment is a complex technical task unique to the Navy.

In order to maintain its required end strength, the Navy obtains some 7,000 officers per year. These officers come primarily from the Naval Academy, NROTC, and OCS. In varying degrees, the Navy has some control over how these officers are educated; that is, the curriculum, staff, and so forth. After commissioning, the Navy has complete control over the education and training of these officers, both in specific programmatic needs such as flight training, nuclear propulsion, and so forth, and in more general terms such as Post-Graduate School and the Naval War College. I see no evidence of any thoughtful approach to linking all of these into a directed program which best supports the needs of the Navy.

This is not due to a lack of a policy within the Department of Defense or Navy, rather a failure to implement. There are several reasons why the policy is not being implemented. They are:

1. *Lack of single person responsibility.*—There is no single person in the Navy who has the overall responsibility for establishing and enforcing the Navy's entire officer education and training program. As it stands today, that responsibility is shared and diffused among various senior officers and members of the secretariat. One element contributing to this is the universal feeling that anyone can be and is an expert on education. Thus, many officers within the Navy exercise "control" over officer education and very few, if any, have a real

understanding of the problem or how to solve it. The result is constantly changing directions, a plethora of studies, and much finger pointing.

2. *Lack of continuity of management.*—In addition to there being no single person responsible, the constant rotation and changing of people contributes to the lack of a consistent program. As the top people change, the program changes. Each new "manager" wants to prove that he is in charge and that he is an expert. Even a well-thought-out program does not get a chance to function because some newcomer invariably comes in and changes it. The experience at the Naval Academy during the 1960's and early 1970's is a classical example of this problem.

3. *Lack of validated requirements.*—For years there have been requirements for the Navy (and all services) to establish their educational needs for officers in both curriculum and degree level. This was done by coding each officer billet in the Navy to a specific specialty and college level such as master's degree in electrical engineering. The responsibility for this determination has been generally left up to the individual commanding officers or program directors. The result is overinflated and unrealistic requirements. Most commanding officers will indicate a need for more highly educated officers than they could ever justify or use on the basis of the job, but will do so in order either to inflate the importance of their own job, or in the hope that they will get better officers. For example, there are very few, if any, officer billets in the Navy that require a Ph. D. A realistic review of the Navy's requirements by a knowledgeable and objective person would certainly show up the absurdity of the billet coding system.

4. *Lack of understanding of purpose.*—Those in responsible positions in the Navy lose sight of the true purpose of naval officer education. For example, much of the reasoning behind the Navy's post-graduate program rests on the desire to improve retention and enhance recruitment. While these may be beneficial side effects, they often become the single most important driving force. The same is true in the NROTC program and at the Naval Academy. Any attempt to bring these programs in better line with the Navy's need is met with the argument that it can't be done because it will affect recruitment or retention. Obtaining well-educated and better qualified officers to do their job seems to be a secondary consideration.

5. *Use of outside consultants.*—Very often policy is shaped and programs are redirected by outside consultants whose claim for expertise is a large staff of social scientists posing as experts in the field of education.

The results of these studies become almost sacred, making it impossible to counter their specious arguments and data. Their thick reports are couched in the unintelligible words of their own trade, and in most cases are only serving their own interests. Seldom do they have any direct knowledge of what they are studying.

6. *Over-reliance on faculty input.*—Throughout the Navy's educational program too much reliance is placed in the hands of the faculty at the various institutions of learning. Generally, any professor, in order to justify or enhance his position, will create new courses, new ways of teaching, or novel ideas on what a naval officer needs to know.

If the curriculum is not tightly controlled these new courses will be added while other more important courses are dropped. To achieve this the professor will usually convince enough students to take the course, and if he grades it sufficiently easy, other students will quickly sign up and the course is thus established.

In addition to the problems I have enumerated above there are a number of points that are relevant to specific elements of the Navy's educational program. These are:

1. *U.S. Naval Academy*.—Over 3-years ago a number of meaningful and proper changes were made at the Naval Academy as a result of the efforts of the Chief of Naval Operations, the Chief of Naval Personnel, and the Superintendent. First, a definitive CNO policy regarding the Naval Academy was promulgated. This clearly established the line of responsibility and set down in writing the basic goals. Thus effort has resulted in some improvement in the following areas:

- (a) A number of meaningless majors were eliminated.
- (b) Many unneeded courses were dropped.
- (c) The core curriculum was strengthened and enlarged.
- (d) Academic "freedom" of the faculty was curtailed.
- (e) Course content was established as a requirement.
- (f) Grading was tightened up.
- (g) Incompetent professors/instructors were replaced.
- (h) Childish practices formerly permitted and encouraged have been reduced.

It is important that these changes be allowed to continue and, if necessary, be reinforced. While these changes have brought improvement in certain areas, I am still disturbed over the general lack of academic seriousness I see in the midshipmen I interview. They continue to look upon their 4 years at the Naval Academy as one of playing the role of midshipman; doing the things that distinguish the Academy from a civilian college. There is certainly a reason for doing some of this. However, it is overdone such that academics clearly take second place. In the minds of the midshipmen it is infinitely more important for them to carry out their battalion duties such as mustering, room inspections, et cetera, than it is to spend time studying. They tell me this very freely. The problem is not with the midshipmen. It is with the Academy. These young young people as they enter the Academy are no different than those that attend any college—if anything they are at a higher academic level because of the selection process—yet within a relatively short period of time they are imbued with the philosophy of what is considered important. Unfortunately, to the vast majority of the staff who have direct contact with the midshipmen, it is not academics. Even the academic faculty succumbs to this pressure. What results is a midshipman, after spending 4 years in a supposedly academic institution, who still retains childish attitudes and who has had his thoughts molded into putting wrong priorities on what is important. Somehow this situation needs to be corrected.

I am also concerned about what I see as a trend to again restructure the academics. In this particular case, there is a feeling that history is not adequately being taught to the midshipmen. Let me make it clear that I strongly support the teaching of history at the Naval Academy. It is essential not only there but in any course of higher education. However, the question is one of degree.

At present, two history courses make up part of the plebe year curriculum. In the first semester the plebes take modern Western civilization since 1715, a survey emphasizing the evolution of military institutions and policies. In the second semester, the plebes take American naval heritage, a course which examines the origins and development of the Navy.

I understand consideration is being given to establishing a course on the development of Western civilization. Although originally proposed as an elective, it is now being considered a requirement. The course would examine selected themes from ancient Egypt to the cold war. It is expected that the plebe would learn the origins of his own civilization and recognize that certain moral problems of today have commonality with certain moral problems of the past. The student is expected to read original sources—where possible—and scholarly syntheses. By these means the plebe is expected to become aware of himself in the context of time.

Making the course a requirement for plebes deserves careful thought. In the first year, midshipmen are faced with the difficulties of adjusting to a military institution, learning military routine, and preparing for a military career. It is doubtful whether a course of one or two semesters following a few major themes through recorded history can offer much of substance to midshipmen at this stage of their careers. Even the use of original sources may be less helpful than anticipated. Most of history from ancient Egypt onward was not written in English. Scholarly syntheses might be useful, but scholars are still debating, synthesizing, and disagreeing. It is not reasonable to expect a plebe to grasp the complicated social background of the crisis in the Hellenistic world, the emergency of Christianity, the flowering of the Renaissance, the emergency of capitalism, and the impact of the enlightenment.

Arranging the course around a few themes may lead the plebe to simplistic conclusions. Simple history is bad history, and bad history may lead to results which are the opposite of those intended.

I believe in the importance of history. I am dismayed by the number of officers whom I encounter who do not read history, and I am troubled by the lack of historical knowledge by the midshipmen I interview. Revising the curriculum to make history more general and more sweeping may not be the answer. The difficulty may be in other areas. Perhaps the faculty members of the history department are poorly trained. It may be more is expected of history courses than is possible. Morality and ethics in their broadest sense cannot be taught. They can only be learned. All that any history course offers is a beginning of a quest for knowledge that no lifetime will satisfy. It is important that changes to the first history courses that midshipmen take be weighed carefully.

2. *NROTC*.—The entire NROTC program needs to be reviewed in order to determine if it is serving the needs of the Navy in the most beneficial manner. This review should specifically include the number and quality of host institutions, the method of student selection, the allowed courses and majors, academic standards required, obligated service, and service payback policy for midshipmen who quit. Unfor-

tunately, as I mentioned earlier the reviews of these programs are too often done by outside consultants that do not have any direct knowledge of what they are studying. As you know, I interview each officer candidate for the nuclear program. I am, therefore, afforded the opportunity to compare the product of our institutions in regard to individual academic majors, and I also can compare graduates with the same major from different schools.

There are great differences in the fundamental knowledge level exhibited by graduates in similar majors from different institutions. Graduates from high-quality schools simply have a much better opportunity to successfully complete our course. I cannot help but believe that naval officers from the better quality schools also can be more effectively trained in the other parts of the Navy. Your help may be needed to make sure that NROTC units are not established or disestablished strictly on the basis of cost or on minority affirmative action programs.

Of even greater concern to me is the renewed effort underway to do away with the requirement for 80 percent of NROTC students to major in either engineering, science, or math. Objections in this 80 to 20 plan center on the grounds that it severely limits students not in science-engineering program from successfully completing for a scholarship and discourages their participation in the NROTC.

This misses the point. If we are truly interested in designing the NROTC program so that it supports the Navy's requirements; then we should retain the 80 to 20 mix which will provide a greater base of officers with technical backgrounds. These officers are more likely to volunteer for the difficult technical programs in the Navy and are more likely to pass technical courses of instruction including nuclear power training. For example, over the past 3 years at Nuclear Power School the academic failure rate for students who had majored in engineering, science or math is about 9 percent compared to 24 percent for students majoring in liberal arts. The Association of NROTC Colleges and Universities in conjunction with the Chief of Naval Education and Training is attempting to develop an alternative "core curriculum" for NROTC similar to the Naval Academy "core curriculum". I do not see how this can help but lower our NROTC graduate standards. Any "core curriculum" that has the agreement of the majority of institutions will be at a level of the lowest common denominator. Thus, we will simply bring our strong schools down to the weaker ones. This situation cannot be compared directly with the Naval Academy "core curriculum" where we are dealing with only one school.

The 80 to 20 plan is effective for the graduating classes in 1981. We have not even measured the effectiveness of this program in providing more officers who will volunteer for and successfully complete nuclear-power training. The Navy should not discard the 80 to 20 plan in favor of a "core curriculum" program.

3. *Navy postgraduate education.*—As I have previously expressed, the Navy should reassess how it validates its graduate requirements and adjust postgraduate school input accordingly. Many of the problems that I have cited for naval officer education apply to this program. The Navy's past management of postgraduate education has

been based on policies which tend to reflect personal ideas and interests of incumbent flag officers and periodic study groups. I am amazed that there is, as I understand it, a study recently completed for the Secretary of the Navy that recommends as Navy policy the possession of a master's degree by all career officer personnel by the year 1990. I certainly agree that the educational level of the naval officer corps is not improving and that this stagnation occurs at a time when operation of the Navy is continuing to become more technical. I cannot agree that all naval officers should have an advanced degree. There are many jobs in the Navy that do not require the incumbent to have completed postgraduate education and in fact, such education would not help him to do his job better.

The Congress can help insure that money for postgraduate education is correctly spent by insisting that the Navy determine its real needs for advanced degrees. Graduate level education as a career enhancement incentive or in preparation for a civilian career is not effective use of the public's tax dollars.

4. *Naval War College*.—The Navy should clearly establish the purpose of the Naval War College. After having done so, it must insist that the people running the college carry out that policy and not be allowed to change its direction. Each president of the Naval War College appears to have had a free hand in teaching whatever has suited his own personal desires. You may have read in a recent *Time* magazine the description of a course, "Foundations of Moral Obligation," which is being personally taught at the Naval War College by Vice Admiral Stockdale, the current president of the War College. I certainly am not in a position where I can judge whether this specific course should or should not be taught. It does appear though, to be a very personalized course based upon the background of the Naval War College president rather than one derived from Navy requirements.

I understand that the same study group that advised the Secretary of the Navy concerning postgraduate education for all officers also made recommendations concerning advanced professional education for all senior officers. There is an implication here that attendance at the Naval War College should be given high priority as a prerequisite for flag rank. I see no reason why the presence or absence of advanced education should affect an officer's selection. Promotion criteria should be based on performance.

I hope I have made my position clear on the current state of naval officer education. There is much that needs to be done.

SALE OF REACTOR TO THE PEOPLE'S REPUBLIC OF CHINA

The CHAIRMAN. Would you give us your views on the administration's recent decision allowing the French to sell light water reactors to the People's Republic of China? Why is the United States involved in this matter?

Admiral RICKOVER. A French firm, Framatome, is a licensee of Westinghouse for pressurized water reactors. Because of the licensing arrangement U.S. approval was required in order to sell reactors to the Chinese. While this issue was the subject of interagency review, as far as I know the decision to approve the French effort was the

President's. I believe he approved of it in order to gain continuing support from the French for the U.S. nonproliferation efforts and of course to support the new relationship we have with the Chinese.

My concern in this issue is that we are giving away latest U.S. nuclear technology, much of which originated from the naval nuclear propulsion program. While commercial in nature, it can only provide a foreign power with assistance in applying nuclear power to such applications as nuclear propulsion for nuclear ships. There is no question that the Chinese are seeking these plants in order to obtain the technology and assist in developing their own nuclear-power capability. I'm aware that the President had many factors to consider in making his decision and I would not second-guess him. However, it should be recognized that there is a military aspect to this kind of assistance.

Another aspect is the direct U.S. participation in this kind of activity. If we are going to let the French export U.S. technology it does not make much sense to me not to allow U.S. manufacturers to do so directly.

I understand because of nonproliferation laws, U.S. exports in this area are not currently allowed. This does not seem logical and I think we should correct this situation. Of course such activities, if allowed, would require careful structuring and monitoring to insure our naval nuclear propulsion technology is protected.

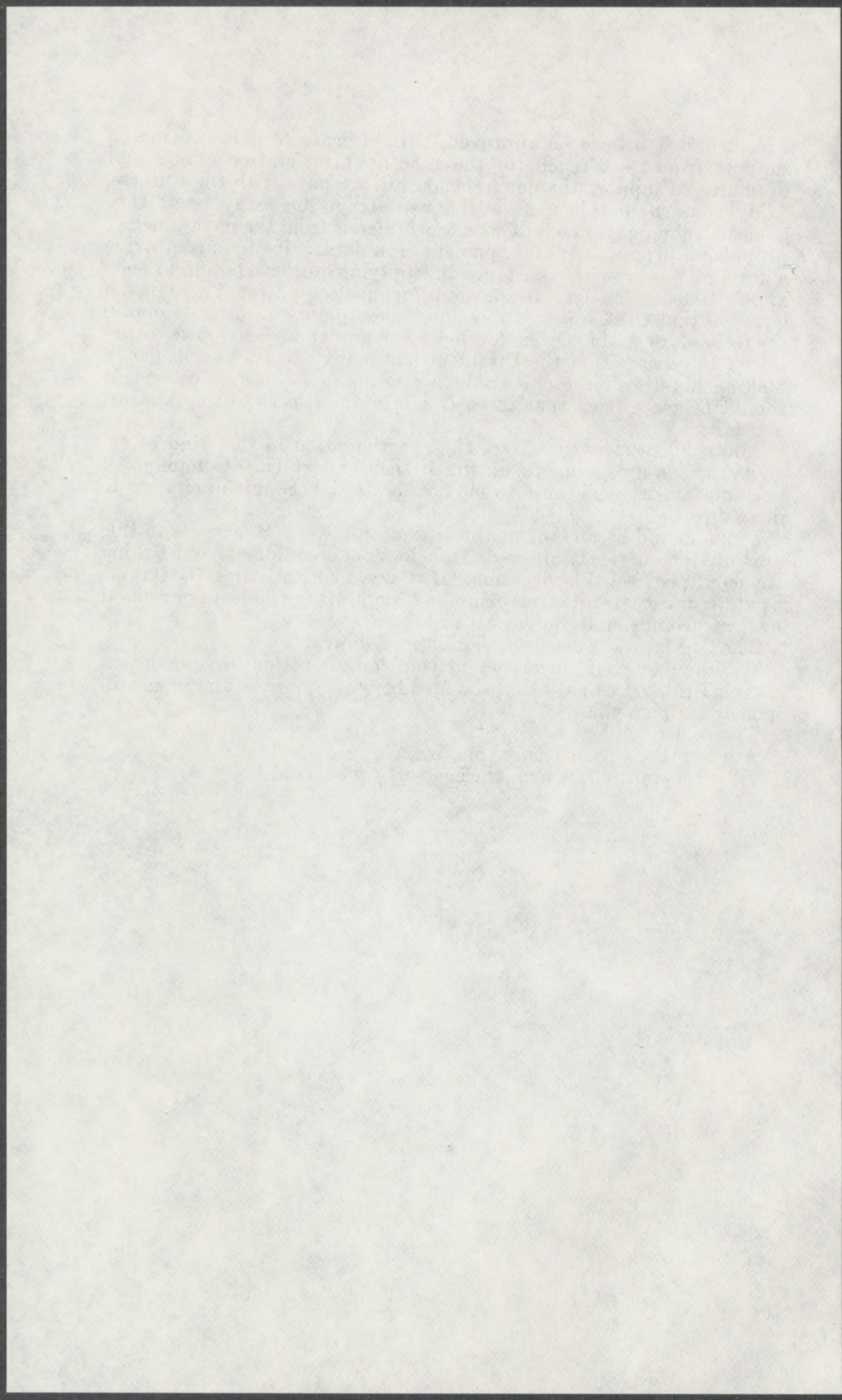
The CHAIRMAN. Very well, thank you, Admiral.

We know of your sincerity and your long devotion to your duties. And I think I can say that the Members of Congress almost unanimously support you.

Thank you.

Admiral RICKOVER. Thank you, sir.

[Whereupon, at 3:55 p.m., the hearing was concluded.]



APPENDIX 1

OCCUPATIONAL RADIATION EXPOSURE
FROM U. S. NAVAL NUCLEAR PROPULSION PLANTS
AND THEIR SUPPORT FACILITIES
1978

Prepared by

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SUMMARY

Radiation exposures to Navy and civilian personnel monitored for radiation associated with U. S. Naval nuclear propulsion plants are summarized in this report. Navy personnel manned thirteen tenders, two submarine bases, 113 nuclear-powered submarines and eleven nuclear-powered surface ships which were in operation at the end of 1978. Nine shipyards were engaged in construction, overhaul, and refueling of these ships. The benefits of nuclear propulsion in our most capable combatant ships have long been recognized and our nuclear-powered ballistic missile submarines form the most invulnerable element of the United States strategic deterrence.

Figure 1 shows that over the last dozen years the total radiation exposure has been reduced to about one quarter of the amount in the peak year of 1966 even though the number of nuclear-powered ships nearly doubled during that period. Total man-rem in this figure is the sum of the annual exposures of each person monitored for radiation.

No civilian or military personnel in the Naval nuclear propulsion program have exceeded the Federal limit which allows five rem exposure for each year of age beyond age eighteen. Since 1967 no person has exceeded the Federal limit which allows up to three rem per quarter year, nor in this period has anyone exceeded the Navy's self-imposed limit of 5 rem per year for radiation associated with Naval nuclear propulsion plants.

No civilian or military personnel in the Naval nuclear propulsion program have ever received more than one tenth the Federal annual occupational exposure limit from internal radiation exposure caused by radioactivity associated with Naval nuclear propulsion plants.

The average occupational exposure of each person monitored has been about one quarter rem per year. The total lifetime exposure from radiation associated with Naval nuclear propulsion plants to date for all personnel monitored since 1954 has averaged about one rem per person.

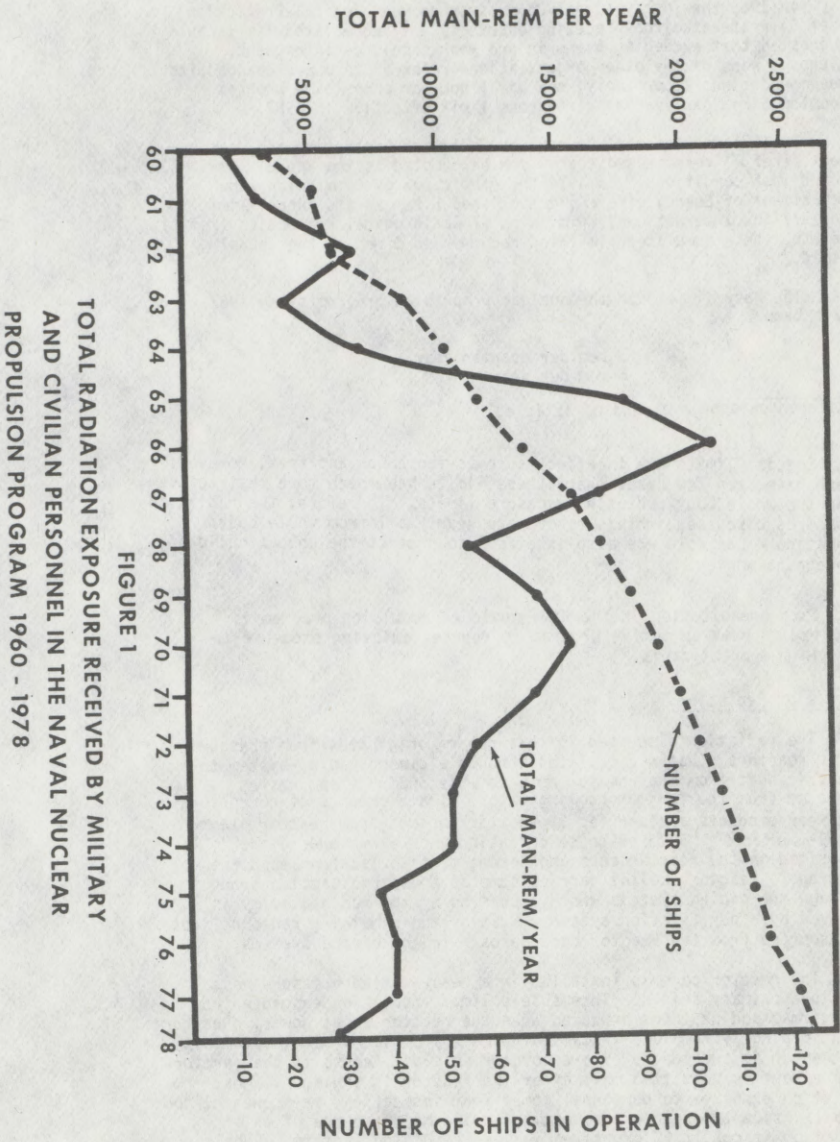
According to the standard methods for estimating risk, the risk to the group of personnel occupationally exposed to radiation associated with Naval nuclear propulsion plants is less than the risk these same personnel have from exposure to natural background radiation or to medical radiation. This risk is small compared to the risks accepted in normal industrial activities and it is small compared to the risks regularly accepted in daily life outside work.

EXTERNAL RADIATION EXPOSURE

Policy and Limits

The policy of the U. S. Navy is to reduce to as low as reasonably achievable, exposure to personnel from ionizing radiation associated with Naval nuclear propulsion plants.

The radiation exposure limits used in the U. S. and abroad for whole body radiation exposure are 3 rem per quarter year, and 5 rem accumulated dose for each year beyond age eighteen. These limits were recommended in 1958 by the U. S. National Committee ("Committee" was changed to "Council" when the organization was chartered by the U. S. Congress in 1964) on Radiation Protection and Measurements (ref 1) and by the International Commission on Radiological Protection (ref 2). They were adopted by the U. S. Atomic Energy Commission (AEC) and applied both within the AEC and to licensees in 1959 (ref 3). The U. S. Federal Radiation Council recommendation that these be used as guidance for Federal agencies was approved by President Eisenhower May 13, 1960 (ref 4). The U. S. Department of Labor adopted these same limits. A key part of each of these standards has been emphasis on minimizing radiation exposure to personnel.



In 1965 the International Commission on Radiological Protection (ref 5) reiterated the preceding quarterly and accumulated limits but suggested that exceeding 5 rem in one year should be infrequent. Although none of the other organizations referred to above changed its recommendations accordingly, the Naval nuclear propulsion program adopted 5 rem per year as a rigorous limit effective in 1967.

In 1971 the National Council on Radiation Protection and Measurements (ref 6) recommended that 5 rem be adopted as the annual limit under most conditions. In 1974 the Atomic Energy Commission (now Department of Energy) (ref 7) established 5 rem as its annual limit. In 1977 the International Commission of Radiological Protection (ref 8) deleted the accumulated limit and recommended 5 rem as the annual limit.

The Navy limits for the nuclear propulsion program since 1967 have been

3 rem per quarter year
5 rem per year

References appear at end of article.

Special limits are in effect such as for hands and feet, however, there have been few cases where these limits have been more restrictive than the whole body radiation exposure limits. Therefore, the radiation exposures discussed in this report are nearly all from whole body radiation. Controls are also in effect to protect the unborn child of a pregnant worker.

Each organization in the Navy nuclear propulsion program is required to have an active program to reduce radiation exposure to the minimum practicable.

Source of Radiation

The radiation discussed in this report originates from pressurized water reactors. Water circulates through a closed piping system to transfer heat from the reactor core to a secondary steam system isolated from the reactor cooling water. Trace amounts of corrosion and wear products are carried by reactor coolant from reactor plant metal surfaces. Some of these corrosion and wear products are deposited on the reactor core and become radioactive from exposure to neutrons. Reactor coolant carries some of these radioactive products through the piping systems where a portion of the radioactivity is removed by a purification system. Most of the remaining radionuclides transported from the reactor core deposit in the piping systems.

The reactor core is installed in a heavy-walled pressure vessel within a primary shield. This shield limits radiation exposure from the gammas and neutrons produced when the reactor is at power. Reactor plant piping systems are installed primarily inside a reactor compartment which is surrounded by a secondary shield. Access to the reactor compartment is permitted only after the reactor is shutdown. Most radiation exposure to personnel comes from inspection, maintenance, and repair inside the reactor compartment. The major source of this radiation is cobalt 60 deposited inside the piping systems. Cobalt 60 emits two high energy gammas and a low energy beta for every radioactive decay. Its half-life is 5.3 years.

Neutrons produced when reactor fuel fissions are shielded by both primary and secondary shields before penetrating to occupied areas. Radiation exposure to personnel from these neutrons during reactor operation has been much less than from gammas. After reactor shutdown when shipyard and other support facility work is done, no neutron exposure is detectable. As a result, the radiation exposures discussed in this report are nearly all from gamma radiation.

Control of Radiation During Reactor Plant Operation

Reactor plant shielding is designed to minimize radiation exposure to personnel. Shield design criteria establishing radiation levels in various parts of each nuclear-powered ship are personally approved by the Deputy Commander for Nuclear Propulsion, Naval Sea Systems Command. Conservation is built into the designs. For example, although the first nuclear-powered submarine USS NAUTILUS (SSN 571) was designed when the exposure limit was 15 rem per year, it meets the Navy's current 5 rem per year limit.

Ship design is also controlled to keep locations such as duty stations where personnel need to spend time as far as practicable away from the reactor compartment shield. Special attention is paid to living quarters. For example, in NAUTILUS the shield design criteria were established such that a person would have to spend more than 120 hours per day in living quarters to exceed exposure limits (which is impossible since there are only 24 hours in a day). In subsequent designs this conservatism was reduced to 48 hours per day for living quarters.

Resulting radiation exposure to those aboard ship outside propulsion plant spaces during reactor plant operation is not any greater than natural background radiation. For submarine operating personnel outside the propulsion plant, the combination of low natural radioactivity in ship construction materials and reduced cosmic radiation under water provides less radiation exposure at sea than the public receives ashore. Those who operate the nuclear propulsion plant receive more radiation exposure in port during maintenance and overhaul periods than they receive from operating the propulsion plant at sea.

Control of Radiation in Support Facilities

Tenders for nuclear-powered submarines and surface ships are designed so that radioactive material is handled only in specially designed and shielded nuclear support facilities. Submarine bases and shipyards limit to the minimum the number of places where radioactive material is allowed. Specific traffic routes are required to be used for any movement of radioactive material outside these nuclear support facilities. A radioactive material accountability system is used to ensure no radioactive material is lost or misplaced in a location where personnel could unknowingly be exposed. Regular inventories are required for every item in the radioactive material accountability system. Radioactive material is tagged with yellow and magenta tags bearing the standard radiation symbol and the measured radiation level. Radioactive material removed from a reactor plant is required to be placed in yellow plastic, and the use of yellow plastic is reserved solely for radioactive material. All personnel assigned to a tender, submarine base, or shipyard are trained to recognize that yellow plastic identifies radioactive material and to initiate immediate action if radioactive material is discovered out of place.

Access to radiation areas is controlled by radiological control personnel. Personnel are required to wear dosimetry badges to enter these areas. Dosimetry badges are also posted outside these areas to verify that personnel outside these areas do not require monitoring. Frequent radiation surveys are required using instruments which are checked before use and calibrated regularly. Areas where radiation levels are greater than 0.1 rem per hour are called high radiation areas and are locked or guarded.

Dosimetry

Thermoluminescent dosimeters (TLDs) are the dosimetry badges worn by personnel to measure their exposure to gamma radiation. The thermoluminescent dosimeter contains two chips of calcium fluoride, with added manganese. It is characteristic of thermoluminescent material that radiation causes internal changes which make the material, when subsequently heated, give off an amount of light directly proportional to the radiation dose. In order to make it convenient to handle, these chips of calcium fluoride are in contact with a metallic heating strip with heater wires extending through the ends of a surrounding glass envelope. The glass bulb is protected by a plastic case designed to permit the proper response to gammas of various energies. Gammas of such low energy that they will not penetrate the plastic case constitute less than a few percent of the total gamma radiation present. To read the radiation exposure, a trained operator removes the glass bulb and places it in a TLD reader so that the metal heater wires contact an electrical circuit. An electronically controlled device heats the calcium fluoride chips to several hundred degrees centigrade in a timed cycle, and the intensity of light emitted is measured and converted to a digital readout in units of rem. The heating cycle also anneals the calcium fluoride chips so that the dosimeter is zeroed and ready for subsequent use. The entire cycle of reading a TLD described here takes about thirty seconds. This rapid readout capability was one reason for changing from film badges to TLDs. The use of TLDs permits more frequent measurement of a worker's radiation exposure than film badges.

TLDs are required to be processed at least daily in shipyards. Aboard ship TLDs are required to be processed at least monthly except that daily processing is required for anyone entering a reactor compartment or high radiation area. To ensure accuracy, a number of calibration checks are performed on the TLD system. For example, each TLD is checked every six months for response within fifteen percent of a known exposure. Also each TLD reader must check within one percent against its internal calibration standard prior to each use and at least hourly when the reader is in use.

Pocket ionization chambers with an eyepiece permit the wearer to read his own radiation exposure. This pocket dosimeter is required in addition to a TLD when entering a reactor compartment or a high radiation area. Pocket dosimeters are used to enable the wearer to keep track of his own radiation exposure during a work period. The official record of radiation exposure is obtained from the TLD.

Dosimetry badges are worn on the trunk of the body, normally at the waist or chest whichever will receive the higher exposure. In some situations additional dosimeters are worn, for example on the hands or fingers or head.

Prior to 1974 film badges were used to measure radiation exposure. Film packets like those used for dental X-ray were placed in holders designed to allow differentiating between types of radiation. The darkness of the processed film was measured with a densitometer and converted to units of radiation exposure. When the first personnel radiation exposures were measured for NAUTILUS, there already was widespread photodosimetry experience in the Navy and precise procedures existed to provide reproducible results.

Each film badge was clearly marked with a name or number corresponding to the individual to whom it was assigned. This number was periodically checked by a radiological control technician before a worker entered a high radiation area. In high radiation areas every worker also wore a pocket dosimeter which was read by radiological control personnel when the worker left the area. At the end of each month when the film badges were processed, the film badge measurements were compared with the sum of the pocket dosimeters readings. The film badge results were, with few exceptions, the data entered in the permanent personnel radiation exposure records.

Discrepancies between film badge and pocket dosimeter measurements were investigated. These investigations included making independent estimates of the worker's exposure using such methods as time spent in the specific radiation area and comparing the estimates with the two measurements to determine which measurement was in error. If the error could not be determined, then the higher exposure was recorded for the worker. In nearly all cases this was the film badge measurement.

Results of numerous tests conducted by shipyards under the same conditions that most radiation exposure was received showed that film measurements averaged fifteen percent higher than actual radiation exposures. This was a conscious conservatism to ensure that under the worst case, the film measurement was not less than the actual radiation exposure. Film response varies with the energy of the gamma radiation. The calibration of the film was performed at high energy where the film has the least response to radiation exposure. Radiation of lower energies corresponding to scattered radiation from shielded cobalt 60 causes the film to indicate more radiation exposure than is present.

Data gathered in over 20 years of neutron monitoring aboard ship using neutron film badges demonstrated that the monitored individuals did not receive neutron exposure above the minimum detection level for neutron film. These facilities now use lithium fluoride TLDs to monitor neutron exposure of the few workers exposed to neutron sources used for radiation instrument calibration and for reactor plant instrumentation. These measured neutron exposures have been added to gamma exposures in the total whole body radiation exposure in this report, but because neutron exposures are so low, the radiation exposures in this report are nearly all from gamma radiation.

Monitoring for beta radiation is not normally required because betas cannot penetrate the metal boundaries of the reactor coolant system. Beta radiation needs to be considered in maintenance or repair operations only when systems are opened so that personnel are close to surfaces which have been contaminated with radioactive corrosion products from reactor coolant. In these cases normal clothing or eyeglasses or plastic contamination control materials completely shield beta radiation of the energies normally present. Support facilities routinely provide such shielding to eliminate personnel radiation exposure from betas.

Monitoring for alpha radiation is not a normal part of operation or maintenance of Naval nuclear propulsion plants. However, alpha monitoring is sometimes necessary to identify radium daughter products naturally present in the atmosphere.

Physical Examinations

Radiation medical examinations have been required since the beginning of the Naval nuclear propulsion program for personnel exposed to radiation. In these examinations the doctor pays special attention to any condition which might indicate that radiation exposure would cause an increased degree of risk. Passing this examination is a prerequisite for obtaining the dosimetry badge which permits entry to areas where radiation exposure can be received. For military personnel who have already been screened by physical examinations, few fail this radiation physical. For civilian shipyard workers the failure rate is a few percent. However, failure of this examination does not mean a shipyard worker will not have a job. Since shipyard workers spend most of their time on nonradioactive work, inability to perform radioactive work does not restrict their job opportunities. No shipyard worker in the Naval nuclear propulsion program has been fired for inability to pass a radiation medical examination.

Radiation medical examinations are given prior to initial radiation work, and at termination of radiation work in the nuclear propulsion program (or at termination of employment) if the worker has received

more than 0.5 rem in any year. In addition, during each three year period anyone who has received more than 0.5 rem in one year receives a radiation medical examination. The basis for selecting 0.5 rem as a criterion for examination is that those who receive less than 0.5 rem in a year have not exceeded radiation exposures permitted by Federal regulations for members of the general population.

A radiation medical examination includes review of medical history to determine, among other subjects, past radiation exposure, history of cancer, history of radiation therapy, and family history of cancer. In the physical examination particular attention is paid to evidence of cancer as well as cataracts in the eyes. Laboratory procedures include urinalysis, blood analysis, and comparison of blood constituents to a specific set of standards. Chest X-rays with full size film to reduce radiation exposure were also a routine part of all radiation medical examinations until 1977. At that time routine chest X-rays were discontinued, further reducing radiation exposure of workers. Chest X-rays are now performed when clinically indicated at the discretion of the medical officer. In event disqualifying conditions are found in an examination of Naval civilian or military personnel, the individual is barred from receiving occupational radiation exposure until the results of the examination are reviewed by the Bureau of Medicine and Surgery Radiation Effects Advisory Board. Only after approval of the board would the individual be permitted to receive occupational radiation exposure.

Shipyard Training:

Periodic radiological control training is performed to ensure each person understands the general and specific radiological aspects which he might encounter, understands his responsibility to the Navy and the public for safe handling of radioactive materials, understands the risks associated with radiation exposure and understands his responsibility to minimize his own radiation exposure. Training is also provided on the biological risk of radiation exposure to the unborn child. Prior to being authorized to perform radiation work, an employee is required to complete satisfactorily a radiological control training course, including a written examination. Typical course lengths for workers range from 16 to 32 hours. In written examinations on radiological controls short answer questions such as multiple choice and true-false questions are not normally used. Following are the requirements for workers:

1. Radiation Exposure Control

- a. State the limits for whole body penetrating radiation. Explain that the rem is a unit of biological dose from radiation.
- b. Explain how "stay times" are used.
- c. Be aware of the seriousness of violating instructions on radiation warning signs and unauthorized passage through barriers; be aware of penalties for violating these requirements.
- d. Discuss procedures and methods for minimizing exposure such as working at a distance from a source, reducing time in a radiation area, and shielding.
- e. Discuss potential sources of radiation associated with work performed by the individual's trade.
- f. State where dosimetry equipment shall be placed on an individual's body.
- g. Demonstrate ability to read all types of dosimeters in use.

- h. Discuss importance of the individual keeping track of his own exposure.
- i. Be aware of the significance of personnel radiation exposure. The National Council on Radiation Protection and Measurements has stated that while exposures of workers and the general population should be kept to the lowest practicable level at all times, the presently permitted exposures represent a level of risk small compared with other hazards of life. The Nuclear Regulatory Commission has stated, "Control of exposure to radiation is based on the assumption that any exposure, no matter how small, involves some risk." The risk of injury from radiation associated with Naval nuclear propulsion plants is low compared to the occupational and nonoccupational risks accepted in everyday life.

2. Contamination Control

- a. Discuss how contamination is controlled during radioactive work (e.g., containment in plastic bags and use of contamination containment areas).
- b. Discuss procedures for preventing contamination of personnel and how contamination is detected on personnel.
- c. Discuss how contamination is removed from contaminated objects and personnel.
- d. Discuss potential sources of contamination associated with work performed the individual's trade
- e. State the beta-gamma surface contamination limit. Discuss the meaning of the units of the limit.
- f. Demonstrate proper procedure for donning and removing a full set of anticontamination clothing.
- g. Demonstrate proper procedures for entering and leaving a contaminated area including proper procedures for self-monitoring.
- h. Explain what radioactive contamination is. Explain the difference between radiation and radioactive contamination.
- i. For personnel required to work in containment areas (e.g., glove bags or tents), demonstrate proper procedures for working in these areas. (This ability may be demonstrated on a mock-up)
- j. For personnel who are likely to encounter airborne radioactivity, demonstrate the proper procedure for donning and removing the type of respiratory equipment the individual will be required to wear. For personnel who are required to wear respiratory equipment with anticontamination clothing, this demonstration shall be performed when donning and removing anticontamination clothing. The demonstration shall include any leak checks required to be made to test for proper operation of respiratory equipment.
- k. For personnel who are likely to encounter airborne radioactivity, state the conditions which require wearing masks, air supplied respirators, or air supplied hoods.

3. Accountability of radioactive Materials - Know that radioactive materials are accounted for when transferred between radiologically controlled areas by tagging, by recording disposition of material, and by specific authorization of radiological control personnel.
4. Waste Disposal - Discuss how the individual workers can reduce the amount of radioactive liquid and solid waste.
5. Radiological Incidents
 - a. Discuss the need for consulting radiological control personnel when questions or incidents occur.
 - b. Discuss procedures to be followed after a spill of material (liquid or solid) which is or might be radioactive.
 - c. Discuss procedures to be followed when notified that airborne radioactivity is above the limit.
 - d. Demonstrate the action to be taken in event of a spill of radioactive liquid. This ability shall be demonstrated during a drill.
 - e. Discuss the action to be taken when an individual discovers his dosimeter is off-scale.
6. Responsibilities of Individuals - Discuss actions required in order to fulfill workers' responsibilities. Include the responsibility of the individual to inform his employer of previous or concurrent occupational radiation exposure received.

In addition to passing a written examination, completion of this training course requires satisfactory performance during basic types of simulated work operations. For an employee to continue as a radiation worker he has to requalify in a manner similar to the initial qualification at least every two years. In between these qualification periods personnel are required to be selected at random for additional examination to determine how well the knowledge has been retained. Training is also conducted by individual shop instructors in the specific job skills for radiation work within each trade. For complex jobs this is followed by special training for the specific job, frequently using mock-ups outside radiation areas.

Radiological control technicians are required to complete a course of about six months in radiological controls, to demonstrate their practical abilities, and to pass comprehensive written and oral examinations. Radiological control supervisors are required to have at least the same technical knowledge and abilities as the technicians; however, passing scores for supervisors' examinations are higher or supervisors' examinations are more difficult than for technicians. Oral examinations are conducted by senior radiological control personnel and require personnel to be able to evaluate symptoms of unusual radiological control situations. The radiological control technician or supervisor is required to evaluate initial symptoms, state immediate corrective action required, state what additional measurements are required, and do a final analysis of the measurements to identify the specific problem. Subsequent to qualification, periodic training sessions are required in which each radiological control technician and supervisor demonstrates ability to handle situations such as are used in the oral examinations. At least every two years radiological control personnel have to requalify through written and oral examinations similar to those used for initial qualification. Radiological control technicians and supervisors are required to demonstrate their practical abilities frequently through unannounced drills.

In addition to the above training for those who are involved in radioactive work, each shipyard employee not involved in radioactive work and each person assigned to a nuclear-powered ship or a support facility is required to receive basic radiological training, which is repeated at least annually. This training is to ensure personnel understand the posting of radiation areas, the identification of radioactive materials, and not to cross radiation barriers. This instruction also explains that the radiation environment of personnel outside radiation areas and outside the ship or shipyard is not significantly affected by nuclear propulsion plant work.

Nuclear Power Training

Military personnel who operate Naval nuclear propulsion plants are required to pass a six month basic training course at nuclear power school and a six month qualification course at a land-based prototype of a shipboard reactor plant. Each nuclear-trained officer and enlisted man receives extensive radiological control training including lectures, demonstrations, practical work, radiological control drills, and written and oral examinations. This training has emphasized the ability to apply basic information on radiation and radioactivity.

Those enlisted personnel who will have additional responsibilities for radiological control are designated Engineering Laboratory Technicians and receive an additional three months training after completion of the one year program.

Prior to becoming qualified as the engineering officer, that is the head of the engineering department of a nuclear-powered ship, a nuclear-trained officer must pass a one day written examination and a sequence of oral examinations conducted at Naval Reactors headquarters. A key part of these qualification examinations is radiological controls.

Prior to becoming a commanding officer of a nuclear-powered ship, an officer completes the one year nuclear power training program. Immediately before serving as commanding officer he attends a three month course at Naval Reactors headquarters. The radiological controls portion of this is an advanced course and assumes the officer starts with detailed familiarity with shipboard radiological controls. The officer must pass both written and oral examinations in radiological controls during this course prior to assuming command of a nuclear-powered ship.

Radiation Exposure Reduction

Maintaining personnel radiation exposures as low as reasonably achievable involves all levels of management in nuclear-powered ships and their support facilities. Operations, maintenance, and repair personnel are required to be involved in this subject; it is not left solely to radiological control personnel. To evaluate the effectiveness of radiation exposure reduction programs, managers use a set of goals. Goals are also set in advance to keep each worker's exposure under certain levels and to minimize the number of workers involved. Goals are also set on the total cumulative personnel radiation exposure (man-rem) for each major job, for the entire overhaul or maintenance period, and for the whole year. These goals are deliberately made hard to meet in order to encourage personnel to improve performance.

Of the various goals used, the most effective in reducing personnel radiation exposure has been the use of radiation control levels which are lower than the Navy's quarterly and annual limits. Control levels in 1978 in shipyards ranged from 0.5 rem to $1\frac{1}{4}$ rem for the quarter year and from 0.5 rem to 3 rem for the year, depending on the amount of radioactive work scheduled. Whereas 3 rem per quarter and 5 rem per year are the Navy limits.

To achieve the benefits of lower control levels in reducing total man-rem it is essential to minimize the number of workers permitted to receive radiation exposure. Otherwise the control levels could be met merely by adding more workers. Organizations are required to conduct periodic reviews to ensure the number of workers is the minimum.

Following is a brief checklist which has been in use for years in maintaining personnel radiation exposure as low as reasonably achievable during maintenance, overhaul, and repair.

Preliminary Planning

- Plan in advance
- Delete unnecessary work
- Determine expected radiation levels

Preparation of Work Procedures

- Plan access to and exit from work area
- Provide for service lines (air, welding, ventilation, etc.)
- Provide communication (sometimes includes closed-circuit television)
- Remove sources of radiation
- Plan for installation of temporary shielding
- Decontaminate
- Work in lowest radiation levels
- Perform as much work as practicable outside radiation areas
- State requirements for standard tools
- Consider special tools
- Include inspection requirements (these identify steps where radiological control personnel must sign prior to work proceeding)
- Minimize discomfort of workers
- Estimate man-rem

Temporary Shielding

- Control installation and removal by written procedure
- Inspect after installation
- Conduct periodic radiation surveys
- Minimize damage caused by heavy lead temporary shielding
- Prohibit use of lead shot for temporary shielding
- Balance radiation exposure received in installation against exposure to be saved by installation
- Shield travel routes
- Shield components with abnormally high radiation levels early in the maintenance period
- Shield position worker occupies
- Perform directional surveys to improve design of shielding by locating sources of radiation
- Use mock-up to plan temporary shielding design and installation

Rehearsing and Briefing

- Rehearse
- Use mock-up duplicating working conditions
- Use photographs
- Brief workers

Performing Work

- Post radiation levels
- Keep excess personnel out of radiation areas
- Minimize beta radiation exposure (anticontamination clothing effectively shields cobalt 60 betas)
- Supervisors and workers keep track of radiation exposure
- Workers assist in radiation and radioactivity measurements

- Delegate radiological control monitoring responsibilities when necessary to minimize radiation exposure
- Evaluate use of fewer workers
- Reevaluate reducing radiation exposures

Radiation Exposure Data

Radioactive materials had been handled in shipyards for years before Naval nuclear propulsion plant work started. Examples of such work include non-destructive testing using radiography sources and radiation instrument calibration using radioactive sources. Since this work is licensed by the Nuclear Regulatory Commission or by a State under Agreement with the Nuclear Regulatory Commission, the radiation exposure from this licensed work has been excluded whenever practicable from this report.

Table 1 shows the dates when radioactive work associated with Naval nuclear propulsion plants started in each of eleven shipyards. Seven of these shipyards have constructed Naval nuclear-powered ships; however, little radiation exposure is received in new construction. The dates of starting reactor plant overhaul, therefore, are the significant dates for start of radioactive work. In 1978 Naval nuclear-powered ships were undergoing overhaul in eight shipyards identified in Table 1.

Table 2 summarizes radiation exposure received in nuclear-powered ships and their supporting tenders and submarine bases since the first nuclear-powered ship went to sea in January 1955. Most of the radiation exposure in this table results from inspection, maintenance and repair work in the reactor compartments of ships. Radiation exposures for reactor compartment work increase as reactor plant radiation levels increase with the age of the plant.

As expected, the number of personnel monitored for exposure to radiation increased with the increasing number of nuclear-powered ships. Initially everyone aboard a nuclear-powered submarine was monitored for radiation exposure. After years of experience showed that personnel outside propulsion plant spaces received exposures indistinguishable from background, the number of personnel monitored for occupational exposure to radiation was sharply reduced in 1974. For example, in 1973 almost sixty percent of those monitored were recorded as receiving zero radiation exposure; in 1978 as a result of reducing numbers of personnel monitored unnecessarily, about ten percent were recorded with zero exposure. Personnel outside propulsion plant spaces in submarines now wear dosimetry badges to verify they receive no occupational exposure.

Table 3 summarizes radiation exposures of shipyard personnel since the start of Naval nuclear propulsion plant radioactive work in 1954. Figure 2 shows graphically that total personnel radiation exposure has been reduced in shipyards even though the amount of work has increased. Since ship overhaul frequently overlapped calendar years, the numbers of ships in overhaul shown in Figure 2 were determined by dividing by 12 the total number of months each ship was in overhaul during a calendar year.

The increase in the numbers of personnel monitored and total man-rem exposure in the early years shows the increasing workload in reactor plant work as the number of ships was increased. By 1962 four submarine reactor plants had been overhauled and major efforts were underway to reduce radiation levels. By 1966 the number of ships in overhaul had quadrupled as indicated by the buildup to the peak in total man-rem. Subsequently, the number of ships in overhaul more than doubled again. Decreases in total annual exposures, numbers of personnel monitored, and numbers of personnel with annual exposures over 3 rem have been results of the program to reduce radiation exposures to the minimum practicable. The total annual exposure for the shipyards has averaged about 6100 man-rem over twenty-five years and for ships has averaged almost 2000 man-rem.

Since a worker usually is exposed to radiation in more than one year, the total number of personnel monitored cannot be obtained by adding the annual numbers. The total number of shipyard personnel monitored for radiation exposure associated with the Naval nuclear propulsion program has been about 100,000. Nearly all of these are civilians, almost half of whom are U. S. Government employees at six Naval shipyards. Table 4 provides further information about the distribution of their radiation exposures. In recent years about 80 percent of those monitored for radiation in shipyards and about 93 percent of those in ships received less than 0.5 rem in a year, the limit allowed by Federal regulations for a member of the general public. The average exposure per year for each person monitored has been 0.35 rem in shipyards, which is less than one tenth the occupational exposure limit. The average exposure per year for those monitored in ships has been 0.13 rem, which is less than the annual exposure a person receives from natural background and medical radiation.

Table 4 also lists the numbers of personnel who have exceeded the 3 rem quarterly exposure limit. In no case have personnel exceeded the accumulated limit of 5 rem for each year of age over eighteen. The total number of persons who have exceeded the quarterly limit since the limit was imposed in 1959 is 36, of whom 3 were military personnel aboard ships. Twenty-nine of the 36 personnel had quarterly exposures in the range of 3 to 4 rem, and the highest exposure was 9.7 rem in a quarter. Navy procedures require any person who receives greater than 25 rem in a short time period to be placed under medical observation. None of the exposures has reached this level.

The average lifetime accumulated exposure from radiation associated with Naval nuclear plants for all shipyard personnel is 1.5 rem. Since the average annual exposure per person is 0.35 rem, this means that the average shipyard radiation worker is monitored because of Naval nuclear propulsion plant work for about four years. The average lifetime accumulated exposure for the 45,000 Naval officers and enlisted men trained to operate a nuclear propulsion plant is about 1 rem. These radiation exposures are much less than the exposure the average American receives from medical diagnostic X-rays during his working lifetime.

Table 5 provides information on the distribution of lifetime accumulated exposure. This table includes all shipyard employees who at some time during 1978 were monitored for radiation exposure. Also shown in this table is the distribution of lifetime accumulated exposure for every person monitored in one shipyard since radioactive work started. For ships the data was obtained by sampling selected ships. Federal radiation exposure limits allow accumulating 100 rem in twenty years of work, or 200 rem in forty years. The fact that no one shown in Table 5 comes close to having accumulated this much radiation exposure is the result of deliberate efforts to keep well below the lifetime accumulated radiation exposure limit.

TABLE 1
SHIPYARD FIRST REACTOR PLANT OPERATION
AND FIRST RADIOACTIVE OVERHAUL WORK

Shipyard	Year First New Construction Reactor Started Operation	Year First Reactor Plant Overhaul Started
Electric Boat Division*	1954	1957
Groton, Connecticut		
Portsmouth Naval Shipyard	1958	1959
Portsmouth, New Hampshire		
Mare Island Naval Shipyard**	1958	1962
Vallejo, California		
Pearl Harbor Naval Shipyard	None	1962
Pearl Harbor, Hawaii		
Charleston Naval Shipyard**	None	1963
Charleston, South Carolina		
Newport News Shipbuilding and Dry Dock Company	1960	1964
Newport News, Virginia		
Bethlehem Steel Shipbuilding***	1961	None
(Subsequently Electric Boat Division) Quincy, Massachusetts		
New York Shipbuilding Corporation***	1963	None
Camden, New Jersey		
Norfolk Naval Shipyard	None	1965
Norfolk, Virginia		
Puget Sound Naval Shipyard**	None	1967
Bremerton, Washington		
Ingalls Shipbuilding Division	1961	1970
Pascagoula, Mississippi		

* Electric Boat Division performed overhauls in 1957-1977 but only new construction in 1978.

** Radioactive work of less extent than in an overhaul commenced in Mare Island in 1958, in Charleston in 1961, and in Puget Sound in 1965.

*** Work on Naval nuclear-powered ships was discontinued at Camden, New Jersey in 1967 and at Quincy, Massachusetts in 1969.

TABLE 2
OCCUPATIONAL RADIATION EXPOSURE RECEIVED BY PERSONNEL
ASSIGNED TO TENDERS, BASES, AND NUCLEAR-POWERED SHIPS FROM
OPERATION AND MAINTENANCE OF NAVAL NUCLEAR PROPULSION PLANTS

Year	Number of Persons Monitored Who Received Exposures In The Following Ranges of Rem for the Year						Total Personnel Monitored	Total Man-Rem
	0-1	1-2	2-3	3-4	4-5	>5*		
1954	36	0	0	0	0	0	36	8
1955	90	11	0	0	0	0	101	25
1956	108	10	4	0	0	0	122	50
1957	293	7	1	0	0	0	301	60
1958	562	11	3	0	0	0	576	100
1959	1057	41	8	3	0	0	1109	200
1960	2607	88	8	4	3	1	2711	375
1961	4812	106	31	4	4	0	4957	680
1962	6788	182	75	31	17	1	7094	1312
1963	9188	197	39	14	3	1	9442	1420
1964	10317	331	93	35	15	4	10795	1964
1965	11883	592	224	96	30	24	12849	3421
1966	18118	541	156	95	44	28	18982	3529
1967	21028	339	139	48	11	0	21565	3084
1968	24200	373	103	20	2	0	24698	2463
1969	26969	577	127	39	6	0	27718	2918
1970	26206	610	134	30	0	0	26980	3089
1971	26090	568	122	31	2	0	26813	3261
1972	33312	602	180	13	1	0	34108	3271
1973	30852	600	102	15	1	0	31570	3160
1974	18375	307	65	2	0	0	18749	2142
1975	17638	330	28	1	0	0	17997	2217
1976	17795	369	56	9	0	0	18229	2642
1977	20236	346	95	36	3	0	20716	2812
1978	22089	290	23	1	0	0	22403	2234

Note: Data obtained from summaries rather than directly from original medical records. However, it is expected that the large effort to compile comparable data from original medical records would show differences no greater than five percent. Total man-rem was determined by adding actual exposures for each individual during the year.

* Limit in the Naval nuclear propulsion program was changed to 5 rem per year in 1967

TABLE 3
OCCUPATIONAL RADIATION EXPOSURE RECEIVED BY SHIPYARD PERSONNEL
FROM WORK ASSOCIATED WITH NAVAL NUCLEAR PROPULSION PLANTS

Year	Number of Persons Monitored Who Received Exposure In The Following Ranges of Rem For The Year						Total Personnel Monitored	Total Man-Rem
	0-1	1-2	2-3	3-4	4-5	>5*		
1954	508	9	3	5	3	0	528	64
1955	2563	80	25	6	3	2	2679	344
1956	2834	20	5	2	0	1	2862	162
1957	3473	97	31	1	2	4	3608	495
1958	5766	165	46	10	4	7	5998	779
1959	10388	221	133	78	49	23	10892	1864
1960	12047	198	97	22	4	0	12368	1158
1961	13383	198	91	44	14	3	13733	1241
1962	14411	642	366	247	146	108	15920	5222
1963	19164	446	159	71	34	28	19902	2725
1964	24044	804	445	215	144	41	25693	5678
1965	22630	2306	1314	814	618	525	28207	15829
1966	29490	2352	1623	1057	1139	513	36174	18804
1967	29853	2388	1563	1096	733	1	35634	13908
1968	30159	1344	773	496	279	0	33051	8719
1969	25672	1790	1080	753	375	0	29670	11077
1970	21182	2127	1382	740	492	0	25923	13084
1971	20041	1928	1066	650	240	0	23925	10616
1972	17514	1692	849	139	5	0	20199	7002
1973	13036	1403	604	203	6	0	15252	6083
1974	12587	1464	745	311	50	0	15157	7206
1975	12825	1116	598	82	42	0	14663	5285
1976	13042	1268	633	30	0	0	14973	5310
1977	13835	1277	586	25	0	0	15723	5199
1978	13700	1016	268	0	0	0	14984	3680

Note: During 1978, verifications were made of data in a similar table in ref (9) which had been obtained from summaries rather than directly from original medical records. Corrected data above differs from that in ref (9). Exposures from Nuclear Regulatory Commission or State licensed radiation sources have been excluded as far as practicable. Total man-rem was determined by adding actual exposures for each individual during the year.

* Limit in the Naval nuclear propulsion program was changed to 5 rem per year in 1967.

TABLE 4
SHIPYARD, SHIPS, TENDERS, AND SUBMARINE BASES
DISTRIBUTION OF PERSONNEL RADIATION EXPOSURE

Year	Average Rem Per Person Monitored		Percent of Personnel Monitored Who Received Greater Than 1 Rem		Number of Personnel Who Exceeded 3 Rem/Quarter
	Fleet	Shipyard	Fleet	Shipyard	
1954	.22	.12	0	3.8	0
1955	.25	.13	10.9	4.3	0
1956	.41	.06	11.5	1.0	0
1957	.20	.14	2.7	3.7	0
1958	.17	.13	2.4	3.9	0
1959	.18	.17	4.7	4.6	8
1960	.14	.09	7.5	2.6	0
1961	.14	.09	2.9	2.5	0
1962	.18	.33	4.3	9.5	9
1963	.15	.13	2.7	3.7	2
1964	.18	.22	4.4	6.4	3
1965	.27	.56	7.5	19.8	5
1966	.19	.52	4.6	18.5	6
1967	.14	.39	2.5	16.2	3
1968	.10	.26	2.0	8.8	0
1969	.11	.37	2.7	13.5	0
1970	.11	.50	2.9	18.3	0
1971	.12	.44	2.7	16.2	0
1972	.10	.35	2.3	13.3	0
1973	.10	.40	2.3	14.5	0
1974	.11	.48	2.0	17.0	0
1975	.12	.36	2.0	12.5	0
1976	.14	.35	2.4	12.9	0
1977	.14	.33	2.3	12.0	0
1978	.10	.24	1.4	8.5	0
Average	.13	.35	2.8	12.2	
NAVYWIDE AVERAGE	.25		8.0		

TABLE 5
DISTRIBUTION OF TOTAL LIFETIME OCCUPATIONAL RADIATION EXPOSURE ASSOCIATED WITH NAVAL NUCLEAR PROPULSION PLANTS

Range of Accumulated Lifetime Radiation Exposure (REM)	Percent of Personnel With Lifetime Accumulated Radiation Exposure in the Radiation Range		
	Ship Personnel Monitored in 1978	All Shipyard Personnel Monitored in 1978	One Shipyard-All Personnel Ever Monitored
0 - 5	99	75	87
5 - 10	1	12	6
10 - 15	0.1	6	3
15 - 20	.03	3	1
20 - 25	0	2	1
25 - 30	0	1	Less than 1
30 - 50	0	Less than 1	Less than 1
Greater than 50	0	0	0

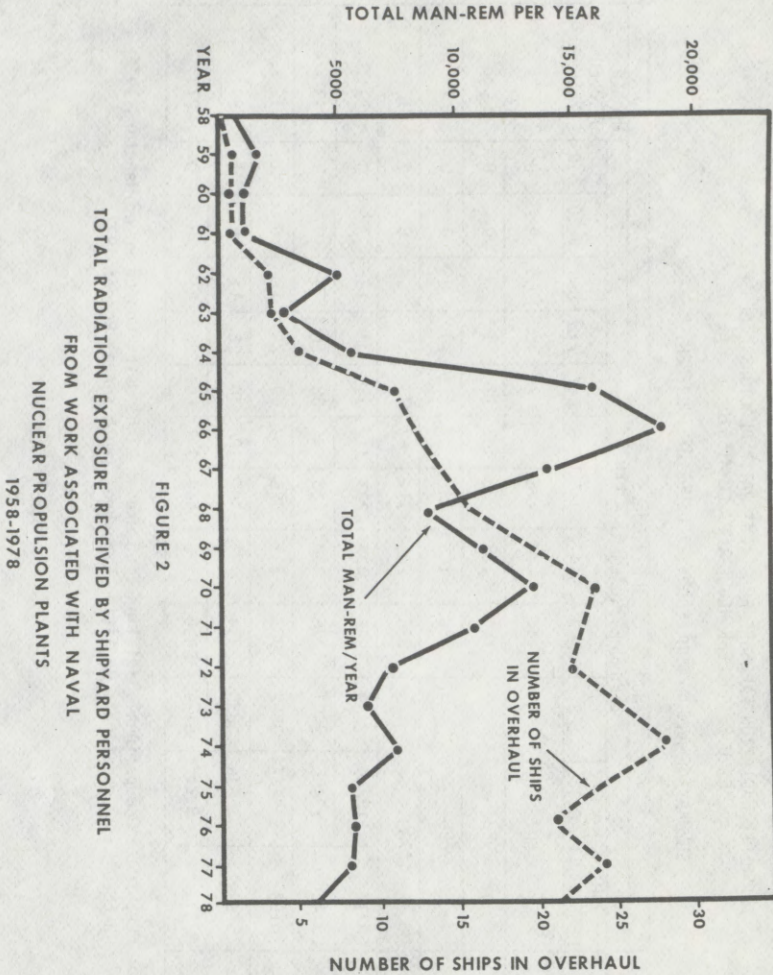


Table 6 provides a basis for comparison between the radiation exposure for light water reactors operated by the Navy and commercial power reactors licensed by the Nuclear Regulatory Commission. The 1977 data in this Nuclear Regulatory Commission table covers 65 licensees with a total of 32,731 man-rem (ref 10). The average annual exposure of each worker at commercial power reactors was 0.46 rem. Licensees of commercial power reactors reported 141 overexposures to external radiation during the years 1971 through 1977. Numbers in excess of 5 rem are not necessarily overexposures since Nuclear Regulatory Commission regulations permit exposures of 3 rem each quarter up to 12 rem per year within the accumulated total limit of 5 rem for each year of a person's age beyond eighteen.

TABLE 6

PERSONNEL RADIATION EXPOSURE FOR LIGHT WATER REACTORS LICENSED
BY U.S. NUCLEAR REGULATORY COMMISSION

SUMMARY OF ANNUAL WHOLE BODY EXPOSURE BY INCREMENT

YEAR	TOTAL MONITORED	NOT MEASURABLE	NUMBER OF INDIVIDUALS EXPOSURE INCREMENT - REM										NUMBER OF OVER- EXPOSURES	
			0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10		>10
1969	2854	2607			144	70	26	5	2	0	0	0	0	
1970	7518	6953			184	175	92	102	11	1	0	0	0	
1971	10269	9660			328	146	107	17	11	0	0	0	0	2
1972	15730	14783			536	205	114	47	23	10	6	6	0	16
1973	35918	20717	10249	2449	1585	432	237	117	71	38	16	7	0	19
1974	38379	20240	13455	2491	1375	470	226	86	30	6	0	0	0	43
1975	45659	20188	18277	3892	1903	707	426	169	60	24	12	0	1	14
1976	61151	25704	26636	4880	2354	789	487	188	70	26	11	5	1	20
1977	70904	27671	33252	6174	2838	1130	569	141	66	36	21	6	0	27

SOURCES: 1969-1976: NUREG-0323 Occupational Radiation Exposure at Light Water Cooled Power Reactors 1976
1977: NUREG-0463 "Occupational Radiation Exposure" Tenth Annual Report 1977

INTERNAL RADIOACTIVITY

Policy and Limits

The Navy's policy on internal radioactivity for personnel associated with the nuclear propulsion program continues to be the same as it was more than two decades ago, to prevent significant radiation exposure to personnel from internal radioactivity. The limits invoked to achieve this objective are one-tenth of the levels allowed by Federal regulations for radiation workers. The results of this program have been that no one has received more than one-tenth the Federal annual internal occupational exposure limits from internal radiation exposure caused by radioactivity associated with Naval nuclear propulsion plants.

The basic Federal limit for radiation exposure to organs of the body from internal radioactivity has been 15 rem per year. There have been higher levels applied at various times for thyroid and for bones, however, use of these specific higher limits has not been necessary in the Naval nuclear propulsion program.

Fifteen rem per year is the limit recommended for most organs of the body by the U. S. National Committee on Radiation Protection in 1954 (ref 1), by the U. S. Atomic Energy Commission in the initial edition of ref 3 applicable in 1957, by the International Commission on Radiological Protection in 1959 (ref 2), and was adopted for Federal agencies when President Eisenhower approved recommendations of the Federal Radiation Council May 13, 1960. Although the International Commission on Radiological Protection revised its recommendations in 1977 (ref 8) to raise limits for most organs, the Naval nuclear propulsion program has not changed its limits.

Source of Radioactivity

Radioactivity can get inside the body through air, through water or food, and through surface contamination via the mouth or skin or a wound. The radioactivity of primary concern is the metallic corrosion products on the inside surfaces of reactor plant piping systems. These are in the form of insoluble metallic oxides, primarily iron oxides. Ref (11) contains more details on why cobalt 60 is the radionuclide of most concern for internal radioactivity.

The design conditions for reactor fuel are much more severe for warships than for commercial power reactors. As a result of being designed to withstand shock, Naval reactor fuel elements retain fission products including fission gases within the fuel. Sensitive measurements are made frequently to verify the integrity of reactor fuel. Consequently, fission products such as strontium 90 and cesium 137 make no measurable contribution to internal exposure of personnel from radioactivity associated with Naval nuclear propulsion plants. Similarly alpha emitters such as uranium and plutonium are retained within the fuel elements and are not accessible to personnel operating or maintaining a Naval nuclear propulsion plant.

Because of the high integrity of reactor fuel and because soluble boron is not used in reactor coolant for normal radioactivity control in Naval reactors, the amounts of tritium in reactor coolant are far less than in typical power reactors. The small amounts that are present are formed primarily as a result of neutron interaction with the deuterium naturally present in water. The radiation from tritium is of such low energy that the Federal limits for breathing or swallowing tritium are one hundred times higher than for cobalt 60. As a result radiation exposure to personnel from tritium is far too low to measure. Similarly the low energy beta radiation from carbon 14 does not add measurable radiation exposure to personnel operating or maintaining Naval nuclear propulsion plants.

Control of Airborne Radioactivity

Airborne radioactivity is controlled in maintenance operations such that masks are not normally required. To prevent exposure of personnel to airborne radioactivity when work might expose radioactivity to the atmosphere, contamination containment tents or bags are used. The areas inside these containments are ventilated to the atmosphere through high efficiency filters which have been tested to remove at least 99.95 percent of particles of a size comparable to cigarette smoke. The occupied area outside these containments is required to be ventilated through high efficiency filters any time work which could cause airborne radioactivity is in progress inside an area such as a reactor compartment. Airborne radioactivity surveys are required to be performed regularly in radioactive work areas. Any time airborne radioactivity above the limit is detected in occupied areas, work which might be causing airborne radioactivity is stopped. This conservative action is taken to minimize internal radioactivity even though the Navy's airborne radioactivity limit would allow continuous breathing for forty hours per week throughout the year to reach an annual exposure to the lungs of one-tenth the Federal limit. Personnel are also trained to use masks when airborne radioactivity is detected, however, masks are seldom needed and are not relied upon as the first line of defense against airborne radioactivity.

It is not uncommon for airborne radioactivity above the limit to be caused by radon naturally present in the air. Atmospheric temperature inversion conditions can allow this buildup of radioactive particles from radon. Radon can build up above the limit in sealed or poorly ventilated rooms in homes or buildings made of stone. Most cases of airborne radioactivity above the limits in occupied areas in the Naval nuclear propulsion program have been caused by radioactive particles from radon, and not from the reactor plant. Procedures have been developed to allow work to continue after it has been determined that the elevated airborne radioactivity is from naturally occurring radon.

Radon also is emitted from radium used for making dials luminous. There have been a number of cases where a single radium dial such as on a wristwatch has caused the entire atmosphere of a submarine to exceed the airborne radioactivity limit used for the nuclear propulsion plant. Radium in any form has been banned from submarines to prevent interference with keeping airborne radioactivity from the nuclear propulsion plant as low as practicable.

Control of Radioactive Surface Contamination

Perhaps the most restrictive regulations in the radiological control program are established in the requirements for the control of radioactive contamination. Work operations involving potential for spreading radioactive contamination are planned using containment to prevent personnel becoming contaminated. The controls for radioactive contamination are so strict that precautions sometimes have had to be taken to prevent tracking contamination from fallout and natural sources into nuclear areas because the contamination control limits used in the nuclear areas were below the levels of fallout and natural contamination occurring outside in the general public areas.

Anticontamination clothing, including coverall, hood to cover the head, ears and neck, shoe covers, and gloves, is provided when needed. However, the basic approach is to avoid the need for anticontamination clothing by containing the radioactivity. As a result, most work on radioactive materials is performed with hands reaching into gloves installed in containments, making it unnecessary for the worker to wear anticontamination clothing. In addition to providing better control over the spread of radioactivity, this method has reduced radiation exposure since the worker can usually do his job better and faster in his normal work clothing. A basic requirement of contamination control is monitoring all personnel leaving any area

where radioactive contamination could possibly occur. Workers are trained to survey themselves and their performance is checked by radiological control personnel. Personnel monitor before, not after, they wash. Therefore, washing or showering at the exit of radioactive work areas is not required. The basic approach is to prevent contamination, not wash it away.

Surveys for radioactive contamination are taken frequently by trained radiological control personnel. Results of these surveys are reviewed by supervisory personnel to provide a double-check that no abnormal conditions exist. The instruments used for these surveys are checked against a radioactive calibration source daily and prior to use and they are calibrated at least every six months.

Control of Food and Water

Smoking, eating, drinking and chewing are prohibited in radioactive areas. Aboard ship drinking water is distilled from seawater by using steam. However, the steam is not radioactive because it is in a secondary piping system separate from the reactor plant radioactive water. In the event radioactivity were to leak into the steam system, sensitive radioactivity detection instruments which operate continuously would give early warning.

Wounds

Skin conditions or open wounds which might not readily be decontaminated are cause for disqualification from doing radioactive work. Workers are trained to report such conditions to radiological control or medical personnel, and radiological control technicians watch for open wounds when workers enter radioactive work areas. In the initial medical examination prior to radiation work and during subsequent examinations skin conditions are also checked. If the medical officer determines a wound is sufficiently healed or considers the wound adequately protected, he may remove the disqualification.

There have been only a few cases of contaminated wounds in the Naval nuclear propulsion program. In most years, including 1978, none occurred. Examples of such injuries have included a scratched hand, a metallic sliver in a hand, a cut finger, and a puncture wound to a hand. These wounds occurred at the same time the person became contaminated. Insoluble metallic oxides which make up the radioactive contamination remain primarily at the wound rather than being absorbed into the blood stream. These radioactively contaminated wounds have been easily decontaminated. No case of a contaminated wound is known where the radioactivity initially present in the wound was as much as one one-thousandth of that permitted for a radiation worker to have in his body.

Monitoring for Internal Radioactivity

The radioactivity of most concern for internal radiation exposure from Naval nuclear propulsion plants is cobalt 60. Although most radiation exposure from cobalt 60 inside the body will be from beta radiation, the gammas given off make cobalt 60 easy to detect. Complex whole body counters are not required to detect cobalt 60 at low levels inside the body. For example, one millionth of a curie of cobalt 60 inside the lungs or intestines will cause a measurement of two times above the background reading with a standard radiation survey instrument. This amount of internal radioactivity will cause the instrument used to monitor personnel for radioactive contamination on their body to reach the alarm level. Every person is required to monitor his entire body every time he leaves an area with radioactive surface contamination. Monitoring the entire body is a requirement in the Naval nuclear propulsion program; monitoring just hands and feet is not permitted. Therefore, if a person had as little as a millionth of a curie of cobalt 60 inside him, it would readily be detected.

Swallowing one millionth of a curie of cobalt 60 will cause internal radiation exposure of about 0.06 rem. The radioactivity will pass through the body and be excreted within a period of a little more than one day.

One millionth of a curie of cobalt 60 deposited in the lungs as a result of an inhalation incident is estimated to cause a radiation exposure of about 3 rem to the lungs over the following year based on standard calculational techniques recommended by the International Commission on Radiological Protection, (ref 12). These techniques provide a convenient way to estimate the amount of radiation exposure a typical individual might be expected to receive from small amounts of internally deposited radioactivity. These techniques account for the gradual removal of cobalt 60 from the lungs through biological processes and the radioactive decay of cobalt 60 with a 5.3 year half life. However in an actual case, the measured biological elimination rate is used in determining the amount of radiation exposure received.

In addition to the control measures to prevent internal radioactivity and the body monitoring frequently performed on those who work with radioactive materials, more sensitive monitoring is also performed during radioactive overhaul work. Shipyard procedures for monitoring internal radioactivity use the type of scintillation detectors which will reliably detect an amount of cobalt 60 inside the body that is more than one hundred times lower than the one millionth of a curie used in the examples above. Shipyards typically monitor for internal radioactivity as part of each radiation medical examination, performed before an employee initially performs radiation work, after he terminates radiation work, and periodically in between. Shipyards also monitor periodically during the year groups of personnel who did the work most likely to have caused spread of radioactive contamination. Any person who has radioactive contamination above the limit anywhere on the skin of his body during regular monitoring at the exit from a radioactive area is monitored for internal radioactivity with the sensitive detector. Also any person who might have breathed airborne radioactivity above limits is monitored with the sensitive detector.

Results of Internal Monitoring in 1978

At the nine shipyards performing work associated with Naval nuclear propulsion plants a total of 11,701 personnel were monitored for internal radioactivity in 1978 using sensitive scintillation detectors. Equipment and procedures provide detection levels at least one hundred times lower than one millionth of a curie. Two persons were found with internal radioactivity in their lungs above this level. One had 0.05 millionths of a curie. This person received his internal radioactivity from separate radioactive work performed outside the Naval nuclear propulsion program.

The other person received internal radioactivity at a support facility. He had 0.03 millionths curie in his gastrointestinal system. Based on his actual biological elimination rate, he received 0.1 rem to the lower large intestine, and he will receive about 0.04 rem to the lungs in the year following this exposure.

EFFECTS OF RADIATION ON PERSONNEL

Control of radiation exposure in the Naval nuclear propulsion program has always been based on the assumption that any exposure no matter how small involves some risk; however, exposure within the accepted limits represents a risk small compared with normal hazards of life. The basis for this statement was presented in the previous Navy report on radiation (ref 9).

More is known about the effects of radiation than almost any industrial hazard to humans. More money has been spent to learn the effects of radiation on humans than for any industrial hazard. The effects of radiation have been put in the form of risk estimates which can be compared with risks from normal hazards of life. Risk estimates have been made by the United Nations Scientific Committee on the Effects of Atomic Radiation (ref 13), the International Commission on Radiological Protection (ref 8), and the U. S. National Academy of Sciences Committee on Biological Effects of Ionizing Radiation (ref 14). All these organizations have developed comparable risk estimates which can be summarized in the following; this will be referred to subsequently as the standard risk estimate:

In a large population group (such as 100,000 people) receiving an annual total of 10,000 man-rem year after year, the increased risk from this radiation appears to be in the region of about one fatal cancer case each year in excess of the normal numbers of cases. Every fifth year this cancer case will be leukemia.

For comparison the eventual cause of death of about 16,000 of a typical group of 100,000 people in the U.S. will be cancer from causes other than this added radiation.

The preceding standard risk estimate can be used to develop risk estimates for personnel exposed to radiation associated with Naval nuclear propulsion plants. In all shipyards there have been a total of about 100,000 personnel monitored for exposure to radiation and their average exposure rate over twenty five years has been 6100 man-rem per year. Therefore according to the above standard risk estimate,

- there should be less than one excess fatal cancer per year and less than one excess leukemia case every five years among the total 100,000 shipyard personnel who have ever been monitored for radiation associated with Naval nuclear propulsion plants.

Radiation exposure received by Naval personnel assigned to nuclear-powered ships and their support facilities has averaged one third of the total exposure to shipyard personnel. Therefore according to the above standard risk estimate,

- there should be less than one excess fatal cancer every three years and less than one excess leukemia case every fifteen years among the approximately 100,000 Naval personnel who have ever been monitored for occupational exposure to radiation associated with Naval nuclear propulsion plants.

Three highly controversial studies have challenged this standard risk estimate as being too low (these are briefly summarized in the previous Navy report on radiation, ref 9). One specifically states the risk estimates are as much as a factor of ten low. Even if the standard risk estimates were increased ten times to meet these challenges, the risks from radiation in the Naval nuclear propulsion program would not be greater than from other normal hazards of everyday life for this same group of personnel.

In contrast, large numbers of scientists believe that the standard risk estimate is too high for gamma radiation at low dose rates under conditions comparable to those in the Naval nuclear propulsion program (ref 15). Essentially every radiation study on animals has shown that damage caused by gamma radiation at low doses is less per rem than from high doses from which the standard risk estimates above is derived. One explanation frequently used is that at low dose rates the body has a chance to heal the damage from gamma radiation more than at high dose rates.

Other examples may also be used to help put into perspective the amounts of radiation exposure received by personnel in the Naval nuclear propulsion program:

- The average radiation exposure of all those monitored in the last 25 years received from radiation associated with the Naval nuclear propulsion program is 0.25 rem. This is only slightly greater than the average radiation exposure received in the U.S. each year from natural background and medical X-rays. (Derived from ref 16)
- The average lifetime occupational radiation exposure of 1.5 rem for shipyard personnel is about one tenth the amount of radiation exposure these same personnel will average over their lifetimes from natural background and medical X-rays. (Derived from ref 16).
- This 1.5 rem average lifetime occupational radiation exposure can also be compared very roughly to the 5 rem received in a year from smoking one pack of cigarettes per day. This comparison is not exact because it requires more lung exposure from natural radioactivity in tobacco to cause the same amount of risk as whole body gamma radiation (ref 17).
- The risk of dying from an automobile accident is 30 or more times higher than the risk of fatal cancer for the average worker with 1.5 rem lifetime radiation exposure.
- The total occupational radiation exposure of 3700 man-rem received by all shipyard personnel from the Naval nuclear propulsion program in 1978 can be compared to the many other sources of radiation exposure received by the U. S. population. Examples follow:
 - 20,000,000 man-rem to the population of the U. S. each year from natural background radiation (ref 16)
 - 17,000,000 man-rem to the population of the U. S. each year from medical and dental radiation (ref 16)
 - 625,000 man-rem to the population of the U. S. from radioactivity in natural gas used for cooking. (ref 17)
 - 100,000 man-rem the one million inhabitants of Denver could save each year if they moved to a region such as Washington, D. C. with lower natural background radiation levels (Derived from ref 16)
 - 12,000 man-rem total to passengers in jet airplane flights in the United States from increased cosmic radiation at the higher altitudes used by jets (ref 18)

Thus, the total occupational radiation exposure received by all shipyard personnel in 1978 is less than one ten thousandth of the total radiation exposure received by the U. S. population from all sources.

CLAIMS FOR RADIATION INJURY TO PERSONNEL

Personnel who consider they have or might have had occupational injury are encouraged to file claims. The compensation systems make allowance for the long latent period for radiation-induced cancer. Naval shipyard personnel are employees of the U. S. Government and therefore file claims with the U. S. Department of Labor's Office of Workmen's Compensation. Shipyards hold no hearing on injury claims. They are not handled in an adversary procedure. The Navy has no rights to present a case to the Labor Department. The claim does not even have to be filed through the shipyard. The shipyard is not permitted to appeal a decision but the employee may appeal. The

primary consideration in the Federal laws and procedures set up for injury compensation is to take care of the Federal employee. The program to compensate Federal employees is well publicized as shown by more than 25,000 claims being paid for Navy employees in 1978. Over half of these claims were filed by shipyard workers. As noted below, however, only a few were related to radiation exposure.

In private shipyards injury compensation claims are handled under the Longshoreman's and Harbor Workers' Compensation Act. The claim may be handled through the shipyard's insurance carrier or by a U. S. Department of Labor claims examiner. Either the employee or the employer may appeal.

Claims for military personnel concerning prior duty are handled through the Veterans Administration.

There have been a total of 58 claims filed for injury from radiation associated with Naval nuclear propulsion plants. Fifty-five originated from employees of the six Naval shipyards, three from one private shipyard, and none that the Navy is aware of from Navy personnel. These claims are summarized in Table 7 and in more detail in the appendix. A number of claims have previously been listed by the Navy as radiation-related because radiation was mentioned as one of a large number of possible causes of an injury. Those which have been handled by the Department of Labor as other than radiation claims have been removed from the Navy list. Two suits have been filed in court alleging injury from radiation. Neither person claims cancer. They are not summarized in this report since these cases are in litigation.

Three claims have been awarded to employees, one for leukemia in 1968 and two for cataracts of the eyes in 1971 and in 1977. The Navy considers all three of these awards were incorrect:

- The leukemia case developed within two years of the occupational exposure of 5.38 rem. This is too short a latency period. The claimant had received hundreds of rem in medical radiation exposure for adenoids. If radiation were to be selected as the cause of this leukemia, then the occupational exposure could not have been more than a tiny part of this total radiation.
- The two cataract cases each had total lifetime radiation exposures of about 3 rem, which is hundreds of times smaller than needed to produce cataracts in the eyes.

From the radiation injury claims filed to date, the Navy has been unable to draw any conclusions concerning radiation injury to personnel occupationally exposed to radiation associated with Naval nuclear propulsion plants.

TABLE 7

CLAIMS FOR RADIATION INJURY TO PERSONNEL

<u>Injury Claimed</u>	<u>Claims Filed</u>	<u>Claims Awarded</u>	<u>Claims Rejected or Deferred</u>	<u>Claims Active</u>
Leukemia	8	1	3	4
Cancer Other Than Leukemia	11	0	6	5
Other	39	2	26	11
Total	58	3	35	20

AUDITS AND REVIEWS

Checks and cross-checks and audits and inspections of numerous kinds have been shown to be essential in maintaining high standards of radiological control. First, each worker is specially trained in radiological control as it relates to his own job. Second, written procedures exist which require verbatim compliance. Third, radiological control technicians and their supervisors oversee radioactive work. Fourth, personnel independent of radiological control technicians are responsible for personnel radiation exposure records.

Fifth, a strong independent audit program is required covering all radiological control requirements. In all shipyards this radiological audit group is independent of the radiological control organization and its findings are reported regularly to senior shipyard management including the shipyard commander. This group performs continuing surveillance of radioactive work. It conducts in-depth audits of specific areas of radiological control. This group checks all radiological control requirements at least annually.

Sixth, the U. S. Department of Energy assigns to each shipyard a representative who reports to the Director, Division of Naval Reactors at headquarters. One assistant to this representative is assigned full time to audit radiological controls, both in nuclear-powered ships and in the shipyard. And seventh, the Naval Sea Systems Command also conducts periodic inspections of radiological control in each shipyard. Similarly, there are multiple levels of audits and inspections for the other Navy shore facilities, tenders, and nuclear-powered ships.

ABNORMAL OCCURRENCES

It is a fact of human nature that people make mistakes. The key to a good radiological control program is to find the mistakes while they are small and prevent the combinations of mistakes that lead to accidents. The preceding section on inspections supports the contention that more attention is given to errors and their prevention in the Naval nuclear propulsion program than to any other single subject. Requiring constant focus on improving performance of radiological work has proven effective in reducing errors.

In addition, radiological control technicians are authorized and required to stop anyone performing work in a manner which could lead to radiological deficiencies. A deficiency, of course is failure to follow a written procedure verbatim. However the broadest interpretation of the term "deficiency" is used in the Navy's radiological control program: anything involved with radiation or radioactivity which could have been done better is also a radiological deficiency.

Radiological deficiencies receive management attention. But there is a higher level of deficiency that is defined as a radiological incident. Incidents attract a great deal of notice, including the personal attention of the Director, Division of Naval Reactors at headquarters. Improvement programs over the years have constantly aimed at reducing the numbers of radiological incidents. As improvements occurred, the definition of what constituted an incident was changed to define smaller deficiencies as incidents. These changes were necessary so that the incident reporting system would continue to play a key role in upgrading radiological controls. As a result it is not practicable to measure performance merely by counting numbers of radiological incidents or deficiencies.

There is a reporting system that has been nearly constant over time and therefore can be used as a basis for comparison. The Department of Energy and its predecessors have used these levels of severity to define radiological occurrences (ref 19). Examples of radiation exposure incidents in each type follow:

- Type A - external radiation exposure over 25 rem in one incident
- Type B - external radiation exposure over 5 rem in one incident
- Type C - external whole body radiation exposure over 3 rem in one quarter year

The Nuclear Regulatory Commission also has criteria defining abnormal occurrences. The Navy regularly evaluates radiological events using these criteria for comparison; results are reported in Table 8.

TABLE 8
ABNORMAL OCCURRENCES
IN THE NAVAL NUCLEAR PROPULSION PROGRAM

<u>Year</u>	<u>Number of Abnormal Occurrences*</u>
1974	0
1975	0
1976	0
1977	0
1978	0

*Abnormal occurrences are reported here if the Navy evaluation determines they meet either the Department of Energy criteria for Type A incidents or the Nuclear Regulatory Commission criteria for quarterly report to Congress as abnormal occurrences

The policy of the Navy is to provide for close cooperation and effective communication with state radiological officials involving occurrences that might cause concern because of radiological effects associated with the ships or shore facilities. The Navy has reviewed radiological matters with state radiological officials in the states where Naval nuclear-nuclear powered ships are based or overhauled. Although there were no occurrences in 1978 which resulted in radiological effects to the public outside these facilities or which resulted in radiological injury to residents of the states working inside these facilities, states were notified when inquiries showed public interest in the possibility such events had occurred.

REFERENCES

- (1) National Council on Radiation Protection and Measurements Report 17, "Permissible Dose from External Sources of Ionizing Radiation," including April 15, 1958 Addendum "Maximum Permissible Radiation Exposures to Man" (originally published in 1954 as National Bureau of Standards Handbook 59)
- (2) International Commission on Radiological Protection Publication 1, "Recommendations of the International Commission on Radiological Protection" (Adopted September 9, 1958), Pergamon Press 1959
- (3) Code of Federal Regulations Title 10 (Energy) Part 20, "Standards for Protection Against Radiation"

- (4) Federal Radiation Council, "Radiation Protection Guidance for Federal Agencies" approved by President Eisenhower May 13, 1960, printed in Federal Register May 18, 1960
- (5) International Commission on Radiological Protection Publication 9, "Recommendations of the International Commission on Radiological Protection" (Adopted September 17, 1965), Pergamon Press 1966
- (6) National Council on Radiation Protection and Measurements Report 39, "Basic Radiation Protection Criteria" January 15, 1971
- (7) Department of Energy Manual Chapter 0524, "Standards for Radiation Protection"
- (8) International Commission on Radiological Protection Report 26, "Recommendations of the International Commission on Radiological Protection" (Adopted January 17, 1977), Pergamon Press 1977
- (9) U. S. Navy Report, "Occupational Radiation Exposure from U. S. Naval Nuclear Propulsion Plants and Their Support Facilities - 1977," M. E. Miles, NT-78-2, March 1978
- (10) U. S. Nuclear Regulatory Commission, "Occupational Radiation Exposure - Tenth Annual Report 1977," NUREG-0463 October 1978
- (11) U. S. Navy Report, "Environmental Monitoring and Disposal of Radioactive Wastes From U. S. Naval Nuclear-Powered Ships and Their Support Facilities - 1978," M. E. Miles, G. L. Sioblom, and J. D. Eagles - NT-79-1 January 1979
- (12) International Commission on Radiological Protection Report 10, "Evaluation of Radiation Doses to Body Tissues from Internal Contamination Due to Occupational Exposure," Pergamon Press 1968
- (13) United Nations Scientific Committee on the Effects of Atomic Radiation, "Sources and Effects of Ionizing Radiation," 1977
- (14) National Academy of Sciences - National Research Council, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation," Report of the Advisory Committee on the Biological Effects of Ionizing Radiations, 1972
- (15) National Council on Radiation Protection and Measurements Report 43, "Review of the Current State of Radiation Protection Philosophy," January 15, 1975
- (16) Environmental Protection Agency, "Estimates of Ionizing Radiation Doses in the United States 1960 - 2000", ORP/CSD 72-1 August 1972
- (17) National Council on Radiation Protection and Measurements Report 56, "Radiation Exposure from Consumer Products and Miscellaneous Sources," November 1, 1977
- (18) U. S. Nuclear Regulatory Commission, "Final Environmental Statement on the Transportation of Radioactive Materials by Air and Other Modes," NUREG-0170, December 1977
- (19) Department of Energy Manual Chapter 0502, "Notification, Investigation and Reporting of Occurrences"

APPENDIXSUMMARY OF CLAIMS FROM RADIATION EXPOSURE
ASSOCIATED WITH NAVAL NUCLEAR PROPULSION PLANTSALL CLAIMS
FROM RADIATION EXPOSURE ASSOCIATED WITH NAVAL NUCLEAR
PROPULSION PLANTS

Shipyard	Claims Filed	Claims Awarded	Claims Rejected or Deferred	Claims Active
Portsmouth Naval Shipyard	9	0	3	6
Electric Boat Division of General Dynamics	3	0	2	1
Norfolk Naval Shipyard	2	1	0	1
Newport News Shipbuilding and Drydock Company	0	0	0	0
Charleston Naval Shipyard	3	0	2	1
Ingalls Shipbuilding	0	0	0	0
Mare Island Naval Shipyard	25	2	13	10
Puget Sound Naval Shipyard	13	0	12	1
Pearl Harbor Naval Shipyard	3	0	3	0
TOTALS	58	3	35	20

CANCER (OTHER THAN LEUKEMIA) CLAIMS
FROM RADIATION EXPOSURE ASSOCIATED WITH NAVAL NUCLEAR
PROPULSION PLANTS

Shipyard	Claims Filed	Claims Awarded	Claims Rejected or Deferred	Claims Active
Portsmouth Naval Shipyard	5	0	2	3
Electric Boat Division of General Dynamics	1	0	1	0
Norfolk Naval Shipyard	0	0	0	0
Newport News Shipbuilding and Drydock Company	0	0	0	0
Charleston Naval Shipyard	1	0	0	1
Ingalls Shipbuilding	0	0	0	0
Mare Island Naval Shipyard	3	0	2	1
Puget Sound Naval Shipyard	1	0	1	0
Pearl Harbor Naval Shipyard	0	0	0	0
TOTALS	11	0	6	5

LEUKEMIA CLAIMS

Portsmouth Naval Shipyard	1	0	0	1
Electric Boat Division of General Dynamics	0	0	0	0
Norfolk Naval Shipyard	2	1	0	1
Newport News Shipbuilding and Drydock Company	0	0	0	0
Charleston Naval Shipyard	0	0	0	0
Ingalls Shipbuilding	0	0	0	0
Mare Island Naval Shipyard	1	0	0	1
Puget Sound Naval Shipyard	2	0	1	1
Pearl Harbor Naval Shipyard	2	0	2	0
TOTALS	8	1	3	4

CLAIMS OTHER THAN CANCER OR LEUKEMIA
FROM RADIATION EXPOSURE ASSOCIATED WITH NAVAL NUCLEAR
PROPULSION PLANTS

Shipyard	Claims Filed	Claims Awarded	Claims Rejected or Deferred	Claims Active
Portsmouth Naval Shipyard	3	0	1	2
Electric Boat Division of General Dynamics	2	0	1	1
Norfolk Naval Shipyard	0	0	0	0
Newport News Shipbuilding and Drydock Company	0	0	0	0
Charleston Naval Shipyard	2	0	2	0
Ingalls Shipbuilding	0	0	0	0
Mare Island Naval Shipyard	21	2	11	8
Puget Sound Naval Shipyard	10	0	10	0
Pearl Harbor Naval Shipyard	1	0	1	0
TOTALS	39	2	26	11

INJURY CLAIMS FROM RADIATION EXPOSURE ASSOCIATED WITH NAVAL NUCLEAR PROPULSION PLANTS

PORTSMOUTH NAVAL SHIPYARD

Occupation	Date Filed	Injury Claim	Lifetime Radiation Exposure-Rem	Status*
Machinist	10/60	Bone Cancer	1.855	REJECTED
Shipfitter	11/73	Lymphosarcoma	2.326	REJECTED
Metals Inspector	11/73	Cryptogenic epileptic condition	7.381	REJECTED
Welder	3/78	Cancer of Rectum	0.419	ACTIVE
Caulker/Chipper	5/78	Lung Cancer	0.544	ACTIVE
Caulker/Chipper	6/78	Cancer of Rectum	4.290	ACTIVE
Welder	8/78	Leukemia	1.530	ACTIVE
Shipfitter	10/78	Polyp on Rectum	8.258	ACTIVE
Marine Mechanic	12/78	Cataract	35.483	ACTIVE

*AWARDED means Department of Labor concluded injury was job related and compensation paid.

REJECTED means Department of Labor concluded injury was not job related.

DEFERRED means Department of Labor concluded claimant did not provide sufficient justification that injury was job related and that claimant has not replied to Department of Labor requests for more information.

ACTIVE means claim is being evaluated by the Department of Labor.

ELECTRIC BOAT DIVISION OF GENERAL DYNAMICS

Occupation	Date Filed	Injury Claim	Lifetime Radiation Exposure-Rem	Status*
Welder	2/74	Radiation and Head Injury	0.010	REJECTED by State Workmen Compensation. However, State paid for psychiatric examination.
Shipping Carpenter	1967	Overexposure; Cancer of Lip	0.068	DEFERRED by insurance company. Removal of lip cancer paid by insurance company.
Health Physicist Monitor	4/78	Loss of Eye	0.234	ACTIVE
<u>NORFOLK NAVAL SHIPYARD</u>				
Boilermaker	3/67	Acute Myelogenous Leukemia	5.38	AWARDED The Navy disagreed with this award. The basis of the Navy disagreement was that (1) his occupational exposure was small compared to his medical exposure, and (2) the leukemia occurred only 2 years after his first occupational exposure which is a too short a latency period.
Electrician	6/78	Leukemia	0	ACTIVE
<u>NEWPORT NEWS SHIPBUILDING AND DRYDOCK COMPANY</u>				
NONE				
<u>CHARLESTON NAVAL SHIPYARD</u>				
Sheet metal worker	11/66	Impaired Vision	4.173	REJECTED
Shipfitter	9/71	Cataract	10.156	REJECTED
Shipfitter	12/78	Cancer of Colon	3.370	ACTIVE

Occupation	Date Filed	Injury Claim	Lifetime Radiation Exposure-Rem	Status*
<u>MARE ISLAND NAVAL SHIPYARD</u>				
Machinist	4/63	Skin condition	0	DEFERRED
Helper electrician	4/64	Blackouts	0	REJECTED
Chemistry Technician	6/65	Cataract	2.961	AWARDED in 1971. The Navy disagrees with this award because the individual's radiation exposure was well below the level considered necessary to produce cataracts. Experts generally agree that many hundreds of rem are required to cause cataracts.
Crane Operator	6/69	Cataract	0	ACTIVE
Janitor	2/70	Partial vision loss, skin condition	0	REJECTED
Radiation Technician	4/70	Tumor caused arm amputation	11.760	REJECTED
Rigger	12/70	Cataract	0.160	REJECTED
Crane Operator	12/70	Cataract	0.080	REJECTED
Crane Operator	1/71	Cataract	0	REJECTED-PRESENTLY IN APPEAL
Marine Machinist	7/71	Cataract	0.580	REJECTED

MARE ISLAND NAVAL SHIPYARD (Continued)

Occupation	Date Filed	Injury Claim	Lifetime Radiation Exposure-Rem	Status*
Shipfitter	9/71	Cataract from steam generator repair work	3.441	AWARDED in 1977. The Navy Disagrees with this award because radiation-caused cataracts generally start in the posterior part of the lens. The claimant's cataracts started in the anterior portion of the lens. In addition the claimant's radiation exposure was well below the threshold level considered necessary to produce cataracts.
Crane Operator	1/72	Cataract	0	REJECTED
Sand Blaster	3/72	Hearing Loss	0	REJECTED
Rigger	5/73	Eye Trouble	1.015	REJECTED-PRESENTLY IN APPEAL
Electrician	2/74	Skin problem on hand	0	ACTIVE
Component cleaner	3/74	Radiation face burn	26.213	ACTIVE
Pipefitter	5/75	Eye trouble	0.060	ACTIVE
Industrial cleaner	1/76	Internal injuries, blood changes	11.430	REJECTED
Laborer	2/76	Heart Condition	0	ACTIVE
Health Physicist	11/76	Chest cancer	2.331	ACTIVE

MARE ISLAND NAVAL SHIPYARD (Continued)

Occupation	Date Filed	Injury Claim	Lifetime Radiation Exposure-Rem	Status*
Painter	12/76	Claustrophobia and Mental disorder	0.330	ACTIVE
Lagger	2/77	Lung disease	7.003	ACTIVE
Security guard	4/77	Brain tumor	0.016	REJECTED-PRESENTLY IN APPEAL
Insulator	6/78	Heart Attack	3.671	ACTIVE
Optical Instrument Technician	11/78	Leukemia	0	ACTIVE
<u>PUGET SOUND NAVAL SHIPYARD</u>				
Welder	6/71	Leukemia	0.079	REJECTED
Radiation monitor	9/71	Stomach cancer	10.566	REJECTED
Metal inspector	9/72	Cataract	29.655	REJECTED
Cement finisher	4/74	Emphysema-many causes including radiation	0	REJECTED
Shipfitter	10/74	Lung ailment-many causes	0	REJECTED-PRESENTLY IN APPEAL
Sheet Metal Worker	12/74	Bronchitis, emphysema-many causes	0	REJECTED
Pipefitter	12/74	Bronchitis-many causes	0.064	REJECTED

PUGET SOUND NAVAL SHIPYARD (Continued)

Occupation	Date Filed	Injury Claim	Lifetime Radiation Exposure-Rem	Status*
Pipefitter	12/74	Epilepsy - many causes	9.548	REJECTED
Machinist	3/75	Cataract	0	REJECTED
Materials Engineer	1/76	Lung injury - many causes	0.037	REJECTED
Shipfitter	12/75 and 7/76	Stress from radio-logical written examinations and nuclear work	5.247	REJECTED
Radiographer	1/77	Lymphocytosis	16.529	REJECTED
Shipfitter	11/77	Leukemia	0.059	ACTIVE

INGALLS SHIPBUILDING

NONE

PEARL HARBOR NAVAL SHIPYARD

Pipefitter	2/70	Leukemia	0.020	REJECTED
Electronic Mechanic	8/73	Upset metabolism	0.180	DEFERRED
Mechanic	11/74	Leukemia	6.140	REJECTED

APPENDIX 2

Report NT-79-1
January 1979

ENVIRONMENTAL MONITORING AND
DISPOSAL OF RADIOACTIVE WASTES
FROM U. S. NAVAL NUCLEAR-POWERED SHIPS
AND THEIR SUPPORT FACILITIES
1978

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ABSTRACT

The environmental effect of disposal of radioactive wastes originating from U. S. Naval nuclear propulsion plants and their support facilities is assessed. The total gamma radioactivity in liquids, less tritium, discharged to all ports and harbors from the more than one hundred Naval nuclear-powered ships and supporting tenders, Naval bases and shipyards was less than 0.002 curie in 1978. The total tritium released to all ports and harbors was less than one curie in 1978. This report confirms that procedures used by the Navy to control releases of radioactivity from U. S. Naval nuclear-powered ships and their support facilities are effective in protecting the environment and the health and safety of the general public.

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SUMMARY

The radioactivity in wastes discussed in this report originates in the pressurized water reactors of U. S. Naval nuclear-powered ships. As of the end of 1978, the U. S. Navy had 113 nuclear-powered submarines and eleven nuclear-powered surface ships in operation. Support facilities involved in construction, maintenance, overhaul and refueling of these nuclear propulsion plants include nine shipyards, thirteen tenders and two submarine bases. This report describes disposal of radioactive liquid wastes, transportation and disposal of solid wastes, and monitoring of the environment to determine the effect of radioactive releases, and updates reports on this subject issued by the Navy in references 1 through 13.* This report concludes that radioactivity associated with U. S. Naval nuclear-powered ships has had no significant or discernable effect on the quality of the environment. A summary of the radiological information supporting this conclusion follows:

From the start of the Naval nuclear propulsion program the policy of the U. S. Navy has been to reduce to the minimum practicable the amounts of radioactivity released into harbors. Navy procedures to accomplish this have been reviewed with the U. S. Department of Energy, the U. S. Nuclear Regulatory Commission and the U. S. Environmental Protection Agency. The total gamma radioactivity released within twelve miles from shore from all U. S. Naval nuclear-powered ships and their support facilities in recent years is shown in Table 1; this includes all harbors both U. S. and foreign entered by these ships.

TABLE 1 RADIOACTIVE LIQUID WASTE RELEASED TO HARBORS FROM U. S. NAVAL NUCLEAR-POWERED SHIPS AND THEIR SUPPORT FACILITIES

Year	Number of Ships In Operation	Radioactivity-Curies (less tritium)
1971	100	less than 0.002
1972	104	less than 0.002
1973	107	less than 0.002
1974	111	less than 0.002
1975	113	less than 0.002
1976	115	less than 0.002
1977	120	less than 0.002
1978	124	less than 0.002

As a measure of the significance of these data, if one person were able to drink the entire amount of radioactivity discharged into any harbor in 1978, he would not exceed the annual radiation exposure permitted for an individual worker by the U. S. Nuclear Regulatory Commission.

Environmental monitoring is conducted by the U. S. Navy in U. S. and foreign harbors frequented by the U. S. Naval nuclear-powered ships. This monitoring consists of analyzing harbor water, sediment and marine life samples for radioactivity associated with Naval nuclear propulsion plants, radiation monitoring around the perimeter of support facilities and effluent monitoring. Environmental samples from each of these harbors are also checked at least annually by a U. S. Department of Energy laboratory to ensure analytical procedures are correct and standardized. The U. S. Environmental Protection Agency has conducted independent surveys in U. S. harbors; results have been consistent with Navy results. These surveys have confirmed that U. S. Naval nuclear-powered ships and support facilities have had no significant effect on the radioactivity of the marine environment.

References appear at end of article.

RADIOACTIVE LIQUID WASTE PROCESSING AND CONTROL

Policy and Procedures Minimizing Release of Radioactivity in Harbors

The policy of the U. S. Navy is to reduce to the minimum practicable the amounts of radioactivity released to the environment, particularly within twelve miles from shore including into harbors. This policy is consistent with applicable recommendations issued by the Federal Radiation Council (incorporated in Environmental Protection Agency in 1970), U. S. Nuclear Regulatory Commission, National Council on Radiation Protection and Measurements, International Commission on Radiological Protection, International Atomic Energy Agency, and National Academy of Sciences—National Research Council (references 14 through 21). Keeping releases small minimizes the radioactivity available to build up in the environment or to concentrate in marine life. To implement this policy of minimizing releases, the Navy has issued standard instructions defining the radioactive waste disposal limits and procedures to be used by U. S. Naval nuclear-powered ships and their support facilities. These instructions were reviewed by the U. S. Department of Energy, the U. S. Nuclear Regulatory Commission and the U. S. Environmental Protection Agency.

Source of Radioactivity

In the shipboard reactors, pressurized water circulating through the reactor core picks up the heat of nuclear reaction. The reactor cooling water circulates through a closed piping system to heat exchangers which transfer the heat to water in a secondary steam system isolated from the primary cooling water. The steam is then used as the source of power for the propulsion plant as well as for auxiliary machinery. Releases from the shipboard reactors occur primarily when reactor coolant water expands as a result of being heated to operating temperature; this coolant passes through a purification system ion exchange resin bed prior to being transferred from the ship.

The principal source of radioactivity in liquid wastes is from trace amounts of corrosion and wear products from reactor plant metal surfaces in contact with reactor cooling water. Radionuclides with half-lives greater than one day in these corrosion and wear products include tungsten 187, chromium 51, hafnium 181, iron 59, iron 55, nickel 63, zirconium 95, tantalum 182, manganese 54, cobalt 58, and cobalt 60. The most predominant of these is cobalt 60, which has a 5.3 year half-life; cobalt 60 also has the most restrictive concentration limit in water as listed by organizations which set radiological standards in references 14, 15, and 16 for these corrosion and wear radionuclides. Therefore, radioactive waste disposal is conservatively controlled by assuming that all the long-lived radioactivity is cobalt 60.

Radioactivity Removal From Liquid Wastes at Shore Facilities

Radioactive liquid wastes at shore facilities are collected in stainless steel tanks and processed through a processing system to remove most of the radioactivity (exclusive of tritium) prior to collection in a clean tank for reuse. Even after processing to approximately 10⁻⁸ microcuries of gamma radioactivity per milliliter, reactor coolant is reused rather than discharged. Illustration 1 shows a simplified block diagram of the waste processing system which consists of particulate filters, activated carbon bed filters, mixed hydrogen hydroxyl resin and colloid removal resin beds. This type of processing system has been developed and used successfully to produce high quality water containing very low radioactivity levels.

Liquid Waste Releases in Harbors

The total amounts of long-lived gamma radioactivity released into harbors and seas within twelve miles from shore have been less than 0.002 curie during each of the last eight years. This total is for releases

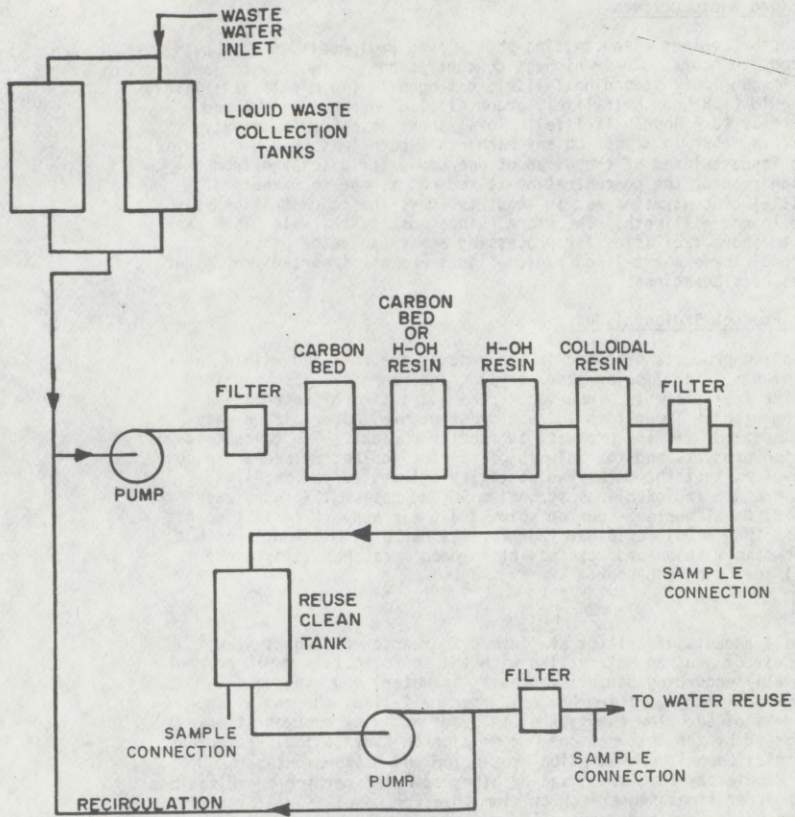


ILLUSTRATION 1
SIMPLIFIED DIAGRAM OF WASTE PROCESSING
SYSTEM

from U. S. Naval nuclear-powered ships and from the supporting shipyards, tenders and submarine bases, and at operating bases and home ports in the U. S. and overseas and all other U. S. and foreign ports which were visited by Naval nuclear-powered ships. This quantity is conservatively reported as if it consisted entirely of cobalt 60, which is the predominant long-lived gamma radionuclide and also has the most stringent concentration limits.

To put this small quantity of radioactivity into perspective, it is less than the quantity of naturally occurring radioactivity (reference 22) in the volume of saline harbor water occupied by a single nuclear-powered submarine.

Although volumes are of less significance than the amounts of radioactivity released, Table 1 of earlier reports has also shown that the total volume of liquids released within twelve miles from shore has been reduced from millions of gallons per year in the 1960's to less than 25 thousand gallons per year beginning in 1973. Thus, the Navy has achieved its policy of reducing releases of radioactive liquids in harbors to the minimum practicable amounts. Therefore, volumes have been deleted from this report.

Short Lived Radionuclides

Reactor coolant also contains short-lived radionuclides with half-lives of seconds to hours. Their highest concentrations in reactor coolant are from nitrogen 16 (7 second half-life), nitrogen 13 (10 minute half-life), fluorine 18 (1.8 hour half-life), argon 41 (1.8 hour half-life) and manganese 56 (2.6 hour half-life). Total short-lived radioactivity released in water in a year to any harbor has been less than 0.001 curie. For the longest-lived of these, about one day after discharge from an operating reactor the concentration is reduced to one thousandth of the initial concentration and in about two days the concentration is reduced to one millionth. Therefore, since most of the water is transferred to shore facilities for processing and reuse rather than discharged, these short-lived radionuclides are not important for water disposal considerations.

Fission Product Radionuclides

Fission products produced in the reactor are retained within the fuel elements. The fission gases krypton and xenon are also retained within the fuel elements. However, trace quantities of naturally occurring uranium impurities in reactor structural materials release small amounts of fission products to reactor coolant. The concentrations of fission products and the volumes of reactor coolant released are so low, however, that the total radioactivity attributed to long-lived fission product radionuclides, strontium 90 and cesium 137, in releases from U. S. Naval nuclear-powered ships and their support facilities has been less than 0.001 curie per year for all harbors combined. Fallout of these same fission products has often been more than this in one rainfall in a single harbor.

Tritium

Small amounts of tritium are formed in reactor coolant systems as a result of neutron interaction with the approximately 0.015 percent of naturally occurring deuterium present in water, and other nuclear reactions. Although tritium has a 12 year half-life, the radiation produced is of such low energy that the radioactivity concentration guide issued by the International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, the U. S. Nuclear Regulatory Commission and by other standard-setting organizations is one hundred times higher for tritium than for cobalt 60. This tritium is in the oxide form and chemically indistinguishable from water; therefore it does not concentrate significantly in marine life or collect on sediment as do other radionuclides.

Tritium is naturally present in the environment because it is generated by cosmic radiation in the upper atmosphere. Reference 23 reports that the production rate from this source is about six million curies per year, which through rainfall causes a tritium inventory in the oceans of about one hundred million curies. Because of this naturally occurring tritium, much larger releases of tritium than are conceivable from Naval nuclear reactors would be required to make a measurable change in the background tritium concentration.

The total amount of tritium released during each of the last ten years from all U. S. Naval nuclear-powered ships and their supporting tenders, bases and shipyards has been less than 200 curies. Most of this has been into the ocean greater than twelve miles from shore. The total tritium from the entire nuclear Navy is less than single electrical generating nuclear power stations typically release each year (reference 24). Total tritium released into harbors within twelve miles from shore was less than one curie in 1978. Such releases are too small to increase measurably the tritium concentration in the environment. Therefore, tritium has not been combined with the data on other radionuclides in other sections of this report.

Carbon 14

Carbon 14 is also formed in small quantities in reactor coolant

systems as a result of neutron interactions with nitrogen and oxygen. Carbon 14 decays with a half-life of 5730 years; however, only low energy beta radiation is emitted as a result of this decay process. As a result, the radioactivity concentration guide for carbon 14 in its chemical form in air issued by the International Commission on Radiological Protection, the National Council on Radiation Protection and Measurements, the U. S. Nuclear Regulatory Commission and by other standard-setting organizations is three thousand times higher than for cobalt 60.

Carbon 14 occurs naturally in the environment. It is generated from cosmic radiation interactions with nitrogen and oxygen in the upper atmosphere and oxidized to form carbon dioxide. Carbon 14 is chemically indistinguishable from other radionuclides of carbon. The carbon dioxide diffuses and convects throughout the atmosphere and enters the earth's carbon cycle. Reference 25 states that the earth's carbon 14 inventory is estimated to be about three hundred and ten million curies. The total amount of carbon 14 released during each of the last ten years from the operation of all U. S. Naval nuclear-powered ships and their supporting tenders, bases and shipyards has been less than 100 curies, most of which is released into the atmosphere at sea beyond twelve miles from shore. The total carbon 14 radioactivity released in a year in any harbor has been less than 0.1 curie. Since the inventory of naturally occurring carbon 14 is so large, it is extremely unlikely that releases from Naval nuclear reactors could result in a measurable change in the background concentration of carbon 14. Therefore, carbon 14 has not been combined with the data on other radionuclides in other sections of this report.

Liquid Waste Releases at Sea

Radioactive liquids incidental to the operation of the nuclear propulsion plants are released at sea under strict controls. These ocean releases are consistent with recommendations the Council on Environmental Quality made in 1970 to the President in reference 26, and consistent with the Marine Protection, Research and Sanctuaries Act, reference 27. Procedures and limits for ocean releases have been consistent with recommendations made by the National Academy of Sciences—National Research Council in reference 18 and by the International Atomic Energy Agency in reference 19. These releases have contained much less radioactivity than these reports considered would be acceptable. Total long-lived radioactivity excluding tritium, released farther than twelve miles from shore by U. S. Navy nuclear-powered ships and supporting tenders is shown in Table 2 for recent years. This is the total amount released from over 100 ships at different times of the year in the open sea at long distances from land in small incremental amounts, and under rapid dispersal conditions due to wave action. The quantity of radioactivity released to the open ocean in 1978 was 0.4 curie, which is less than the naturally occurring radioactivity in a cube of sea water approximately 100 yards on a side.

TABLE 2 TOTAL RADIOACTIVITY IN LIQUID WASTE RELEASED AT SEA ORIGINATING FROM U. S. NAVAL NUCLEAR-POWERED SHIPS

	Radioactivity-Curies (less tritium)
1974	0.4
1975	0.4
1976	0.4
1977	0.4
1978	0.4

Loss of USS THRESHER and USS SCORPION

Two U. S. Navy nuclear-powered submarines have been lost at sea in the Atlantic Ocean. The submarine THRESHER sank 10 April 1963, 100 miles

from land in water 8,500 feet deep at latitude 41°45'N and longitude 65°00'W. The submarine SCORPION sank between 21 and 27 May 1968, 400 miles southwest of the Azores in more than 10,000 feet of water. The reactors used in all U. S. Naval submarines and surface ships are designed to minimize potential hazards to the environment even under the most severe casualty conditions such as actual sinking of the ship. First, the reactor core is so designed that it is physically impossible for it to explode like a bomb. Second, the reactor fuel elements are made of materials that are extremely corrosion resistant, even in sea water. The reactor core could remain submerged in sea water for decades without releases of fission products while the radioactivity decays, since the protective cladding on the fuel elements corrodes only a few millionths of an inch per year. Thus, in the event of a serious accident where the reactor is completely submerged in sea water, the fuel elements will remain intact for an indefinite period of time, and the radioactive material contained in these fuel elements should not be released. The maximum rate of release and dispersal of the radioactivity in the ocean, even if the protective cladding on the fuel were destroyed, would be so low as to be insignificant.

Radioactive material could be released from this type of reactor only if the fuel elements were actually to melt and, in addition, the high-strength, all-welded reactor system boundary were to rupture. The reactor's many protective devices and inherent self-regulating features are designed to prevent any melting of the fuel elements. Flooding of a reactor with sea water furnishes additional cooling for the fuel elements and so provides added protection against the release of radioactive fission products.

Radiation measurements, water samples, bottom sediment samples and debris collected from the area where THRESHER sank were analyzed for radioactivity shortly after the sinking and again in 1965 by various laboratories with highly sensitive equipment. Similarly, sea water and bottom sediment samples taken near SCORPION's hull were analyzed for radioactivity. None of these samples showed radioactivity above naturally occurring background levels and none showed evidence of radioactivity released from either THRESHER or SCORPION.

In 1977 followup samples of water, sediment, marine life and debris were collected from the immediate THRESHER debris areas. None of these samples showed any evidence of release of radioactivity from the reactor fuel elements. However, cobalt 60 released from THRESHER coolant systems was detectable at low levels in sediment samples from a localized area which was not sampled during previous surveys. The cobalt 60 radioactivity in these sediment samples was small compared to naturally occurring radioactivity. Cobalt 60 was not detectable in the samples of water, marine life or debris. Thus, the THRESHER and SCORPION have not had a significant effect on the radioactivity in the environment.

SOLID RADIOACTIVE WASTE DISPOSAL

During maintenance and overhaul operations, solid low-level radioactive wastes consisting of contaminated rags, plastic bags, paper, filters, ion exchange resin and scrap materials are collected by nuclear-powered ships and their support facilities. These low level radioactive materials from nuclear-powered ships are required to be strictly controlled to prevent loss. These controls include Naval accountability procedures which require serialized tagging and marking and signatures by radiologically trained personnel.

Solid radioactive waste materials are packaged in strong tight containers, shielded as necessary and shipped to burial sites licensed by the U. S. Nuclear Regulatory Commission or a State under agreement with the U. S. Nuclear Regulatory Commission. Solid radioactive materials from Naval nuclear-powered ships have not been dumped at sea since 1970 when the Navy issued procedures prohibiting sea disposal

of solid radioactive materials. Shipyards and other shore facilities are not permitted to dispose of radioactive solid wastes by burial on their own sites.

Table 3 summarizes total radioactivity and volumes of radioactive solid waste disposal for the last five years. Table 3 includes all waste generated at the listed facilities because any radioactive waste generated by U. S. nuclear-powered ships is transferred to the listed facilities. The quantity of solid radioactive waste in any one year from a particular facility depends on the amount and type of support work performed that year. Table 3 does not include expended fuel or radioactive material associated with expended fuel since expended fuel is shipped from the refueling shipyard by the Department of Energy to its facilities in Idaho for processing in the same manner as other expended nuclear fuel.

Because of efforts to minimize solid waste and the utilization of compaction equipment, total volumes have been reduced by one half in the past ten years in spite of increasing work caused by increasing numbers of ships. The average annual volume for the entire Naval nuclear propulsion program could be contained in a cube measuring fifteen yards on a side. The total annual volumes of solid radioactive waste from the Naval nuclear propulsion program listed in Table 3 are less than some individual nuclear electric power reactors generate annually. The total annual volumes are also less than 5 percent of the solid radioactive waste generated annually by all nuclear electric power reactors (reference 24) and less than 2 percent of the total volumes of radioactive solid waste buried in all U. S. commercial burial grounds each year (reference 28).

TRANSPORTATION OF RADIOACTIVE MATERIAL

Shipments of radioactive materials in the Navy nuclear propulsion program are required to be made in accordance with regulations of the U. S. Department of Transportation, U. S. Department of Energy, and U. S. Nuclear Regulatory Commission. The purpose of these regulations is to ensure that shipments of radioactive material are adequately controlled to protect the environment and the health and safety of the general public. These regulations are applicable to all radioactive material shipments including waste. The shipments discussed herein cover areas in addition to waste for completeness.

The above regulations provide requirements for the container design, certification, and identification as applicable for the specific quantity, type and form of radioactivity being shipped. Naval shipping container design requirements meet all regulatory requirements and invoke shielding and integrity specifications. They provide for testing of container designs, training and qualification of workers who construct containers, and quality control inspections during fabrication to ensure the containers will meet their design requirements.

In addition to imposing requirements of Federal transportation regulations, the Navy has issued standard instructions to further control shipments of radioactivity associated with U. S. Naval nuclear propulsion plants. Only designated persons knowledgeable in shipping regulations are permitted to authorize shipments of radioactive material. Protective transport service such as signature security service or sealed shipping vehicles are required for these shipments to ensure point-to-point control and traceability of each shipment from shipper to receiver. Return receipts are required to be made in writing by receivers to ensure that radioactive material has not been lost in shipment. Receipt inspection of containers of radioactive material and accompanying documents are required promptly after receipt to monitor compliance. Even minor discrepancies from detailed shipping regulations are required to be reported to the shipper so that correction can be made in future shipments. This is done to ensure compliance with shipping regulations.

TABLE 3 RADIOACTIVE SOLID WASTE FROM U. S. NAVAL NUCLEAR-POWERED SHIPS AND THEIR SUPPORT FACILITIES FOR 1974 THROUGH 1978.

Facility	1974		1975		1976		1977		1978	
	Thousand Cubic Feet	Curies	Thousand Cubic Feet	Curies	Thousand Cubic Feet	Curies	Thousand Cubic Feet	Curies	Thousand Cubic Feet	Curies
Portsmouth, New Hampshire Naval Shipyard	7	4	14	6	6	7	9	6	6	2
Groton, New London, Conn. Electric Boat Division., Tender at State pier, & Sub Base	7	4	5	3	7	4	8	14	3	<1
Newport News, Virginia Newport News Shipbuilding Norfolk, Virginia	4	4	2	2	2	5	2	5	3	15
Naval Shipyard and Tenders Charleston, South Carolina	3	5	4	4	11	5	6	1	4	2
Naval Shipyard and Tenders Pascagoula, Mississippi	4	22	3	13	4	20	7	13	7	17
Ingalls Shipbuilding Div. San Diego, California	3	5	2	6	3	1	3	10	2	1
Tenders Vallejo, California	<1	<1	<1	2	1	<1	1	4	1	<1
Mare Island Naval Shipyard Bremerton, Washington	7	34	11	19	8	10	7	27	11	18
Puget Sound Naval Shipyard Pearl Harbor, Hawaii	20	306	14	7	8	34	6	10	7	5
Naval Shipyard & Sub Base	6	3	2	1	3	6	4	1	4	12
TOTAL	62	387	58	63	53	92	53	91	48	72

NOTES:

- (1) This table includes all radioactive waste from tenders and nuclear-powered ships. This radioactivity is primarily cobalt 60. This radioactive waste is shipped to burial facilities licensed by the U. S. Nuclear Regulatory Commission or State.
- (2) Volumes less than 500 cubic feet are reported <1 thousand and less than 0.5 curie is reported <1.

Radioactive materials shipped in the Naval nuclear propulsion program include anticontamination clothing for laundry, small sealed sources used for calibrating radiation monitoring instruments, tools and equipment used for radioactive work, low-level radioactive waste, radioactive components and new and spent nuclear fuel. A total of approximately 1500 shipments were made in 1978, which is a small part of the approximately two million shipments of radioactive materials made annually in the United States (Reference 29).

Nearly all radioactive shipments in the Naval nuclear propulsion program contain only low-level radioactivity classified under Department of Transportation regulations as low specific activity or limited quantity shipments. The predominant radionuclide associated with these shipments is cobalt 60 in the form of insoluble metallic oxide corrosion products attached to surfaces of materials inside shipping containers. Most low-level shipments are made by truck. Air transport is used no more than a few times per year for the Naval nuclear propulsion program. These air shipments involve only very low-level radioactivity and are not shipped on passenger planes.

Nearly one-half of the low-level radioactivity shipments are minute quantities in sealed instrument calibration check sources. These sources contain insignificant quantities of radioactivity which are comparable to the radioactivity in typical ionization type smoke detectors. Approximately 40 percent of the shipments are anticontamination clothing, equipment and tools. The anticontamination laundry involves shipments of special outer clothing potentially contaminated with low-levels of radioactivity while worn in controlled work areas. This laundry is shipped by Nuclear Regulatory Commission licensed contractors to their facilities for cleaning. On the average, one shipment of low-level radioactive waste per month is made from each facility listed in Table 3.

The remaining few shipments are new and spent nuclear fuel and radioactive components associated with spent nuclear fuel and are shipped by the U. S. Department of Energy. Spent nuclear fuel shipments are made to Department of Energy facilities for disposition. Such shipments are made infrequently since U. S. Naval nuclear-powered ships need refueling infrequently. Measures are carried out to assist in safeguarding these shipments and assuring they reach their destination. Each spent fuel shipment is escorted by U. S. Government representatives. Each shipping container is specifically designed to withstand extreme accident impacts, fire, or water immersion, and to prevent release of the material to the environment in the event of an accident. The cargo is non-explosive and non-flammable. Similarly the radioactive components contain radioactive material in insoluble form that should not be dispersed even in the event of an accident.

Estimates of radiation exposure to transportation crews and the general public from shipments of radioactive materials in the Naval nuclear propulsion program have been made in a manner consistent with that employed by the U. S. Nuclear Regulatory Commission in reference 29. Based on comparisons of the types and numbers of radioactive shipments made, the total annual radiation exposure to all transportation crews for all shipments is estimated to be less than 3 man-rem. If one person were to receive all this exposure, he would not exceed the radiation exposure permitted for an individual worker by the U. S. Nuclear Regulatory Commission. The total estimated radiation exposure for the public along transportation routes is not more than a few times higher than the exposure to transportation workers. The maximum exposure to any individual member of the public would be far less than received from natural radiation.

Shipments of radioactive materials associated with Naval nuclear propulsion plants have not resulted in any measureable release of radioactivity to the environment. There have never been any significant accidents involving release of radioactive material during shipment since the Naval nuclear propulsion program began. In general, the few

accidents that have occurred involved incidents such as broken truck axles or slight external damage to a shipping container with no release of radioactivity. In one incident a train collision resulted in minor denting of a new fuel shipping container with no loss of integrity of the container, no damage to the fuel and no release of radioactivity. In the only two instances that involved loss of contents, one quart containers holding samples were broken open in shipment. In one case this occurred when a cargo aircraft crashed. The other container was lost from a commercial ship. Both containers were recovered and there was no measureable radioactivity released since the original contents were less than one millionth of a curie, too small to be measureable in the environment.

The requirements of the Naval nuclear propulsion program specify that the carriers for all radioactive material shipments shall have accident plans which identify the actions to be taken in the event the transportation vehicle is involved in an accident. These plans provide for notification of civil authorities, and the originating facility. The U. S. Navy would communicate with and cooperate fully with State radiological officials in the event of occurrences involving shipment of radioactive materials.

ENVIRONMENTAL MONITORING

To provide additional assurance that procedures used by the U. S. Navy to control radioactivity are adequate to protect the environment, the Navy conducts environmental monitoring in harbors frequented by its nuclear-powered ships. Environmental monitoring surveys for radioactivity are periodically performed in harbors where U. S. Naval nuclear-powered ships are built or overhauled and where these ships have home ports or operating bases. Samples from each harbor monitored are also checked at least annually by a U. S. Department of Energy laboratory to ensure analytical procedures are correct and standardized. The Department of Energy laboratory results have been consistent with shipyard and operating base results.

Navy Environmental Monitoring Program

The current Navy environmental monitoring program consists of analyzing samples of harbor water and sediment, supplemented by shoreline surveys, posted dosimeters and effluent monitoring. Sampling harbor water and sediment each quarter year is emphasized since these materials would be the most likely affected by releases of radioactivity. Marine life samples have also been collected from some harbors.

Five water samples are taken in each harbor once each quarter year in areas where nuclear-powered ships berth and from upstream and downstream locations. These samples are analyzed for gross gamma radioactivity and for cobalt 60 content. A solid state lithium-drifted germanium detector with a multichannel analyzer is used to measure gross gamma activity in an energy range from 0.1 MeV to 2.1 MeV expressed in terms of cobalt 60 equivalent and to analyze the resulting gamma data for the presence of cobalt 60. Procedures for analysis will detect cobalt 60 if its concentration exceeds one three hundredth of the U. S. Nuclear Regulatory Commission limit of reference 14. No cobalt 60 has been detected in any of the water samples from all harbors monitored.

A radiological laboratory of the Environmental Protection Agency has analyzed samples from harbors to identify radionuclides present in sediment. These analyses showed cobalt 60 was the predominant radionuclide added to sediment from Naval nuclear reactor operations. Therefore, Navy monitoring procedures require collecting in each harbor approximately 20 to 120 sediment samples once each quarter year for cobalt 60 and gross gamma analyses. Locations and numbers of sediment samples for a particular harbor depend on the size of the harbor and the number and separation of locations where nuclear-powered ships berth. Sampling points are selected to form a pattern around ship berthing locations and to provide points in

areas away from these berthing locations. The sampling locations are selected individually for each harbor considering characteristics of the harbor. Sediment samples are collected using the dredge shown in Illustration 2. The dredge samples a surface area of 36 square inches and has been modified to collect only the top one-half to one inch of sediment. The top layer was selected because it should be more mobile and more accessible to marine life than deeper layers. After the dredge is lowered to the harbor bottom, the messenger weight lowered on the support from the surface causes the spring-loaded jaws on the dredge to close and trap the sediment. The samples are placed directly into a one quart container lined with a plastic bag. Each sediment sample is analyzed for gamma activity in the container in which collected using the lithium-drifted germanium detector with a multichannel analyzer. The sediment samples are not dried prior to analysis but excess water is drained off. Gross gamma activity in an energy range from 0.1 MeV to 2.1 MeV is expressed in terms of equivalent cobalt 60 and the resulting gamma data is analyzed for the presence of cobalt 60 activity. Results of the sediment samples from harbors monitored by the Navy in the U. S. and possessions for 1978 are summarized in Table 4.

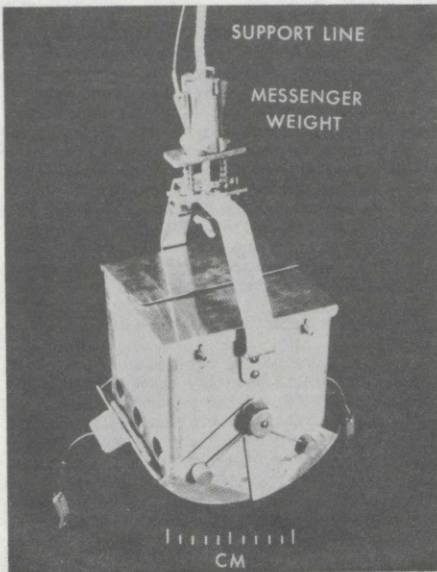


ILLUSTRATION 2

DREDGE FOR SAMPLING HARBOR SEDIMENT

Evaluation of the data summarized in Table 4 shows that low-level cobalt 60 radioactivity in harbor bottom sediment is detected around a few piers at operating bases and shipyards where nuclear-powered ship maintenance and overhauls have been conducted over a period of several years. The activity detected is from operations in the early 1960's since releases such as shown earlier in Table 1 are too small to be detectable in the harbors. Cobalt 60 is not detectable above background levels in general harbor bottom areas away from these piers. Maximum total radioactivity observed in a U. S. harbor is less than 0.1 curie of cobalt 60. This radioactivity is small compared to background; based

TABLE 4 SUMMARY OF 1978 SURVEYS FOR COBALT 60 IN BOTTOM SEDIMENT OF U. S. HARBORS WHERE U. S. NAVAL NUCLEAR-POWERED SHIPS HAVE BEEN REGULARLY BASED, OVERHAULED OR BUILT

	Number of Samples with Cobalt 60 less than 3 pCi/g*	Number of Samples with Cobalt 60 greater than 30 pCi/g	Total Bottom Area with Cobalt 60 over 3 pCi/g** (Square Kilometers)	Estimated Total*** Cobalt 60 in Top Layer of Sediment (Curies)
Portsmouth, New Hampshire	176	0	0	ND
Naval Shipyard				
Groton, New London, Conn.	531	13	0	.02
Electric Boat Division, State Pier and Submarine Base				
Newport News, Virginia	141	0	0	ND
Newport News Shipbuilding				
Norfolk, Virginia	248	0	0	ND
Naval Shipyard and Base				
Charleston, South Carolina	216	0	0	ND
Naval Shipyard and Bases				
Pascagoula, Mississippi	80	0	0	ND
Ingalls Shipbuilding Division				
San Diego, California	244	0	0	ND
Navy Piers				
Long Beach, California	153	0	0	ND
Naval Shipyard and Base				
Vallejo, California	224	0	0	ND
Mare Island Naval Shipyard				
Bremerton, Washington	248	0	0	ND
Naval Shipyard and Base				
Pearl Harbor, Hawaii	172	0	0	ND
Naval Shipyard and Sub Base				
Apra Harbor, Guam	128	0	0	ND
Port Canaveral, Florida	80	0	0	ND

NOTE: *Minimum detectable radioactivity is approximately 0.2 pCi/g (picocurie per gram). Results in units of pCi/cm² range from two to four times the value of pCi/g. $1 \text{ pCi} = \frac{1}{10} \times 10^{-12} \text{ Ci}$

**One square kilometer is approximately equal to 0.4 square mile. Areas with cobalt 60 over 3 pCi/g were in immediate vicinity of piers used for berthing nuclear-powered ships.

***Where total cobalt 60 in the surface sediment layer is less than 0.01 curie, ND is reported. Samples more than one foot deep from several harbors show that total cobalt 60 present may be two to five times that measured in the surface layer.

on the typical concentrations of naturally occurring radioactivity such as potassium 40, radium, uranium and thorium which are described in reference 22 for marine sediment, the natural radioactivity in the sediment of a typical harbor amounts to hundreds of curies. Comparison to previous environmental monitoring data in references 1 through 13 shows that these environmental cobalt 60 levels have been steadily decreasing.

The first data column in Table 4 includes all samples with less than three picocuries of cobalt 60 per gram of sediment. Most of the sediment samples did not contain detectable cobalt 60 and are tabulated in this range. In this range cobalt 60 is difficult to distinguish from the levels of naturally occurring radioactivity such as potassium, radium, uranium and thorium. Cobalt 60 in sediment in this low range may also be detectable as a result of world wide dispersion from atmospheric nuclear weapons testing.

The value of 30 picocuries per gram was selected for the top of the second range of data in Table 4. A measure of the significance of this range is that if all a person's food were to contain cobalt 60 in this range of activity throughout the year, he would not exceed radiation exposure levels permitted in references 14, 15, and 16 for members of the general public. Only a small fraction of the sediment samples are in this second range and none of the samples exceeded this range in 1978. Data on uptake of this cobalt 60 by marine life obtained to date show that in the salt water harbor bottom environments, no significant buildup of cobalt 60 occurs in marine life. EPA evaluation in reference 30 shows that the cobalt 60 from Naval nuclear propulsion plants is in the form of metallic corrosion product particles which do not appear to be concentrated in the food chain. Because of the nature of the radioactivity and low concentrations noted in Table 4, extensive monitoring of radioactivity in marine life has not been necessary as part of routine environmental monitoring programs in these harbors.

In addition to Navy analysis of environmental samples at least two sediment samples from each harbor monitored have been sent each year to a U. S. Department of Energy laboratory, as a check of Navy results. This Department of Energy laboratory provides a further check on the quality of environmental sample analyses by participating in the quality control programs sponsored by the Department of Energy and the Environmental Protection Agency.

The check samples were analyzed for gamma radionuclides in a manner similar to Navy procedures but with greater sensitivity. Illustration 3 depicts the gamma spectra for two such samples. Both spectra show the presence of abundant naturally occurring radionuclides which contribute to measured radioactivity even if cobalt 60 were not present. The upper spectrum is for a sample to which cobalt 60 has been added to an activity of approximately 3 picocuries per gram and shows easily recognizable energy peaks due to the presence of this small activity of cobalt 60. The lower spectrum depicts the appearance of most of the sediment samples in the first column in Table 4.

In addition to the extensive quarterly monitoring of harbor water and sediment, selected samples of marine life such as mollusks, crustaceans and marine plants have been collected in 1978 from most harbors monitored. Marine life samples are also analyzed using a lithium-drafted germanium detector with a multi-channel analyzer. No cobalt 60 associated with U. S. Naval nuclear-powered ships has been detected in these samples of marine life.

For comparison, references 31 and 32 contain evaluations by laboratories of the Environmental Protection Agency and of the Department of Energy of the effects on the environment from the accumulation near points of discharge of radionuclides from several nuclear facilities. The referenced reports conclude for these other facilities that radioactivity levels much greater than shown in Table 4 have caused no significant radiation exposure to the general public.

In all monitored harbors, twice per year shoreline areas uncovered at low tide are surveyed for radiation levels with sensitive scintillation detectors to determine if any radioactivity from bottom sediment washed ashore. All results were the same as background radiation levels in these regions, approximately 0.01 millirem per hour. Thus, there is no evidence in these ports that radioactivity from sediment is washing ashore.

Ambient radiation levels are measured using sensitive thermoluminescent dosimeters continuously posted at locations outside the boundaries of areas where radioactive work is performed. These dosimeters are also posted at locations remote from support facilities to measure background radiation from natural radioactivity. Results of dosimeters posted at support facilities between radiologically controlled areas and the general public are compared with dosimeters posted at remote background locations up to several miles away. These results showed that radiation exposure to the general public from radioactive work on Naval nuclear propulsion plants has not increased above that received from natural background radiation.

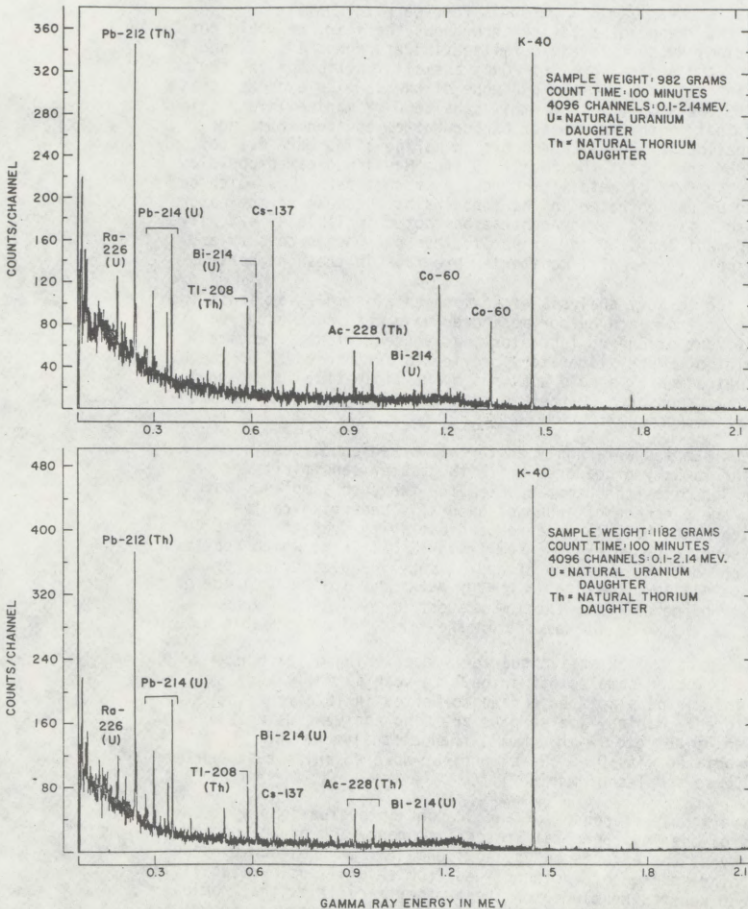


ILLUSTRATION 3 GAMMA SPECTRA OF HARBOR BOTTOM SEDIMENT SAMPLES WITH LITHIUM-DRIFTED GERMANIUM DETECTOR

Naval nuclear reactors and their support facilities are designed to ensure there are no significant discharges of radioactivity in airborne exhausts. Radiological controls are exercised in support facilities to preclude exposure to working personnel to airborne radioactivity exceeding limits for the general population specified in reference 14. These controls include a total containment concept for radioactive materials and provide a barrier to prevent significant radioactivity from becoming airborne. Further, all air exhausted from these facilities is passed through high efficiency particulate air filters and monitored during discharge. Comparison of sensitive airborne radioactivity measurements in shipyards demonstrates that air exhausted from facilities actually contained a smaller amount of radioactivity than this same air contained when it was drawn from the environment into the facilities. There were no discharges of airborne radioactivity above concentrations normally present in the atmosphere.

ENVIRONMENTAL PATHWAYS ANALYSIS

Results of monitoring of environmental samples described above have shown that environmental radioactivity levels have not been changed appreciably and therefore radiation exposure to the public from operations of nuclear-powered ships and their support facilities is too low to measure. Nevertheless, a detailed analysis has been performed to provide a quantitative estimate of the radiation exposure to which any member of the general public might be exposed as a result of radioactivity in liquid and airborne effluents.

This analysis has been performed in a conservative manner which ensures that the estimated exposure is higher than any actual exposure would be. For example, the sites chosen for analysis were shipyards since the amount of radiological work at these facilities is considerably higher than at other types of support facilities. Quantities of radioactivity from shipyard releases used in this analysis are higher than have been measured from any shipyard in the last five years. Values of environmental parameters including meteorological conditions and radionuclide concentration factors have been chosen to provide conservative results. In addition, the analysis assumes the individual receiving the maximum exposure is located right at the site boundary. Thus, the actual exposures to members of the public are expected to be lower than the results of this analysis.

The environmental pathways which were considered are depicted in Illustration 4, which is based on reference 16. The hypothetical releases assumed are listed in Table 5. Table 6 shows the assumed usage parameters which are based on reference 33. Concentration factors for radionuclides in the marine environment were assumed as published in reference 34 and are also in Table 6. The pathways analysis, including meteorology, population distribution, and radiological exposure rates was performed in a manner consistent with that employed by the U. S. Nuclear Regulatory Commission in reference 33.

Results of the analysis are summarized in Tables 7 and 8. Table 7 compares the estimated maximum exposure to a member of the public with guidelines of the Nuclear Regulatory Commission, although these guidelines are not applicable to nuclear-powered ships and their support facilities. Those numerical guidelines on calculated radiation exposures have been issued by the Nuclear Regulatory Commission in reference 21 for implementing the concept that radioactivity in effluents from light water nuclear electric power reactors should be limited to amounts and quantities as low as reasonably achievable. These numerical guidelines of the NRC are consistent with environmental standards for the uranium nuclear fuel cycle issued by the Environmental Protection Agency in reference 35. Table 8 presents the estimated total whole-body radiation exposure to the total population within 50 miles from the assumed radioactivity releases compared with the radiation exposure received by the same population from natural background radioactivity, as reported in references 20, 25 and 36. As shown in Tables 7 and 8, conservative estimates of the

TABLE 5 RADIONUCLIDE RELEASES ASSUMED FOR ENVIRONMENTAL PATHWAYS ANALYSIS

Radionuclide	Assumed Annual Release, Curie	
	<u>Liquid Release</u>	<u>Airborne Release</u>
Cobalt 60	0.001	0.001
Tritium	0.100	0.001
Carbon 14	*	0.100
Krypton 83m	*	0.020
Krypton 85m	*	0.024
Krypton 85	*	0.001
Krypton 87	*	0.050
Krypton 88	*	0.020
Xenon 131m	*	0.005
Xenon 133m	*	0.010
Xenon 133	*	0.210
Xenon 135	*	0.250
Argon 41	*	0.410

*These gaseous radionuclides are released into the air, not into water.

TABLE 6 ENVIRONMENTAL EXPOSURE TIMES, CONSUMPTION AND CONCENTRATION PARAMETERS ASSUMED FOR ENVIRONMENTAL PATHWAYS ANALYSIS

Pathway Parameter*	Assumed Parameter Value	
	<u>For Highest Individual</u>	<u>For Average Individual</u>
Fraction of Year Occupancy.		
For Air Immersion	1	1
For Land Deposition	1	1
Along Shoreline	.05	.0005
Swimming	.01	.0001
Boating	.01	.0001
Food Consumption		
Leafy vegetables, Kg/year	72	18
Water, liters/year	730	180
Fish,** Kg/year	18	2.3
Mollusks,** Kg/year	9	.25
Crustacea,** Kg/year	9	.90
Sediment, Kg/year	1	.10

* Refer to Illustration 4

** Cobalt 60 was assumed to concentrate from sea water to the edible flesh of fish, mollusks, and crustacea by factors as follows: fish, 650; mollusks, 170; crustacea, 1700, based on reference 34.

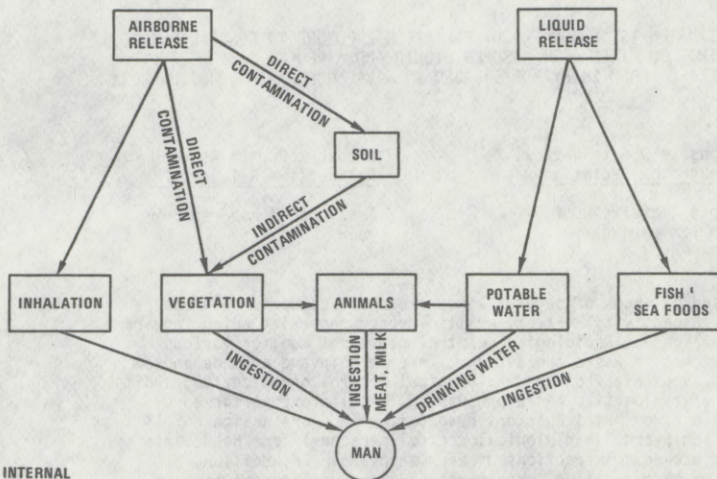
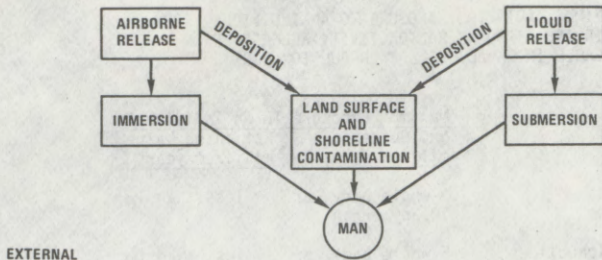


ILLUSTRATION 4

PATHWAYS FOR EXTERNAL AND INTERNAL EXPOSURE OF MAN FROM AIRBORNE AND LIQUID RELEASES OF RADIOACTIVE EFFLUENTS

exposures to members of the public from the Naval nuclear propulsion program are far less than either the EPA standards, the guidelines of the Nuclear Regulatory Commission or the exposure from natural background radioactivity.

AUDITS AND REVIEWS

The requirements and procedures for control of radioactive waste are important parts of the training programs for everyone involved with radioactivity in the Naval nuclear propulsion program. Such training is part of the initial qualification of shipyard workers and of Naval personnel assigned to ships and bases, and is required to be repeated regularly. Emphasis on this training is part of the concept that radiological control personnel alone cannot cause radiological work to be well performed; production and operations personnel and all levels of management are required to be involved in the control of radioactivity.

TABLE 7 ESTIMATED MAXIMUM RADIATION EXPOSURE TO AN INDIVIDUAL FOR ASSUMED LIQUID AND AIRBORNE RADIOACTIVITY RELEASES FROM SHIPYARDS ENGAGED IN NAVAL NUCLEAR PROPULSION WORK

	Maximum Exposure NRC Guideline millirem/year	To An Individual Estimated Value millirem/year
From Radionuclides In Liquid Releases	3 whole body, or 10 any organ	less than 1
From Gaseous Radionuclides In Airborne Releases	5 whole body, or 15 skin	less than 1
From Other Radionuclides In Airborne Releases	15 any organ	less than 1

TABLE 8 ESTIMATED TOTAL WHOLE BODY RADIATION EXPOSURE TO GENERAL PUBLIC WITHIN 50 MILES FOR ASSUMED LIQUID AND AIRBORNE RADIOACTIVITY RELEASES FROM SHIPYARDS ENGAGED IN NAVAL NUCLEAR PROPULSION WORK

<u>Exposure Due to Natural Background Radiation</u>	<u>Exposure Due to Assumed Radioactive Releases</u>
Approximately 100,000 man rem per year	less than 1 man rem per year

Checks and balances of several kinds are also set up to help ensure control of radioactivity. First, written procedures exist which require verbatim compliance. Radiological control personnel monitor various steps in radioactive waste processing. In each shipyard an independent organization, separate from the radiological control organization, audits all aspects of radioactive waste processing. Audits are performed by representatives from Naval Reactors headquarters who are assigned full time at each shipyard. Radiological control personnel from headquarters also conduct periodic inspections of each shipyard. In addition, shipyards have made detailed assessments of the environmental effects of shipyard operations and have published reports on the results of these assessments. Similarly, there are multiple levels of audits and inspections for the other Navy shore facilities, tenders, and nuclear-powered ships and for other radiologically controlled functions such as transportation. Even the smallest audit findings are followed up to ensure proper recovery and permanent corrective actions are taken and to help minimize the potential for future incidents.

The policy of the Navy is to provide for close cooperation and effective communication with state radiological officials involving occurrences that might cause concern because of radiological effects outside the ships or shore facilities. The Navy has reviewed radioactive waste disposal, radiological environmental monitoring, transportation and other radiological matters with state radiological officials in the states where Navy nuclear-powered ships are based or overhauled. Although there were no occurrences in 1978 which resulted in radiological effects to the public outside these facilities, states were notified when inquiries showed public interest in the possibility that such events had occurred. The Navy has encouraged states to conduct independent radiological environmental monitoring in harbors where Naval nuclear-powered ships are based or overhauled; available results of monitoring by states have been consistent with Navy results.

The U. S. Environmental Protection Agency (EPA) conducts detailed reviews of the Navy's procedures for controlling radioactive waste and for radiological environmental monitoring. An EPA laboratory has conducted detailed environmental surveys of selected U. S. harbors (references 30, 37, 38, 39, 40). This laboratory has performed these surveys in the harbors at Charleston, South Carolina; Pearl Harbor, Hawaii; San Diego, California; Vallejo, California; New London, Connecticut; Newport News, Virginia; Norfolk, Virginia; Bremerton, Washington; and Kittery, Maine—Portsmouth, New Hampshire. EPA results have been consistent with Navy results. In the latest such EPA survey conducted in 1977 at the Portsmouth Naval Shipyard, EPA analyzed harbor water, sediment, marine life and air for radioactivity. No radioactivity from shipyard operations was detected.

CONCLUSIONS

1. The total gamma radioactivity in liquids, less tritium, released into all ports and harbors from the U. S. Naval nuclear propulsion program was less than 0.002 curie in 1978. The total tritium released into all ports and harbors was less than one curie in 1978.
2. No increase of radioactivity above normal background levels has been detected in harbor water where U. S. Naval nuclear-powered ships are based, overhauled, or constructed.
3. Liquid wastes from U. S. Naval nuclear-powered ships and support facilities have not caused a measurable increase in the general background radioactivity of the environment.
4. Low-level cobalt 60 radioactivity in harbor bottom sediment is detectable around a few piers at operating bases and shipyards from low level liquid releases in the 1960's. Cobalt 60 is not detectable above background levels in general harbor bottom areas away from these piers. Maximum total radioactivity observed in a U. S. harbor of less than 0.1 curie of cobalt 60 is small compared to the naturally occurring radioactivity. Comparison to previous environmental data summarized in references 1 through 13 shows that these environmental cobalt 60 levels are continuing to decrease.
5. Conservative estimates of radiation exposures to members of the public from the Naval nuclear propulsion program are far less than either the EPA environmental standards, the guidelines of the Nuclear Regulatory Commission or the exposure from natural background radioactivity.
6. Procedures used by the Navy to control discharges of radioactivity from U. S. Naval nuclear-powered ships and their support facilities have been effective in protecting the environment and the health and safety of the general public. Independent radiological environmental monitoring performed by the U. S. Environmental Protection Agency and states have confirmed the adequacy of these procedures.

REFERENCES

- (1) - (5) U. S. Navy Reports—"Disposal of Radioactive Wastes from U. S. Naval Nuclear-Powered Ships and Their Support Facilities," M. E. Miles et al, for calendar years 1965 through 1969 published in Radiation Health Data and Reports; May 1966, December 1967, April 1969, September 1969 and August 1970.
- (6) - (13) U. S. Navy Reports—"Environmental Monitoring and Disposal of Radioactive Wastes from U. S. Naval Nuclear-Powered Ships and Their Support Facilities" M. E. Miles et al, for calendar years 1970 through 1977 published with the following numbers and dates: NT-71-1, May 1971; NT-72-1, September 1972; NT-73-1, September 1973; NT-74-1, October 1974; NT-75-1, May 1975; NT-76-1, August 1976; NT-77-1, June 1977; NT-78-1, February 1978.
- (14) Code of Federal Regulations, Title 10 (Nuclear Regulatory Commission), Part 20, "Standards for Protection Against Radiation."
- (15) National Council on Radiation Protection and Measurements, Report No. 22, "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure," (Published as National Bureau of Standards Handbook 69, Issued June 1959, superseding Handbook 52).
- (16) International Commission on Radiological Protection, Publication 2, "Report of Committee II on Permissible Dose for Internal Radiation (1959)," with 1962 Supplement Issued in ICRP Publication 6; Publication 9, "Recommendations on Radiation Exposure (1965)"; ICRP Publication 7 (1965), amplifying specific recommendations of Publication 9 concerning environmental monitoring; and ICRP Publication 26 (1977).
- (17) Federal Radiation Council Memoranda, approved by President Eisenhower on May 13, 1960, President Kennedy on September 20, 1961, and President Johnson on July 31, 1964.
- (18) National Academy of Sciences—National Research Council, Publication 658, "Radioactive Waste Disposal from Nuclear-powered Ships," 1959.
- (19) International Atomic Energy Agency, "Radioactive Waste Disposal into the Sea," Safety Series No. 5, Vienna 1961.
- (20) National Council on Radiation Protection and Measurements, Report No. 39, "Basic Radiation Protection Criteria," January 1971.
- (21) Code of Federal Regulations, Title 10 (Nuclear Regulatory Commission), Part 50, "Licensing of Production and Utilization Facilities, Appendix I, Radioactive Material In Light-Water Cooled Nuclear Power Reactor Effluents," published in Federal Register, May 5, 1975.
- (22) National Academy of Sciences—National Research Council, "Radioactivity in the Marine Environment," 1971.
- (23) U. S. Atomic Energy Commission Report—"Sources of Tritium and Its Behavior Upon Release to The Environment," by D. G. Jacobs, TID-24635, 1968.
- (24) U. S. Nuclear Regulatory Commission Report—"Radioactive Materials Released from Nuclear-Powered Plants (1977)," by T. R. Decker, NUREG-0521 January 1979.

- (25) National Council on Radiation Protection and Measurements, Report No. 45, "Natural Background Radiation In the United States," November 1975.
- (26) Council on Environmental Quality Report to The President "Ocean Dumping: A National Policy," October 1970.
- (27) Marine Protection, Research and Sanctuaries Act of 1972, United States Public Law 92-532.
- (28) Nuclear Regulatory Commission Report, "NRC Task Force Report on Review of the Federal/State Program for Regulation of Commercial Low-Level Radioactive Waste Burial Grounds," NUREG 0217, March 1977.
- (29) U. S. Nuclear Regulatory Commission, "Final Environmental Statement on the Transportation of Material By Air and Other Modes," NUREG-0170, December 1977.
- (30) U. S. Environmental Protection Agency Report—"Radiological Surveys of Pearl Harbor, Hawaii, and Environs," by D. F. Cahill, H. D. Harvey, Jr., et al., issued in Radiation Data and Reports, June 1972.
- (31) U. S. Energy Research and Development Administration, ERDA 1537, Final Environmental Statement, "Waste Management Operations, Savannah River Plant."
- (32) U. S. Environmental Protection Agency Report—"Environmental Radiation Effects of Nuclear Facilities in New York State," by M. S. Terpilak and B. L. Jorgensen, issued in Radiation Data and Reports, July 1974.
- (33) U. S. Nuclear Regulatory Commission, Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I."
- (34) "Concentration Factors in the Aquatic Environment," S. M. Jinks and M. Eisenbud, issued in Radiation Data and Reports, May 1972.
- (35) Code of Federal Regulations, Title 40 (Environmental Protection Agency), Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."
- (36) U. S. Environmental Protection Agency Report—"Radiological Quality of the Environment in the United States, 1977," by Kurt L. Feldman et. al., EPA Report-520/1-77-009, September 1977.
- (37) U. S. Public Health Service Report—"Radiological Survey of Major California Nuclear Ports," by D. F. Cahill, D. C. McCurry and W. D. Breakfield, Clearinghouse for Federal Scientific and Technical Information No. PH178728, April 1968.
- (38) U. S. Environmental Protection Agency Report—"Radiological Survey of New London Harbor, Thames River Connecticut and Environs," by S. T. Windham and C. R. Phillips, issued in Radiation Data and Reports, November 1973.
- (39) U. S. Public Health Service Report—"Radiological Survey of Hampton Roads (Norfolk—Newport News), Virginia," by H. D. Harvey, Jr., E. D. Toerber and J. A. Gordon, Clearinghouse for Federal Scientific and Technical Information No. AD683208, January 1968.
- (40) U. S. Environmental Protection Agency Report—"Radiological Survey of Puget Sound Naval Shipyard, Bremerton, Washington, and Environs," by R. S. Callis, S. T. Windham, and C. R. Phillips, EPA Report—520/5/77-001, February 1977.

APPENDIX
ENVIRONMENTAL MONITORING SURVEY CHARTS

Environmental monitoring survey charts for harbors monitored for radioactivity associated with U. S. Naval nuclear-powered ships in the U. S. and possessions during 1977 are listed below and included in this appendix. The sampling locations for harbor water and harbor sediment are shown. In addition, shoreline survey areas and the locations of posted dosimetry devices are shown on the figures.

<u>Figure No.</u>	<u>Location</u>
	California
1	U. S. Naval Air Station, Alameda
2	Hunters Point Naval Shipyard, San Francisco
3	Mare Island Naval Shipyard, Vallejo
4	Long Beach Harbor
5	Long Beach Harbor, Anaheim Bay Area
6	San Diego Harbor
7	San Diego Harbor, Ballast Point Area
	Connecticut
8	Electric Boat Division, Groton
9	U. S. Naval Submarine Support Facility, New London Harbor
10	State Pier, New London
	Florida
11	Port Canaveral
	Guam
12	Apra Harbor
	Hawaii
13	Pearl Harbor Area
14	Pearl Harbor Naval Shipyard
15	U. S. Naval Submarine Base, Pearl Harbor
	Mississippi
16	Ingalls Shipbuilding Division, Pascagoula
	New Hampshire/Maine
17	Portsmouth Naval Shipyard
	South Carolina
18	U. S. Naval Station and Naval Shipyard, Charleston
19	U. S. Naval Weapons Station, Charleston
	Virginia
20	Newport News Shipbuilding and Dry Dock Co., Newport News
21	Norfolk Naval Shipyard, Portsmouth
22	U. S. Naval Station Norfolk, Destroyer and Submarine Piers
23	Norfolk—Portsmouth Virginia Area
	Washington
24	Puget Sound Naval Shipyard
25	Bangor/Hood Canal

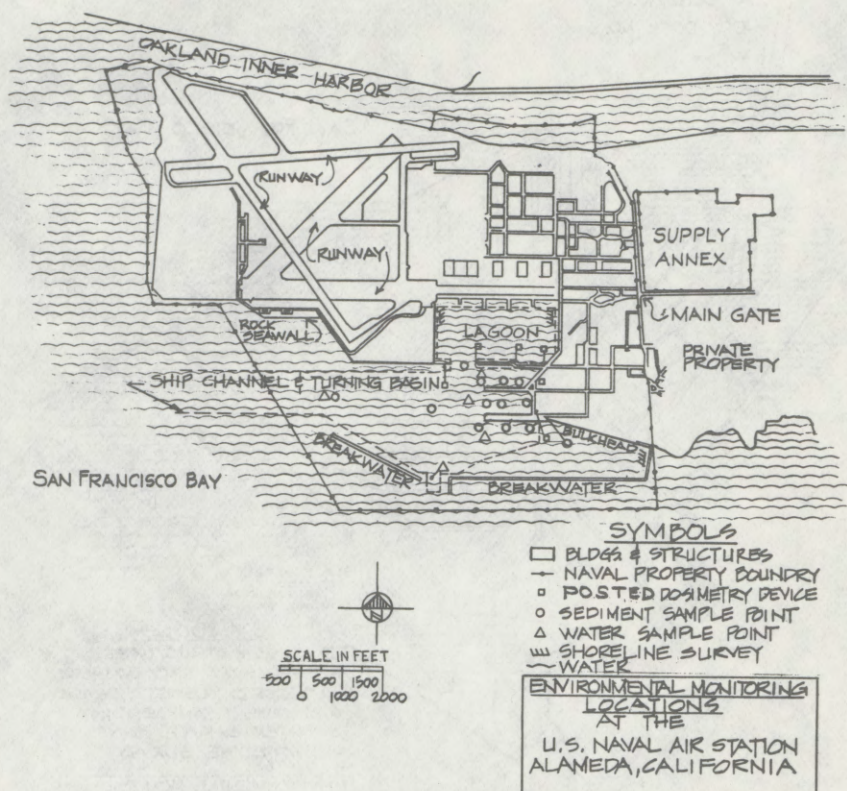


FIGURE 1

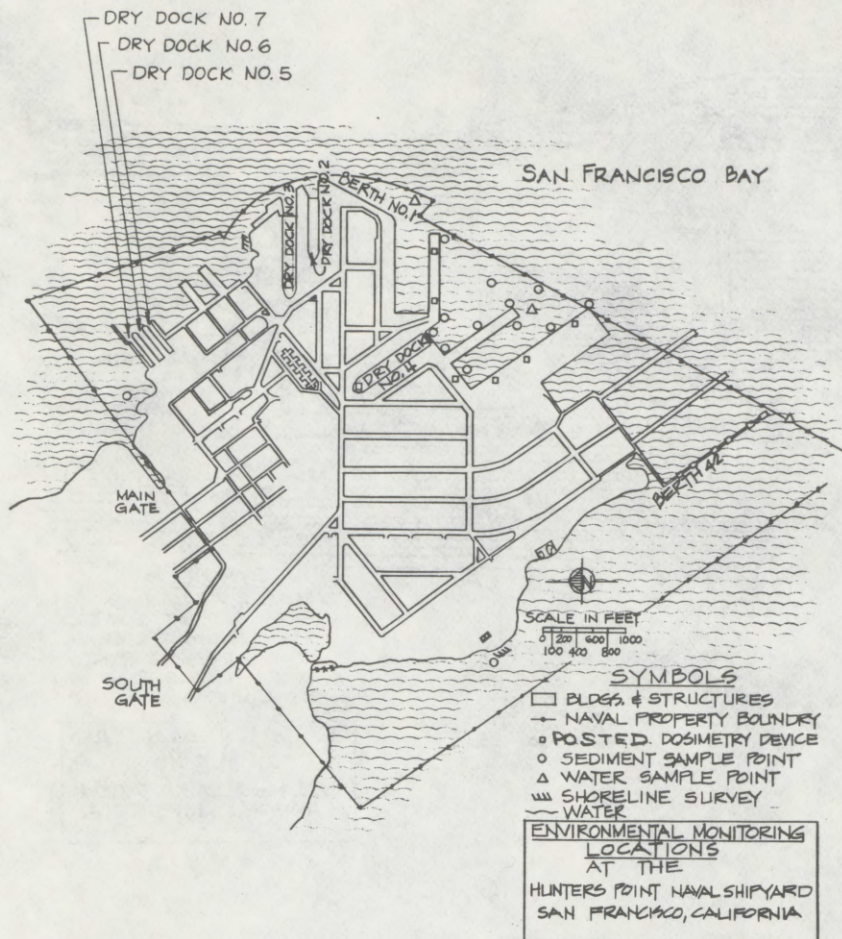


FIGURE 2

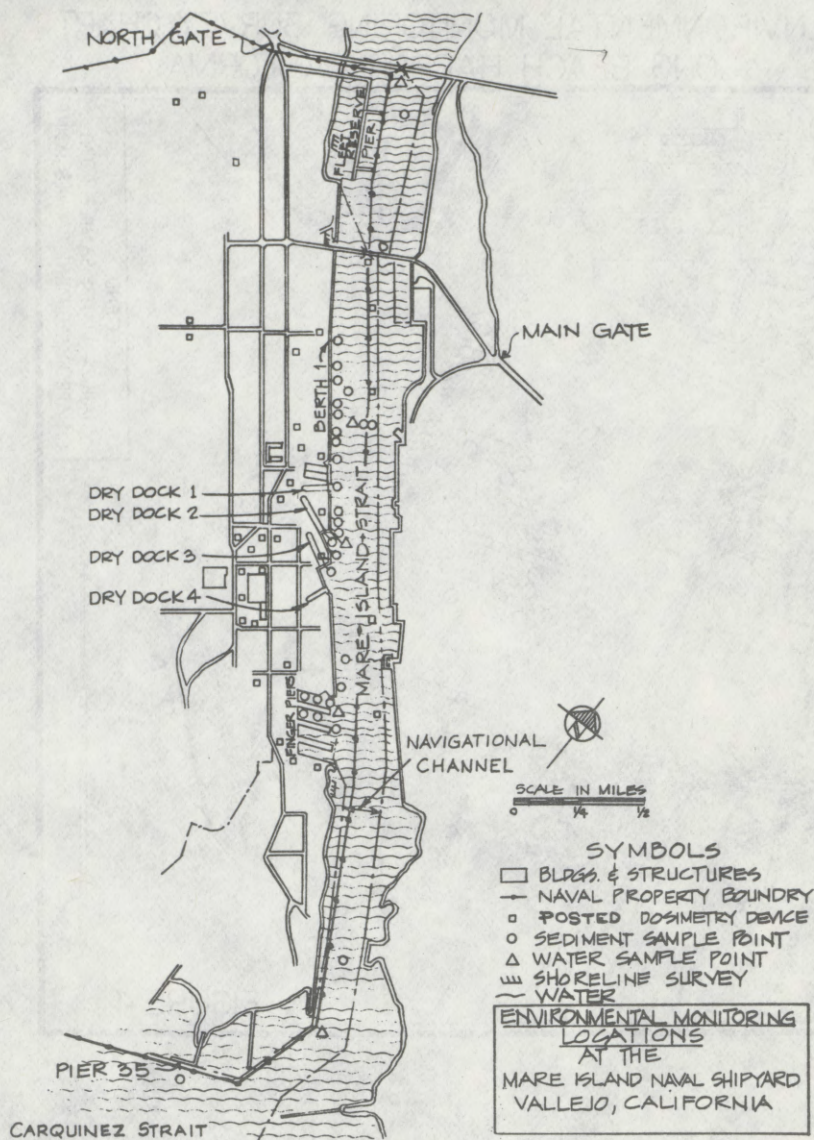
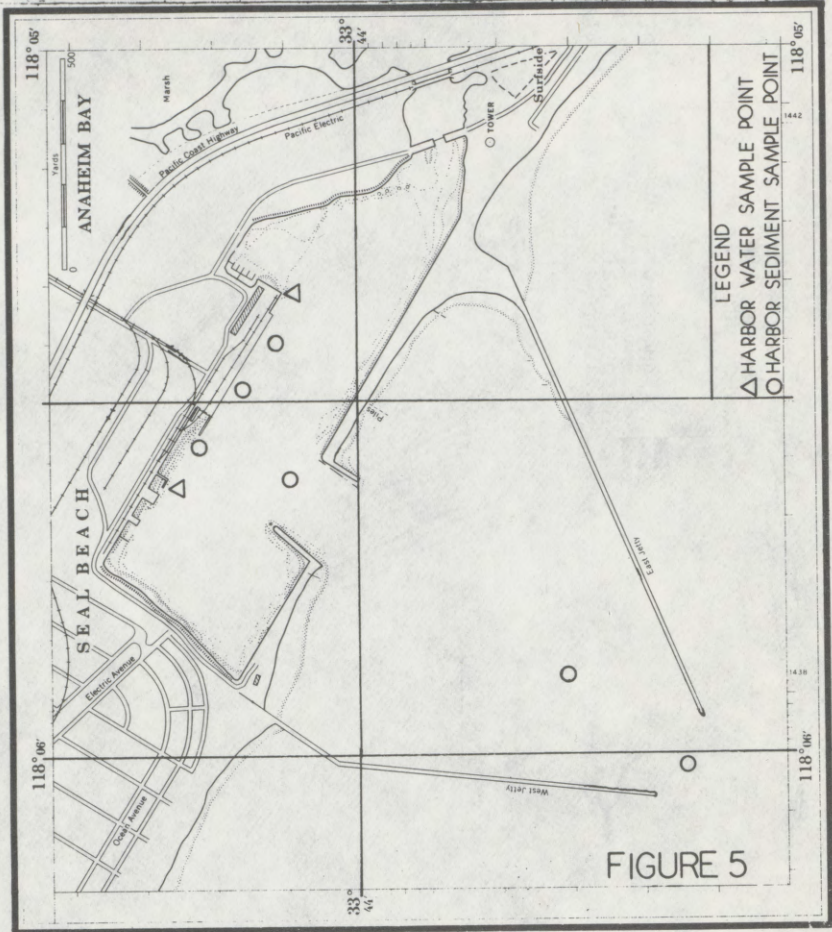
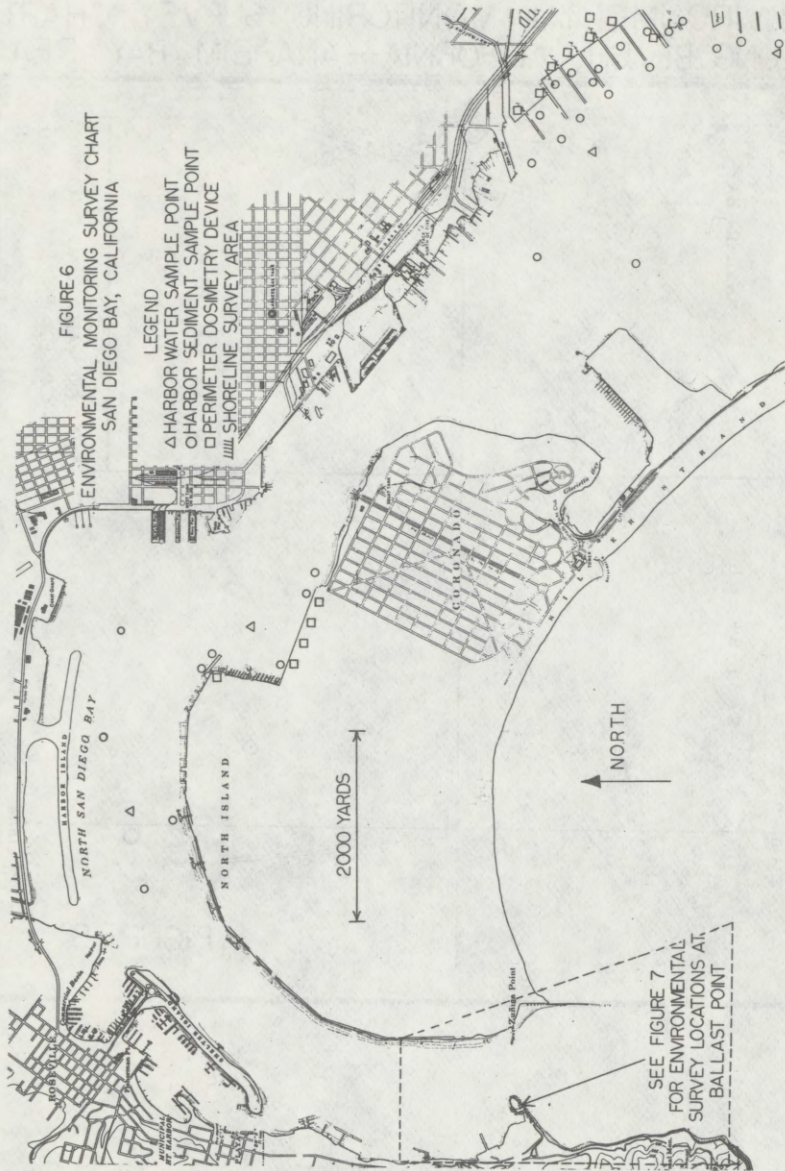


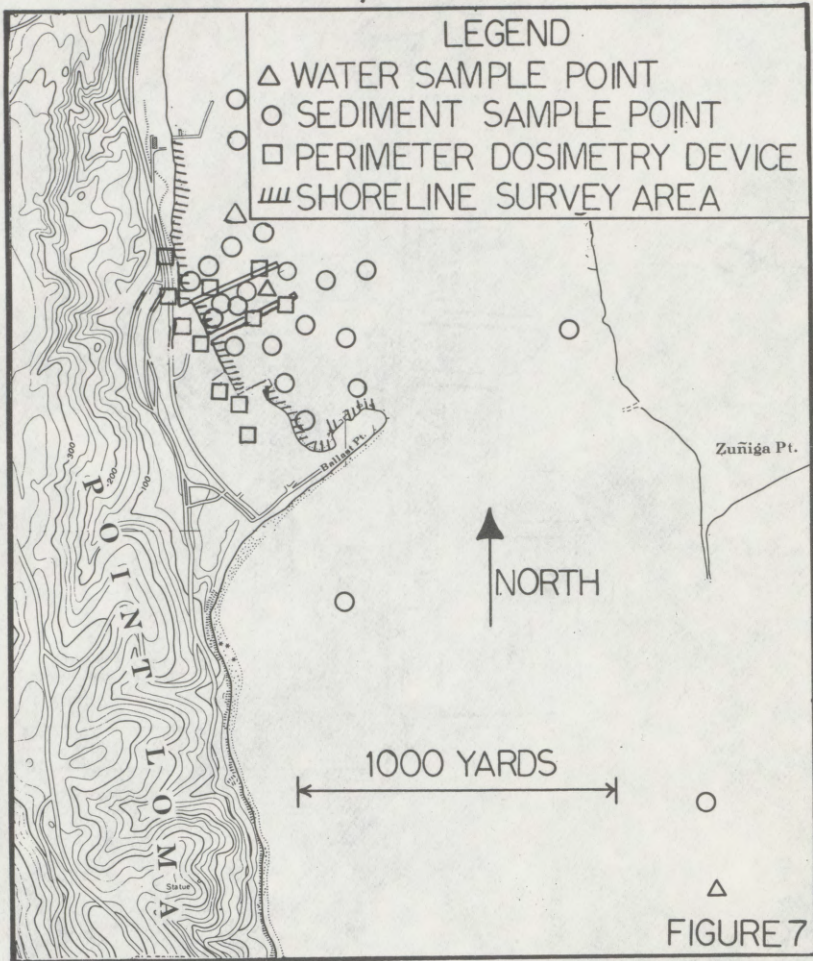
FIGURE 3

ENVIRONMENTAL MONITORING SURVEY CHART LONG BEACH, CALIFORNIA—ANAHEIM BAY AREA





ENVIRONMENTAL MONITORING SURVEY CHART BALLAST POINT, SAN DIEGO HARBOR



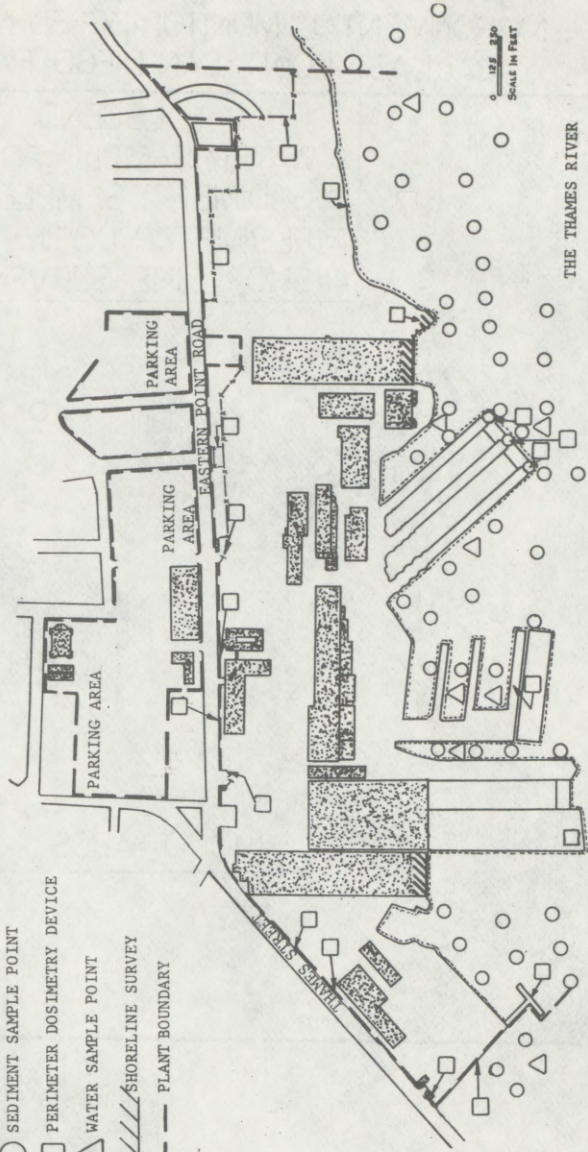
GENERAL DYNAMICS/ELECTRIC BOAT
Groton, Conn.
ENVIRONMENTAL
SURVEY
MAP

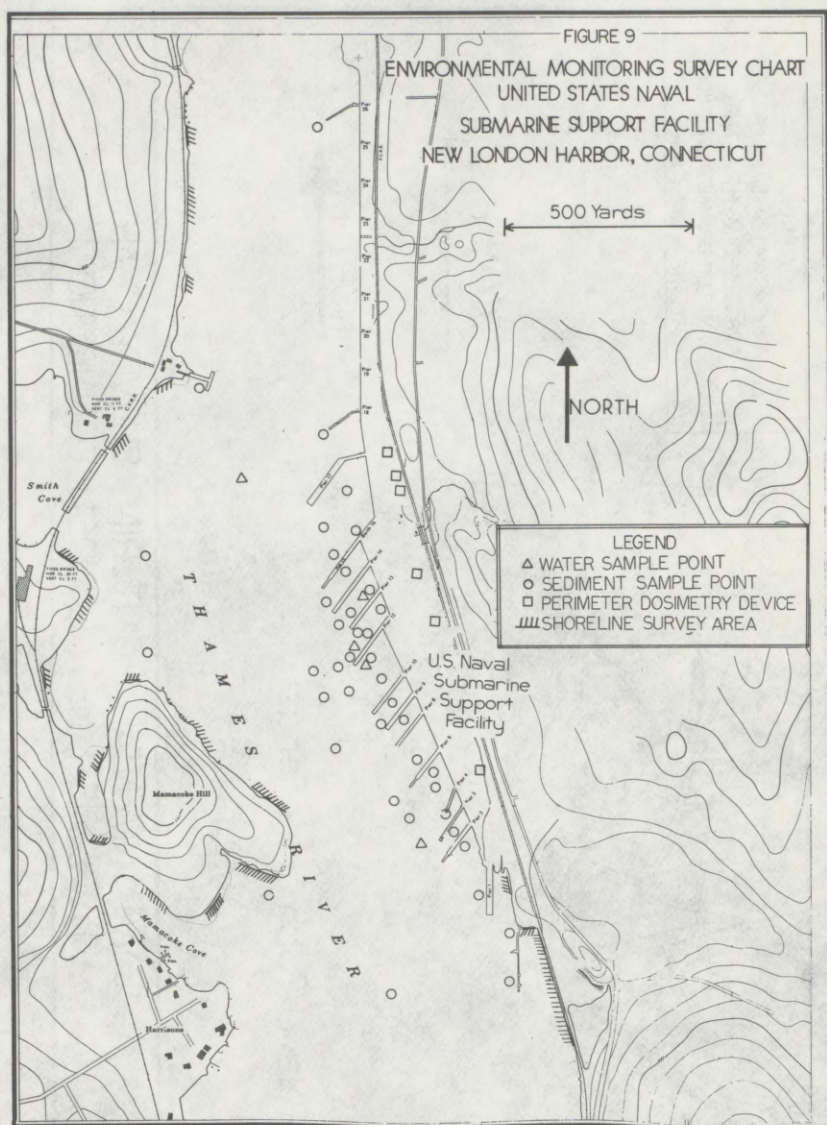


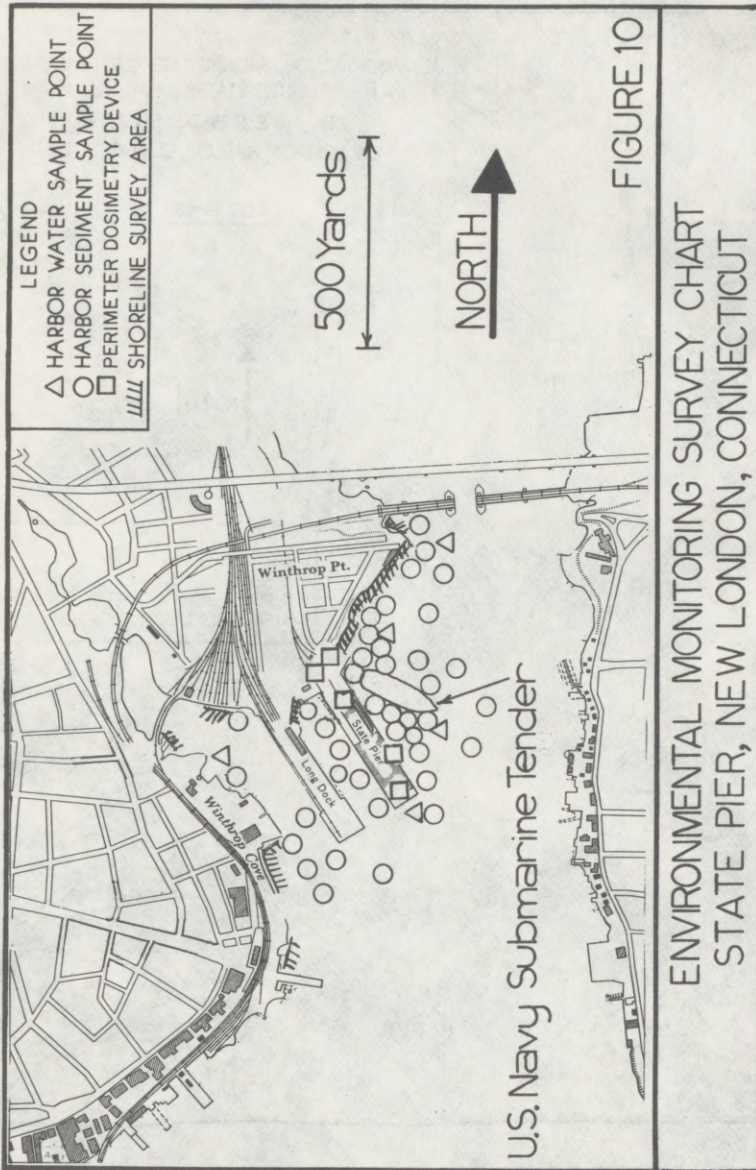
FIGURE 8

KEY

- SEDIMENT SAMPLE POINT
- PERIMETER DOSIMETRY DEVICE
- △ WATER SAMPLE POINT
- //// SHORELINE SURVEY
- PLANT BOUNDARY







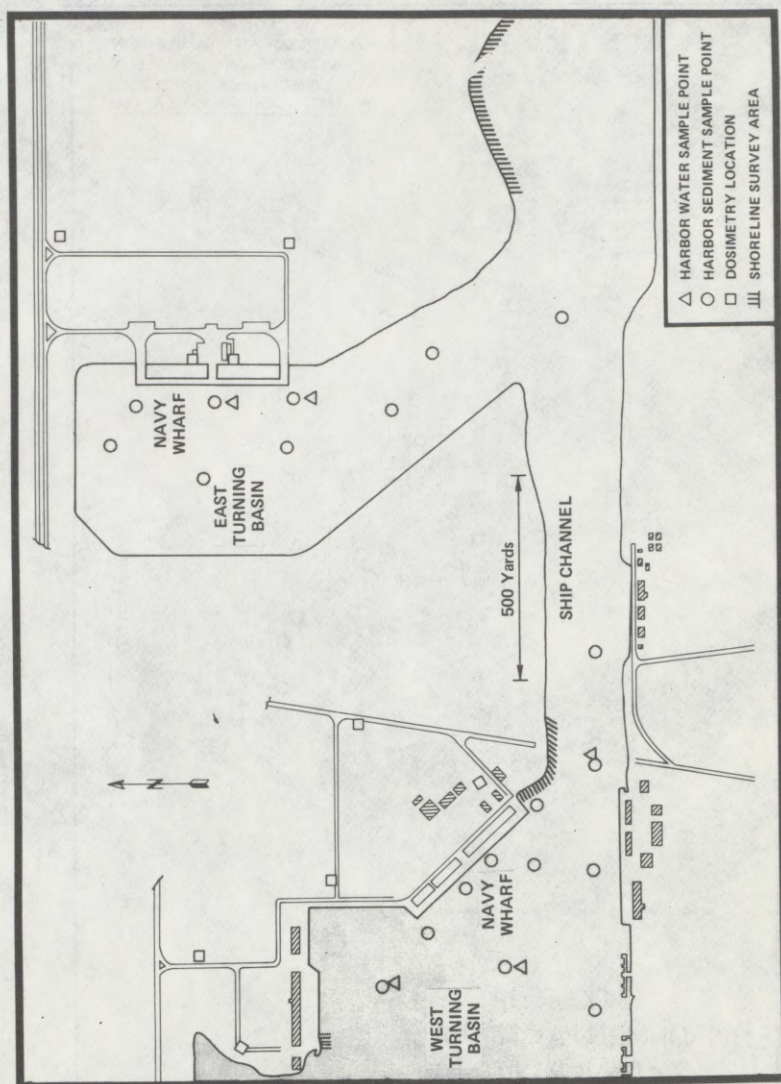
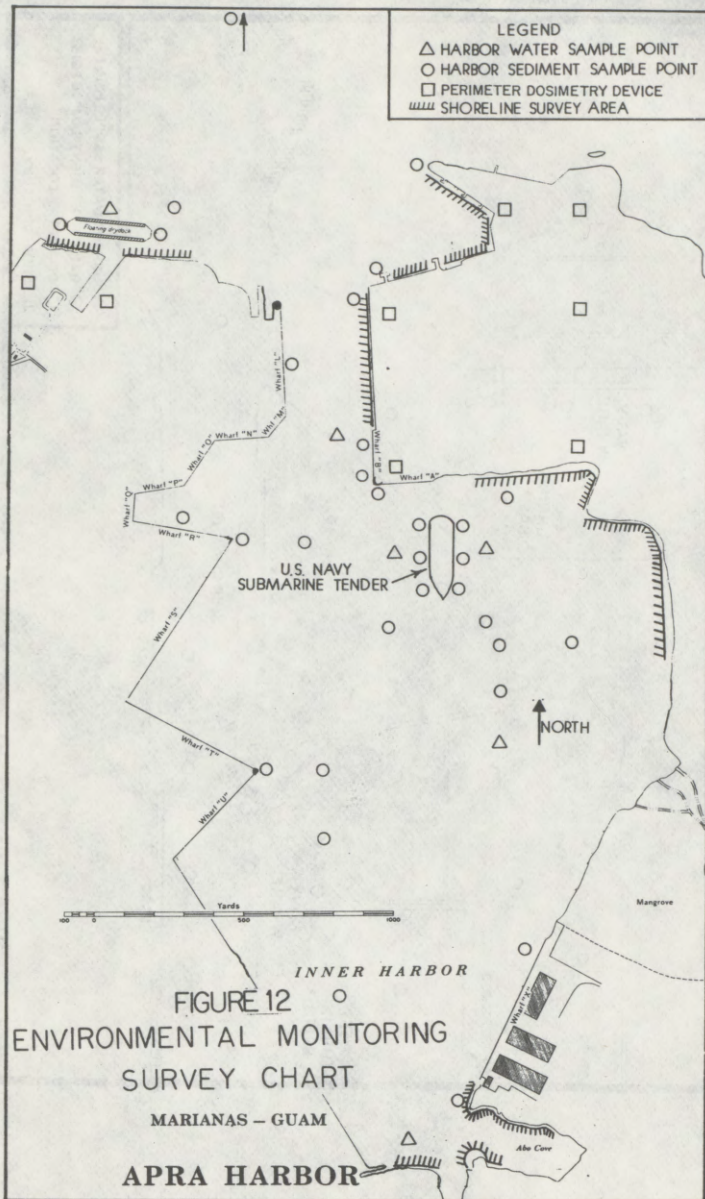


Figure 11. ENVIRONMENTAL MONITORING SURVEY CHART PORT CANAVERAL, FLORIDA



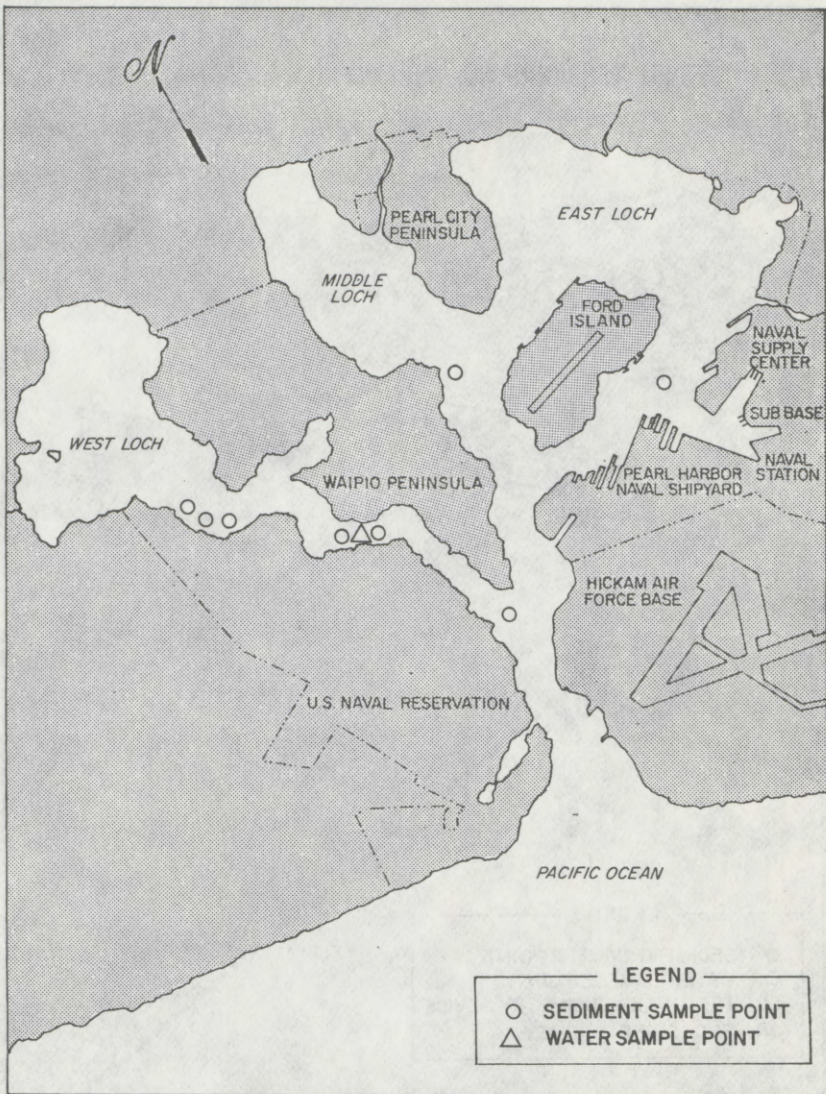


FIGURE 13

OVERALL MAP OF PEARL HARBOR
SHOWING ENVIRONMENTAL MONITORING LOCATIONS
IN OTHER AREAS OF PEARL HARBOR

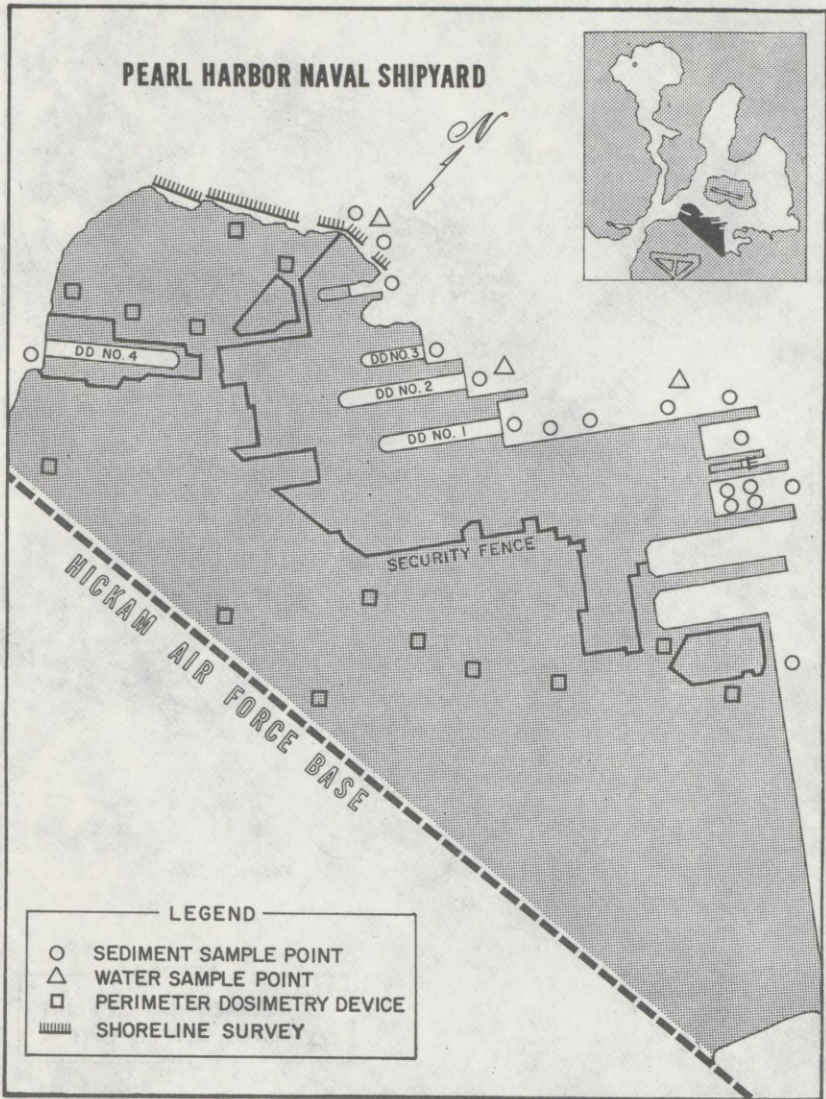


FIGURE 14

ENVIRONMENTAL MONITORING LOCATIONS
PEARL HARBOR NAVAL SHIPYARD

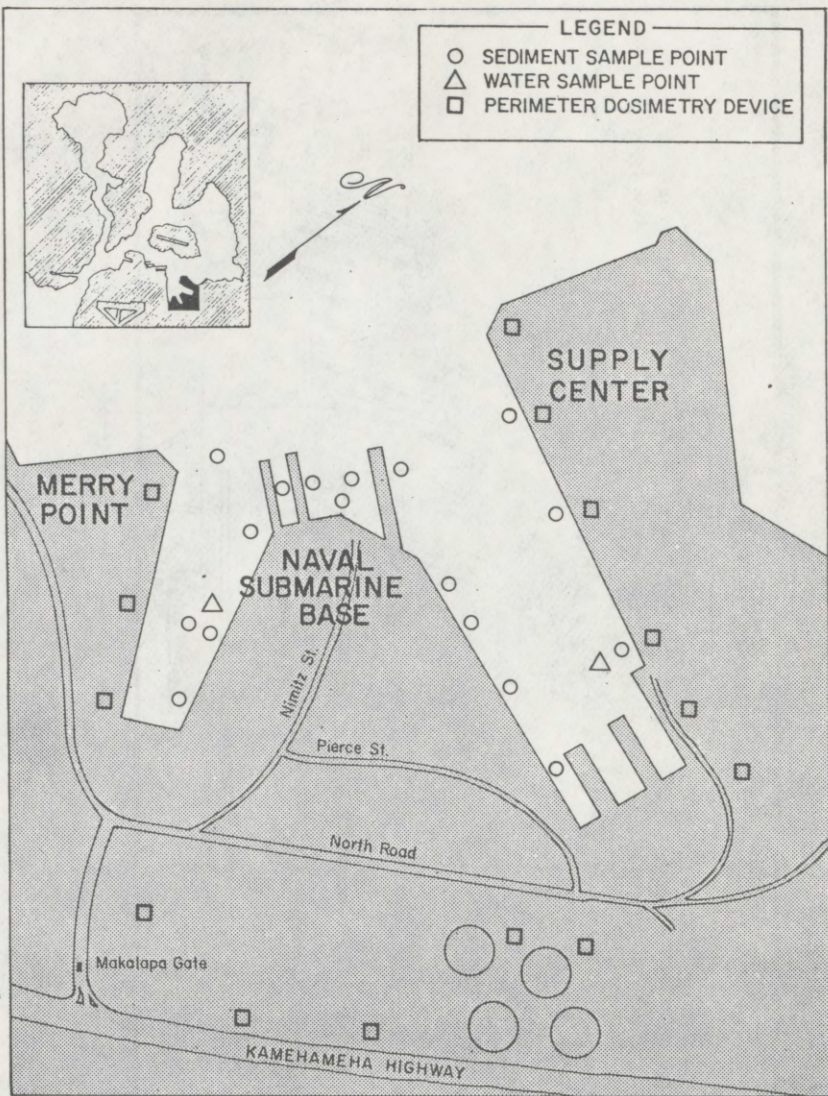
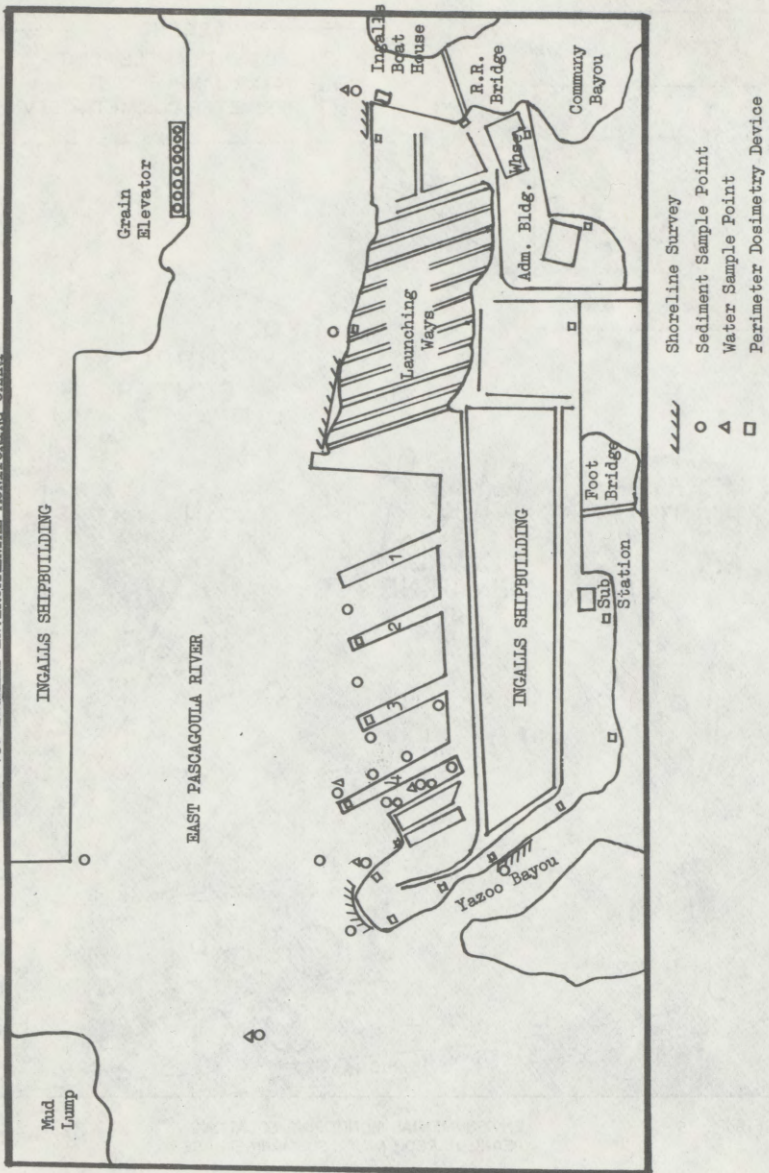
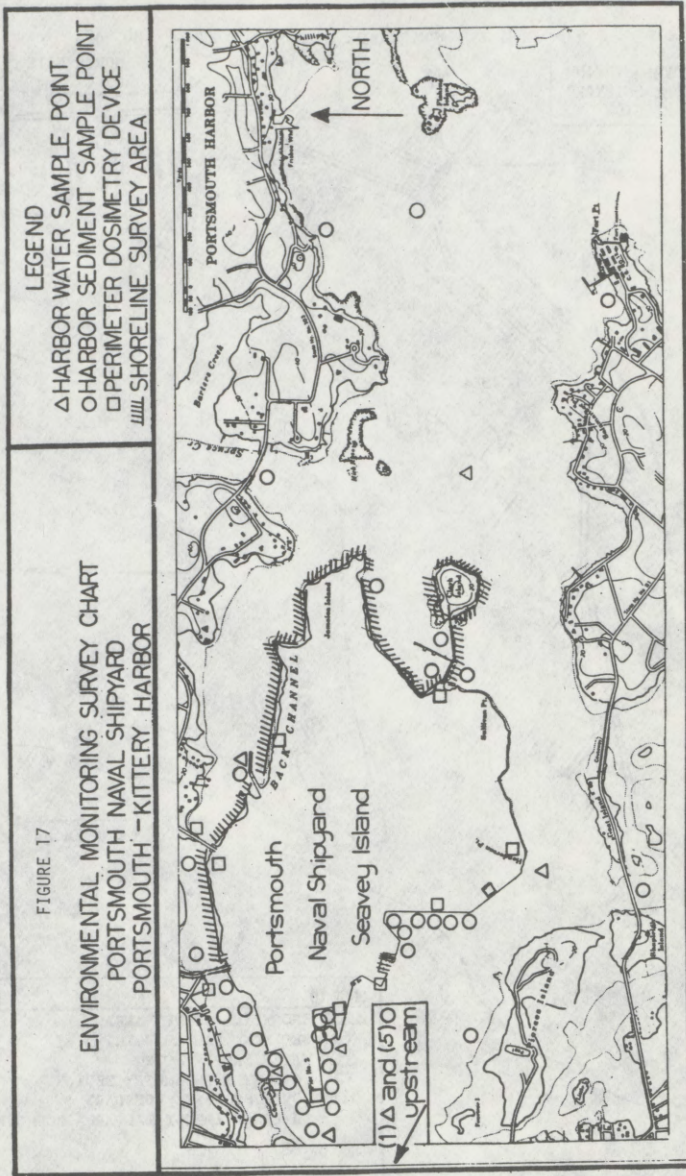


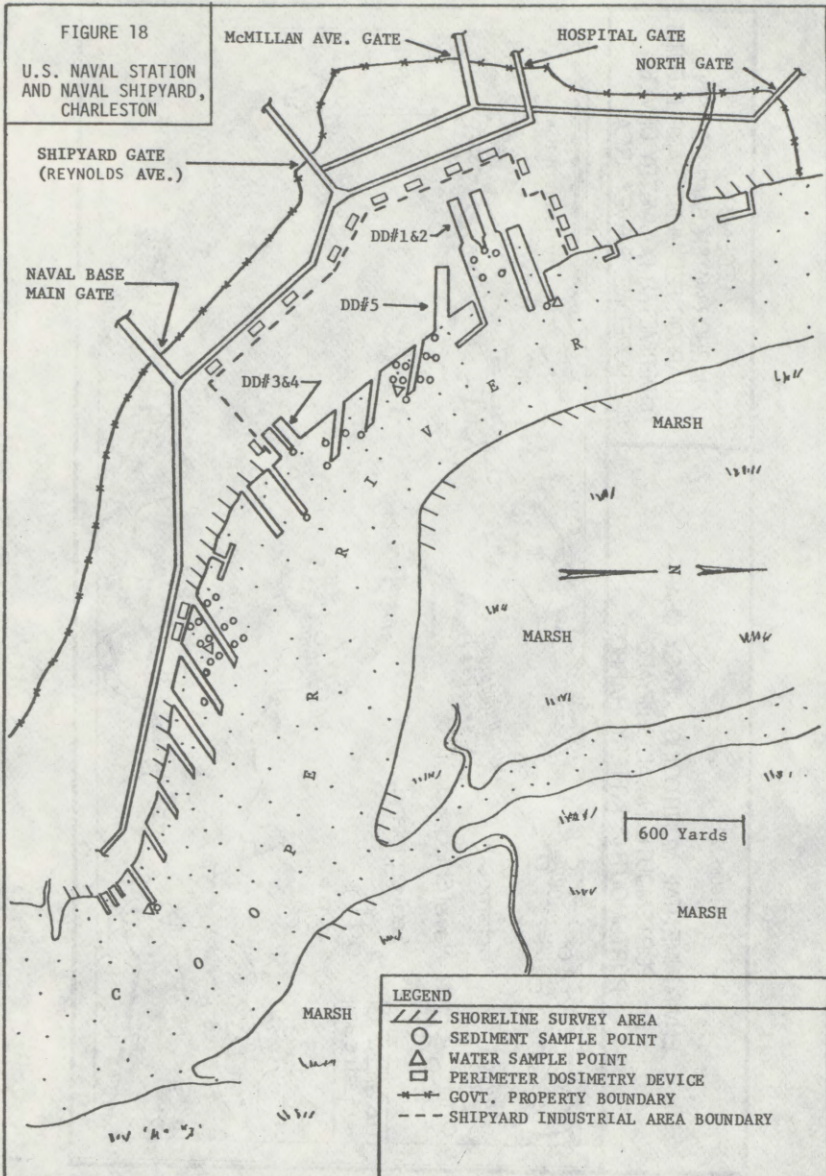
FIGURE 15

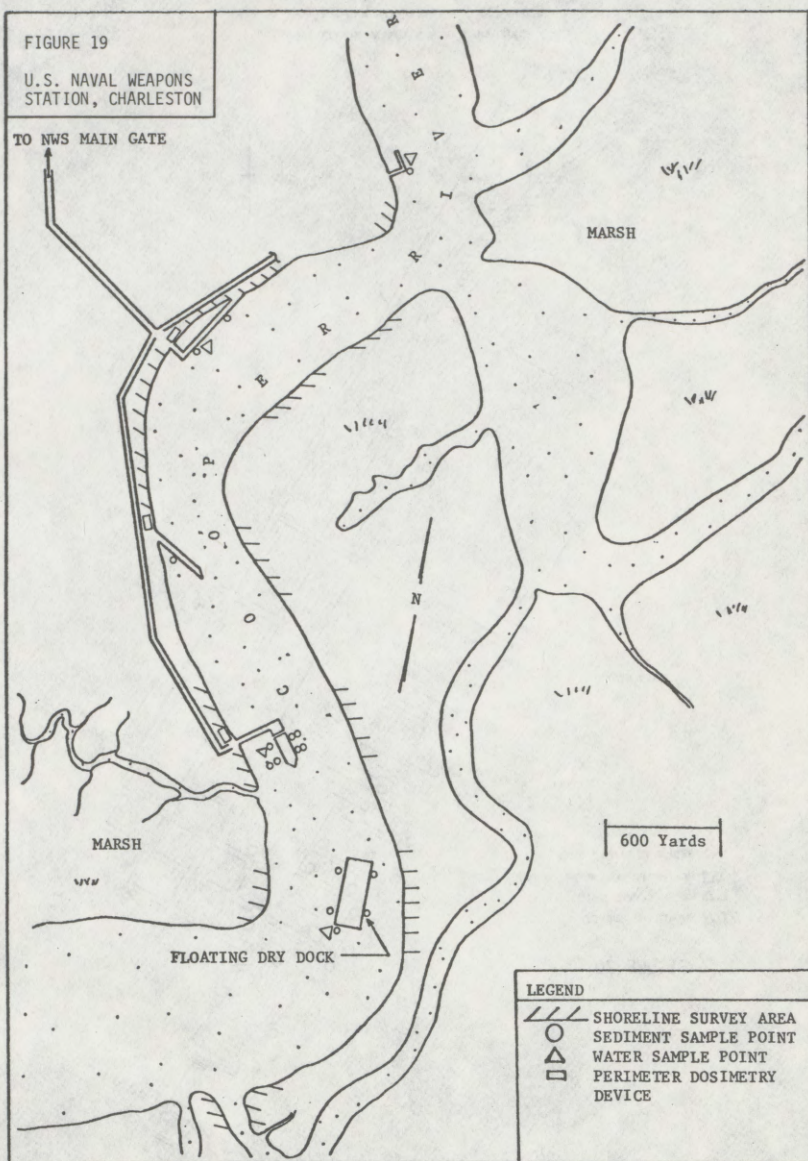
ENVIRONMENTAL MONITORING LOCATIONS
PEARL HARBOR NAVAL SUBMARINE BASE

FIGURE 16: INGALLS ENVIRONMENTAL MONITORING CHART









NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY
ENVIRONMENTAL MONITORING SURVEY LOCATIONS

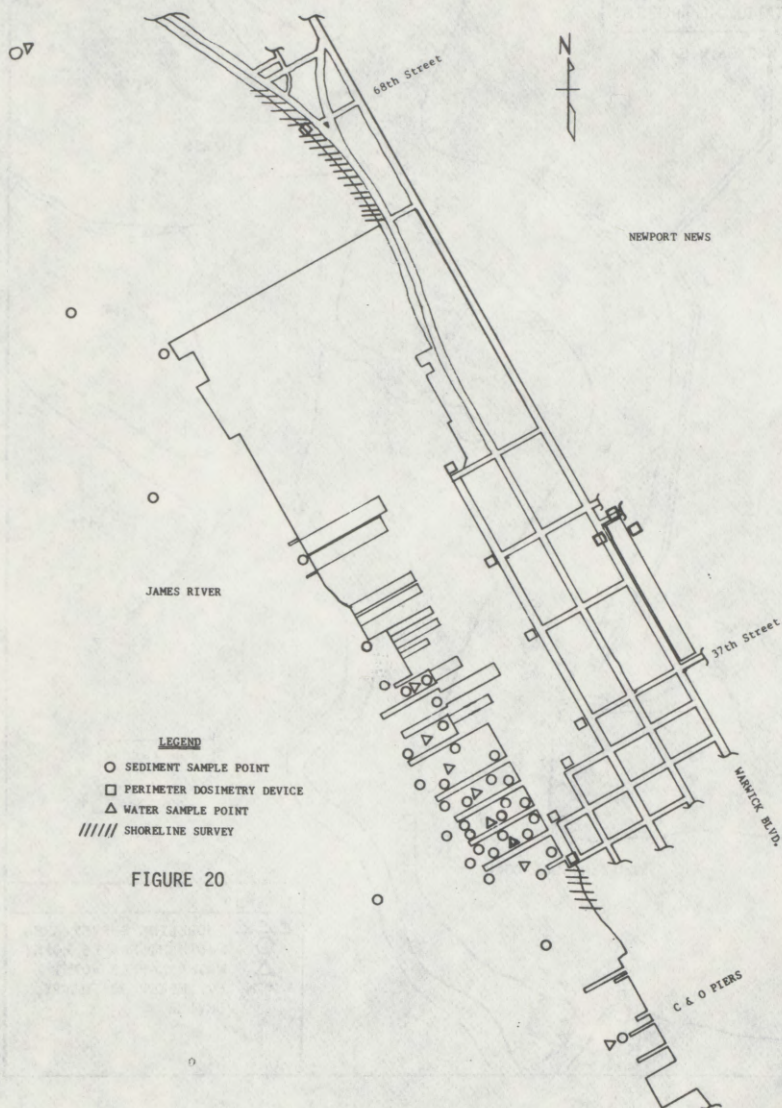
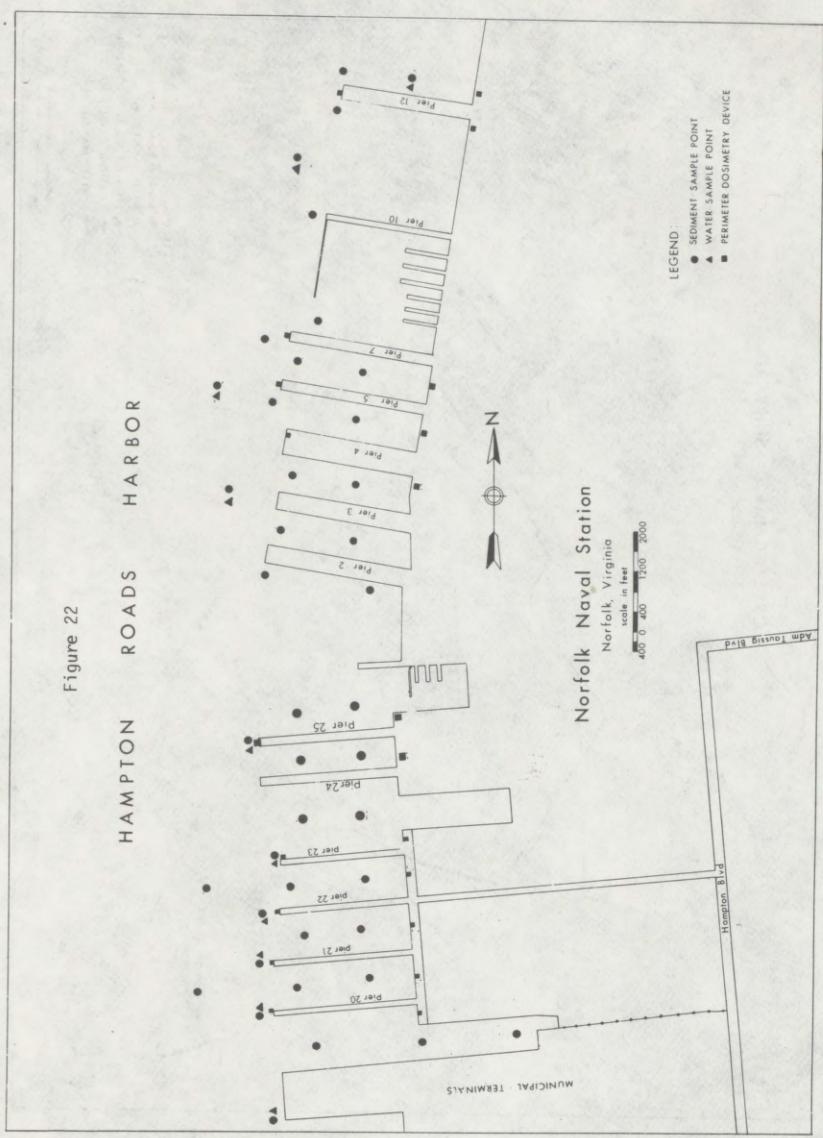


FIGURE 20

Figure 22



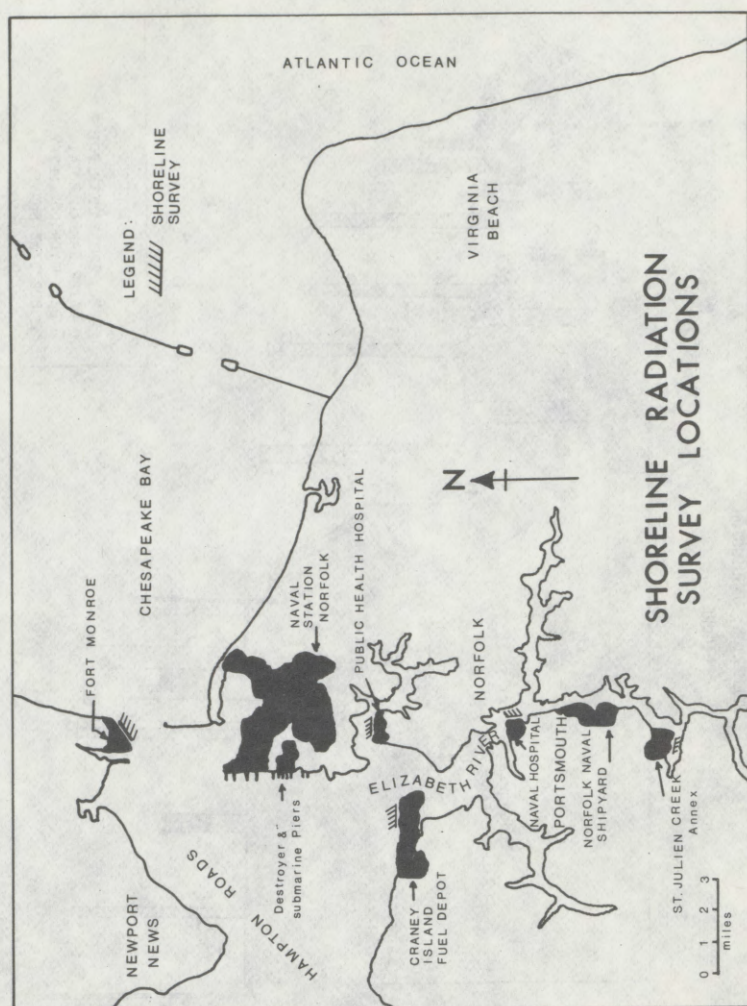
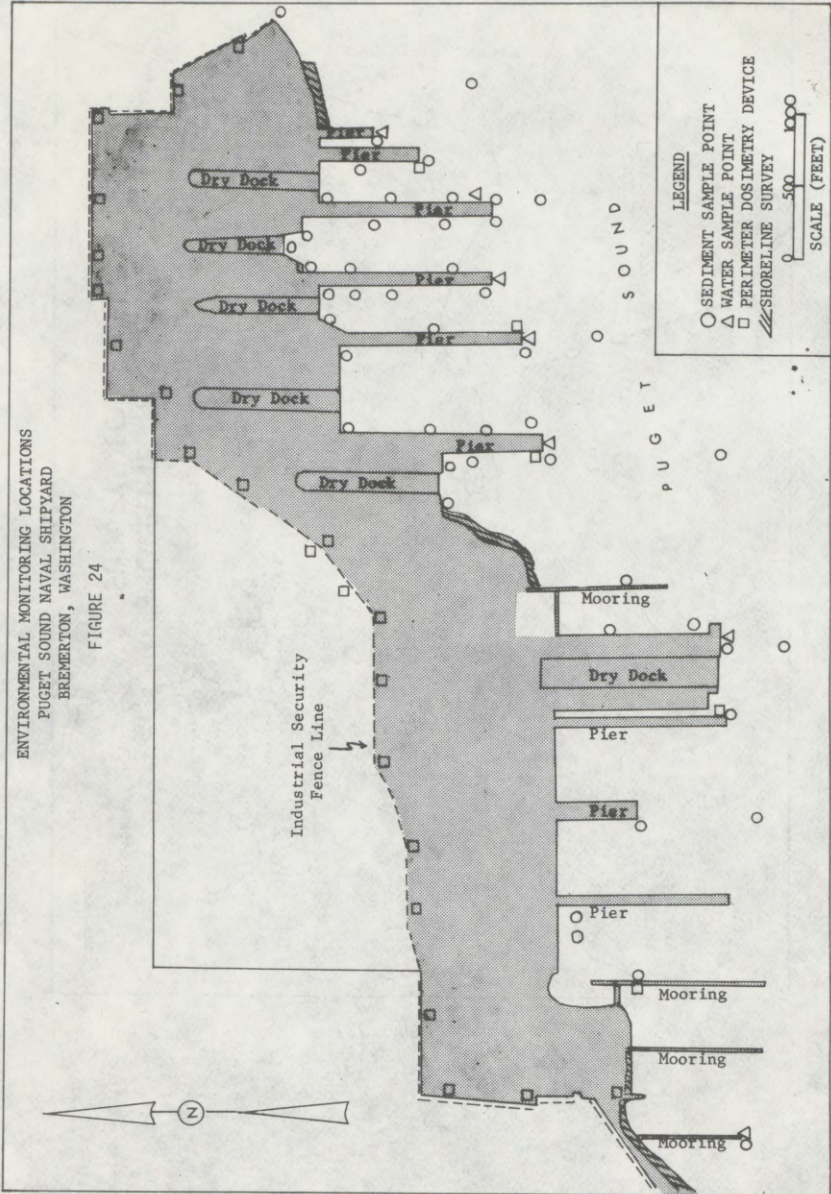
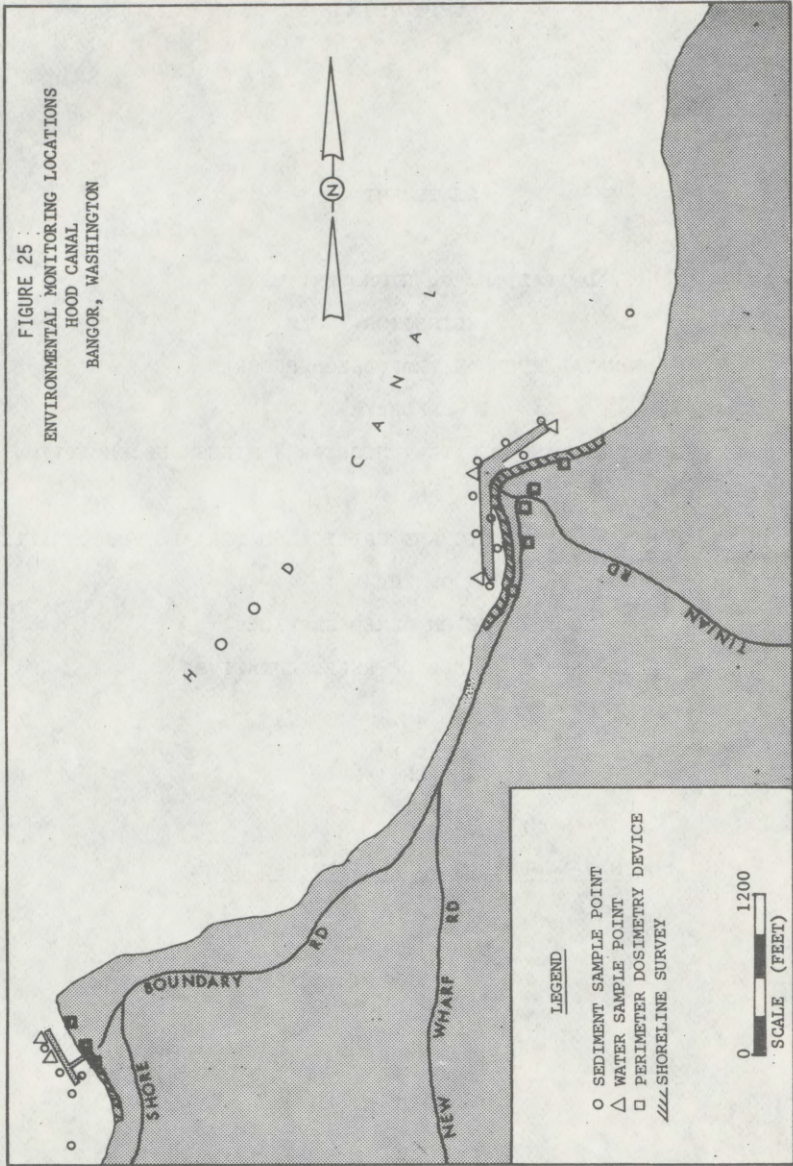


FIGURE 23

ENVIRONMENTAL MONITORING LOCATIONS
PUGET SOUND NAVAL SHIPYARD
BREMERTON, WASHINGTON

FIGURE 24





APPENDIX 3

STATEMENT
of
ADMIRAL, H. G. RICKOVER, USN
DIRECTOR
NAVAL NUCLEAR PROPULSION PROGRAM
BEFORE
THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE
AND
THE SEAPOWERS AND STRATEGIC AND CRITICAL MATERIALS SUBCOMMITTEE
OF THE
COMMITTEE ON ARMED SERVICES
UNITED STATES HOUSE OF REPRESENTATIVES

1 MARCH 1979

2:00 P.M.

"NAVAL NUCLEAR PROPULSION PROGRAM"

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 SSN 688 Class
 TRIDENT
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Soviet Naval Threat

Soviet Ballistic Missile Submarines
 Soviet Attack & Cruise Missile Submarines
 Soviet Surface Warships
 Soviet Cruiser Probably Nuclear Powered

Surface Warships

FY 1980 Budget Proposes Non-Nuclear Carrier & AEGIS
 Opposition to Nuclear Propulsion by Systems Analysts
 Role of Congress in Creating Nuclear Navy
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Aircraft Carriers

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Industrial Base

Shipbuilding Claims

STATEMENT OF ADMIFAL H. G. RICKOVER, USN, DIRECTOR, NAVAL NUCLEAR PROPULSION PROGRAM, BEFORE A JOINT SESSION OF THE PROCUREMENT AND MILITARY NUCLEAR SYSTEMS SUBCOMMITTEE AND THE SEAPOWERS AND STRATEGIC AND CRITICAL MATERIALS SUBCOMMITTEE OF THE COMMITTEE ON ARMED SERVICES, UNITED STATES HOUSE OF REPRESENTATIVES

Mr. Chairman, I deeply appreciate this opportunity to state my views concerning the naval shipbuilding program as it affects the Naval Nuclear Propulsion Program.

INTRODUCTION

In some of my remarks I may express views contrary to those of some of my superiors. You are aware that since the inception of the Naval Nuclear Propulsion Program there have been basic differences between my opinions and those of many of my superiors. My superiors have more responsibilities and problems different and more onerous than mine, and these responsibilities and problems may require different solutions than I propose. I claim no superior wisdom. I make no claim that my views are right and theirs are wrong. As I have in the past, I will give you my personal and professional views based on the information available to me and leave it to you to make your judgments as you see fit.

NAVAL NUCLEAR PROPULSION PROGRAM

The Naval Nuclear Propulsion Program is a joint program of the Departments of Energy and Navy. I serve both as the Director of the Division of Naval Reactors, in the Department of Energy, and the Deputy Commander for Nuclear Propulsion in the Navy's Naval Sea Systems Command. The combination of the responsibilities of the Departments of Energy and Navy for naval nuclear propulsion under one organization, eliminates duplication of programs and resources and provides close coordination of technical work.

DIVISION OF RESPONSIBILITIES BETWEEN NAVY AND ENERGY DEPARTMENTS

The naval nuclear propulsion work funded by the Department of Energy provides for the research and development of nuclear reactors for warships. In this regard, I am responsible for reactor plant research, design, development, construction, operation and health matters pertaining to naval nuclear propulsion

plants and for all related safety aspects. Furthermore, my responsibilities also include selection, training and qualification of personnel for operating and maintaining these plants. Within the Department of Energy, I am also responsible for the Water Cooled Breeder program; a civilian reactor development program. The Department of the Navy is responsible for the military application of nuclear propulsion including constructing, operating, and maintaining nuclear powered ships, and for developing the non-reactor portions of the nuclear propulsion plants. The joint Naval Nuclear Propulsion Program involves many activities, including two Department of Energy owned, contractor operated, laboratories where research and development work is performed; a number of land prototypes owned by the Department of Energy; reactor component manufacturing plants owned by the private sector; also shipyards, private and Navy, where nuclear ships are designed, built, and overhauled.

LAND PROTOTYPES

In carrying out these responsibilities, the Naval Nuclear Propulsion Program conducts research and development programs in conjunction with building, testing and operating land prototype nuclear propulsion plants. Seven land prototype propulsion plants are now in operation; these are used to test and evaluate reactor and reactor propulsion plant designs, and to train and qualify Navy personnel for operating and maintaining naval nuclear propulsion plants. In addition, the propulsion plant prototype for the TRIDENT ballistic missile firing submarine will commence operation at West Milton, New York, this year.

NUCLEAR WARSHIPS

In the quarter century since 1953, When the NAUTILUS land prototype first operated, the number of nuclear powered warships has grown to a present total of 125 warships. These represent more than 40% of the Navy's combatant ships. This figure includes 41 ballistic missile submarines (SSBN's), 73 attack submarines (SSN's), three aircraft carriers (CVN's), and eight cruisers (CGN's). We also have one nuclear powered deep submergence research vehicle, the

NR-1. These ships have steamed a total of more than 40 million miles; yet there has never been an accident involving a reactor nor has there been any release of radioactivity which has had a significant effect on the environment. In addition to the ships in operation, seven TRIDENT ballistic missile submarines, 24 LOS ANGELES Class high speed attack submarines, one NIMITZ Class carrier, and one VIRGINIA Class cruiser have been authorized by Congress or are under construction.

The Naval Nuclear Propulsion Program is responsible for more operating reactors than the combined total of all U.S. civilian power reactors. Altogether, there are 152 reactors in operation, which have accumulated over 1700 reactor-years of operating experience.

LONG LIFE REACTOR CORES

The goal of the Department of Energy's Naval Reactors Development portion of the Naval Nuclear Propulsion Program is to design, develop, and test improved nuclear propulsion plants and reactor cores having long fuel life, increased reliability, improved performance, and simplified operation and maintenance requirements and, ultimately, to develop reactor cores that will last the lifetime of a ship.

Particular emphasis is placed on obtaining advanced long life cores necessary for increased ship performance and availability. Extending the operating lives of these cores will materially benefit the Navy from the standpoint of both cost and operations. A longer nuclear core operating life will increase the percentage of time the nuclear fleet units are able to undertake operational duties. This will allow greater operational flexibility and provide additional assurance of availability and endurance to fight a war. This is a most important consideration, because any future naval war will have to be fought with the ships available at the start of hostilities.

An additional benefit of developing long life cores is that as core lives increase the number of refuelings will be reduced, thereby reducing costs and minimizing radiation exposure and radioactive waste. As an example, the first core for the USS

NAUTILUS propelled the submarine two years and 62,000 miles, while a modern core is capable of propelling nuclear ships for ten to fifteen years and over 400,000 miles.

SSN 688 CLASS ATTACK SUBMARINES

The shipbuilding program proposed by the Department of Defense for FY 1980 includes funds for the 34th high speed LOS ANGELES Class submarine. Nine have already been delivered to the Navy. Fourteen more are being built at Electric Boat and eight at Newport News. The contract for the remaining two already authorized is expected to be awarded in a few weeks.

These high speed nuclear submarines, whose principal mission is anti-submarine warfare, are meant to counter the rapid increase in both the quantity and speed capability of the Soviet nuclear submarine fleet.

The high speed capability in the SSN 688 Class permits them to be used in direct support of high speed surface task forces in an escort role. High speed also provides tactical advantages over previous, slower classes of U.S. submarines. Ships of the SSN 688 Class are currently participating in a tactical development and assessment program which is designed to determine the best tactics to employ in the various missions which this ship will perform. The program is only partly completed; but it has already shown that the high speed of the SSN 688 Class considerably expands the tactical options and capabilities available to attack submarines.

TRIDENT

The shipbuilding program proposed by the Department of Defense for Fiscal Year 1980 includes funds for the eighth TRIDENT submarine. The TRIDENT submarines will have increased survivability compared to our existing POLARIS and POSEIDON submarines because they are being built with all the latest technology. They will be more difficult to detect than existing POLARIS and POSEIDON submarines because the TRIDENT submarines will be quieter and their longer range missiles will give the submarines 10 to 20 times more ocean area in which to hide. Our existing POLARIS and POSEIDON

submarines are noisy compared to current standards. They were all built with the technology of the 1950's. Quieter submarines are necessary to decrease the probability of detection and to ensure the survivability of our seaborne strategic deterrent.

The POLARIS and POSEIDON submarines are wearing out and we must plan now for an orderly construction program to provide replacement. Unless we do so we will be confronted with block obsolescence. Our current force of 41 ballistic missile submarines was commissioned during the seven-year period from 1959 to 1967, and were built to specifications based on a 20-year life. These ships have been operated hard, with two crews, to allow them to be on station the maximum possible time. It is unreasonable to expect them to operate for more than 20 years without the possibility of breakdowns.

The longer range of the TRIDENT missiles will permit basing our ballistic missile submarines in the United States--no foreign basing will be required. This will eliminate the vulnerability of our ballistic missile submarine force to international political action that could deny us the use of foreign bases. This is extremely important because we are always in danger of losing our foreign bases.

I recommend that Congress continue to support the TRIDENT program which is vital to our national survival.

GENERAL PURPOSE NAVAL FORCES

The bulk of our naval ships, the general purpose forces, are designed to carry out naval missions in conflicts short of all-out nuclear war. Less than half of these are submarine and surface combatants and aircraft carriers designed to fight in areas of high threat; they are our naval strike force ships.

The majority of general purpose force ships are assigned to non-strike force functions, such as underway replenishment groups, amphibious assault forces, convoy escorts, and support ships which service the Fleet. I have never recommended, and I know of no serious consideration ever having been given to providing nuclear propulsion for ships in the non-strike forces.

Aside from submarines, the only warships I have recommended to be provided nuclear propulsion are aircraft carriers and guided-missile firing ships. I will address my views on nuclear propulsion for surface warships shortly, but first I want to summarize the growing Soviet Naval threat.

THE SOVIET NAVAL THREAT

Admiral of the Fleet, Gorshkov, the Commander-in-Chief of the Soviet Navy, took command of a defense oriented extension of the Soviet Army 23 years ago. Under his leadership development of the Soviet Navy was assigned highest national priority. As a result, since 1958 the Soviet Navy has taken delivery of at least 1800 new ships and combatant craft in 137 different classes, a program of naval expansion that surpasses the efforts of any other naval power. From a defensive posture in World War II, the Soviet fleet has evolved into a major blue-water Navy that today can challenge the U. S. for control of the seas. More important, the Soviet momentum for superiority in all phases of naval warfare continues while U. S. naval plans are far from certain and fluctuate every year. There has never in peacetime been anything comparable to the current growth of Russian naval power. We need to view these efforts critically because such actions appear to be inconsistent with, if not a repudiation of, efforts to reduce tensions between the superpowers.

From 1969 through today the Soviet Navy has increased in numbers of ships and in capability. For example, the nuclear submarines in the Soviet fleet increased from 69 in 1969 to about 155 today, surpassing us in this area in 1970. During this time period, the number of Soviet surface combatants and aircraft carriers have increased from 220 to 272 while the number of U. S. major surface combatants and aircraft carriers fell from 301 to 174. While their numbers have continued to increase, ours have continued to decline.

Looking at the submarine situation specifically, the comparison is particularly ominous. Currently the Soviets have a total of about 355 submarines, consisting of about 155 nuclear powered and 200 diesel powered ships, all of which have been built since World War II.

The total U. S. force is 122 submarines with 114 nuclear powered and 8 diesel powered. By 1985 the 7 TRIDENT and 24 LOS ANGELES Class nuclear attack submarines already authorized are expected to be delivered, averaging about 5 new nuclear submarines a year. The current Department of Defense plan is to authorize only two additional nuclear submarines a year. Thus, after 1985 our deliveries will drop to that rate. If the Soviets continue delivering at the rate of ten nuclear submarines a year, as they have averaged for the past four years, the nuclear submarine gap will continue to widen rapidly.

SOVIET BALLISTIC MISSILE SUBMARINES

In the critical area of strategic submarines the Soviets have built about 71 nuclear powered ballistic missile submarines compared to our 41. They have 34 YANKEE Class submarines which are equivalent to our POLARIS and POSEIDON submarines, but their submarines are all newer than ours.

The Soviets also have at sea 29 ships of their DELTA Class ballistic missile submarines, with more under construction. These ships carry missiles with a 4,200 mile range. This means that from their operating areas in the Barents Sea and Northern waters they can cover the entire United States, Canada, and most of Mexico. In total, the Soviets have almost twice as many nuclear-powered ballistic missile submarines as we, and they are continuing to build new ones. Our first TRIDENT submarine will not be delivered until 1980. Even then our building rate will only be about 1 a year.

SOVIET ATTACK AND CRUISE MISSILE SUBMARINES

In attack and cruise missile submarines the Soviets have a total of 260 units to our 81. Of their total, about 84 are nuclear powered, while the U. S. has 73 nuclear powered attack submarines. We do not have any submarines capable of firing cruise missiles, although the Navy is developing a version of the HARPOON missile which will be capable of being fired from submarine torpedo tubes.

The Soviets have the largest and most modern submarine yards in the world. They are credited with a nuclear submarine production capability

of 20 ships a year on a single shift basis. While not fully utilizing this vast building capacity, they have since 1974 completed 40 submarines. As late as 1966, the Russians had only two new construction yards for building nuclear submarines; today they have four with this capability, and further expansion of such facilities is currently in progress. At present, the maximum U. S. capacity to build nuclear submarines is less than half that of the Soviets.

Of greater concern than total numbers is the fact that since 1968 the Soviets have introduced over 9 new submarine designs, or major modifications in design, besides converting older submarines to improve their capabilities. They have introduced significantly improved versions of their attack, cruise missile, and ballistic missile nuclear submarines. In the last 10 years they have introduced more new submarine designs than have ever been put to sea, during a comparable period, in all of naval history. The U. S., on the other hand, has introduced only two new submarine designs in this period.

SOVIET SURFACE WARSHIPS

The trends in the surface navy are also of concern. Today, the Soviets have more major surface combatants than we, and many of their ships carry surface-to-surface missiles, which our ships do not yet have. They presently have 272 surface combatants and aircraft carriers compared to our 174. Since 1969 the Soviets have built over 800 major and minor surface combatants, mine warfare, and amphibious ships, while the U. S. has built 85, or about one-tenth as many. The Soviets have recently shown that they have a place in their Navy for aircraft carriers. The recent operation of the KIEV and MINSK along with construction of a sister ship shows that the Soviets intend to enter into the area of naval aviation capability which has been the major strength of the U. S. Navy.

SOVIET CRUISER PROBABLY NUCLEAR POWERED

The Soviets have begun construction of a new class of cruiser, which will probably be nuclear powered and which, at an estimated 25,000 tons would be the world's largest nuclear powered cruiser. Our

largest nuclear powered cruiser, the USS LONG BEACH, is about 700 feet long and displaces 17,000 tons. The new Soviet cruiser will be larger than the nuclear-powered Strike Cruiser (CSGN), that was proposed for construction by the Ford Administration. The tables that follow compare the Soviet and U.S. submarine and surface fleets.

COMPARISON OF UNITED STATES AND SOVIET SUBMARINES

MARCH 1979

<u>SUBMARINE TYPE</u>	<u>SOVIETS*</u>	<u>U.S.</u>
<u>Ballistic Missile</u>		
Nuclear	71**	41
Non-nuclear	20	0
<u>Cruise Missile</u>		
Nuclear	40	0
Non-nuclear	25	0
<u>Attack</u>		
Nuclear	44	73
Non-nuclear	155	8
<u>Total</u>		
Nuclear	155	114
Non-nuclear	<u>200</u>	<u>8</u>
GRAND TOTAL	355	122

*Numbers are approximate

** Ballistic missile submarine includes 34 YANKEE's, 29 DELTA's and 8 older units. Not all units are capable modern launcher platforms.

COMPARISON OF UNITED STATES AND SOVIETACTIVE SURFACE SHIPSMARCH 1979

	<u>SOVIETS</u>	<u>U.S.</u>
<u>Aircraft Carriers</u>	2	13
 <u>Surface Combat Type</u>		
Aviation Cruiser	2	0
Cruisers	35	18
Destroyers	71	68
Frigates	<u>162</u>	<u>65</u>
SUBTOTAL	272	174
 <u>Other Type Ships/Craft</u>		
Patrol Combatant Type	100	3
Coastal Patrol Craft	470	0
Amphibious Ships/Craft	101	64
Mine Warfare Ships/Craft	430	3
Auxiliaries	<u>755</u>	<u>87</u>
SUBTOTAL	1856	157
 TOTAL	2128	331

SURFACE WARSHIPS

The question of the direction to be followed for our surface naval strike forces continues to be the central argument concerning the Navy's future shipbuilding program.

Overall, I believe that in a non-nuclear war our Navy still has a slight edge over the Soviet Navy because of our aircraft carriers, listed in the following table. However, even this is not reassuring since, as a land power, the Soviets do not have to depend on sea lines of communication to conduct military operations. Further, the number of deployable carriers in our fleet continues to decline,

and no new carrier has been authorized since the CARL VINSON six years ago. This is the longest gap in carrier authorization at any time in the past quarter century.

CURRENT CARRIER FORCE

NAME	NUMBER	COMMISSIONING DATE	AGE AS OF 7-1-79	AGE AS OF 7-1-88 WHEN CVN-71 IS OPERATIONAL
UNNAMED	CVN 71	1987*	-	-
CARL VINSON	CVN 70	1982	-	6

DWIGHT D. EISENHOWER	CVN 69	10-18-77	1	10
NIMITZ	CVN 68	05-03-75	4	13
JOHN F. KENNEDY	CV 67	09-07-68	10	19
AMERICA	CV 66	01-23-65	14	23
ENTERPRISE	CVN 65	11-25-61	17	26
CONSTELLATION	CV 64	10-27-61	17	26
KITTY HAWK	CV 63	04-29-61	18	27
INDEPENDENCE	CV 62	01-10-59	20	29
RANGER	CV 61	08-10-57	21	30
SARATOGA	CV 60	04-14-56	23	32**
FORRESTAL	CV 59	10-01-55	24	32**

CORAL SEA	CV 43	10-01-47	31**	40**
MIDWAY	CV 41	09-10-45	33**	42**

*If authorized in FY 1980 with passive protection Option D.

**Beyond expected life.

Apparently, it is now planned that one more carrier will be built in the foreseeable future. Even so, the ship included in the budget this year is substantially inferior in almost every respect to any carrier, nuclear or conventional, authorized in the past twenty-five years.

Any comparison of the Soviet and U. S. navies must be viewed in the context that we are a maritime power dependent upon being able to maintain sea lines of communication in order to conduct military operations overseas and to support our allies. The mission assigned to our Navy is a far more difficult task than the Soviet Navy mission of denying us free use of the seas.

The United States has long since given up any chance of matching the Soviet Navy in numbers of ships. Therefore, the quality of our ships must be superior, if we are to be able to withstand their attacks and protect the sea lines of communication. It is axiomatic in war that a nation dependent on the quality of its weapons to

prevail over numerically superior forces must design its forces around an offensive strategy. A nation whose forces are outnumbered cannot afford to fight a defensive war of attrition. If we expect to be able to prevent defeat in a non-nuclear conflict, then we must be able to penetrate the opposing forces and strike their bases and sources of supply.

FY 1980 BUDGET PROPOSES NON-NUCLEAR CARRIER AND AEGIS SHIP

As you know, the FY 1980 shipbuilding program includes a medium size, oil-fired aircraft carrier known as the CVV; also the second ship of the DDG-47 Class AEGIS Fleet air defense ship, the DDG 48, which is an oil-fired, gas turbine powered ship.

Aircraft carriers and AEGIS fleet air defense ships will form the backbone of our firstline naval strike forces. Thus they will have to be capable of fighting in the areas of highest threat. Considering the difficulties of providing logistic support in such areas, in my view it is essential that our firstline warships be given the mobility and flexibility that only nuclear propulsion can provide. In my opinion, in the 1980's and beyond, in any area where the Soviets challenge us, we will need all-nuclear carrier task forces if we are to be able to keep our sea lines of communication open.

The decisions you reach this year concerning whether you authorize these non-nuclear ships, or decide to take on the uphill fight to reestablish the nuclear powered ships the Congress and the Department of Defense once agreed upon--the nuclear carrier CVN 71 and the nuclear AEGIS cruiser CGN 42--are of fundamental importance to the future of the U. S. Navy.

The justification for providing nuclear propulsion for major combatants has been documented in detail through analysis, the military judgement of senior naval commanders, and experience in the fleet. I have seen nothing in recent world events which diminishes the need for the mobility in our naval strike forces which only nuclear propulsion can provide.

OPPOSITION TO NUCLEAR PROPULSION BY SYSTEMS ANALYSTS

The Defense Department systems analysts in opposing nuclear propulsion have relied on the argument that since nuclear propulsion costs more, conventional ships should be built instead. The analysts include the cost of nuclear fuel in the acquisition cost of nuclear warships, but ignore the cost of buying and delivering oil to the conventional ships. Nowhere in their arguments do they address the difficulty the Navy can expect to encounter in providing and delivering oil to its major combatants in high threat areas. In their analyses they study the effects to be expected when combatant ships are attacked by aircraft, missiles, and torpedoes. But in the same analyses they assume that the much more vulnerable logistic support forces will not be attacked, and that the combatants will be supplied propulsion fuel whenever and wherever they need it. Even then, the studies show that on a life-cycle cost basis, a nuclear task force costs about the same as an oil-fired task force, when all costs are considered.

ROLE OF CONGRESS IN CREATING NUCLEAR NAVY

The cognizant congressional committees have studied this matter in great detail over a period of many years. Three decades ago it was the Congress that overrode the cost analysts' arguments against the nuclear submarine, to get the program established. Your Chairman, Melvin Price, is the only Member of Congress today who was a charter member of the Joint Committee on Atomic Energy (JCAE). He has pointed out many times that it was the JCAE that authorized the Atomic Energy Commission to buy and pay for the nuclear propulsion plants for our first two nuclear submarines, the NAUTILUS and the SEAWOLF, because the Department of Defense could not envision the worth of nuclear propulsion. Congress has had to step in many times since, to keep the nuclear submarine program going. Even so, the nuclear submarine building program has now been slowed to a trickle. And the talk of reverting to diesel submarines grows louder every day.

The NIMITZ Class nuclear carriers and the TRUXTUN, CALIFORNIA, and VIRGINIA Classes of nuclear cruisers evolved from similar

arguments between Congress and the Department of Defense. This argument led to enactment by Congress, five years ago, of Title VIII of the Department of Defense Appropriations Authorization Act, 1975, which established as a matter of law that the policy of the United States is to provide nuclear propulsion for major combatants built for naval strike forces. The systems analysts did not accept that policy and worked to circumvent it; this culminated last year in the repeal of Title VIII. No nuclear powered surface warship has been authorized for construction since Title VIII became law. The closest was the CVN 71 last year, but this ship was removed from the Authorization Act consequent to the President's veto. Also, Congress authorized advance procurement funds two years ago for a nuclear-powered AEGIS cruiser, the CGN 42, with four such ships included in the Department of Defense plan at that time. However, that program now appears to have been shelved by the Department of Defense.

CREDIBILITY OF NON-NUCLEAR WAR

Perhaps the opposition to nuclear propulsion is based on the assumption that we do not need to be prepared to fight a non-nuclear war against a technologically sophisticated enemy. But if that is so, why do we need another carrier at all? Or why do we need AEGIS ships designed to counter sophisticated air attack? If a confrontation between U. S. and Soviet naval forces is not credible, why are the Soviets embarked on such a major upgrading of their naval capability?

It takes many years to build a major warship. What if we miscalculate and do not build ships adequate to meet the threats we can expect to face? What alternative will we then face—giving in on all issues for which we are not willing to resort to nuclear war? The price of investing in adequate strength to ensure peace may appear high, but it is small compared to the cost of war.

AIRCRAFT CARRIERS

For the foreseeable future, the aircraft carrier will continue to be the principal offensive striking arm of the Navy in a non-nuclear war. No other weapon system existing

or under development can replace the long-range, sustained, concentrated firepower of the carrier air wing. Torpedo-firing nuclear submarines, cruise-missile-firing nuclear submarines, nuclear cruisers with anti-air, anti-surface, and anti-submarine capabilities—all are needed to supplement and augment the capabilities of the nuclear carrier. But without the tactical airpower provided by carriers, all of our other surface forces would have greatly increased vulnerability. If an opponent is successful in developing weapons that can sink a number of our carriers, and we are not successful in developing adequate counter weapons—or if we simply do not have a sufficient modern carrier force to protect our sealanes—the United States will have to change its national objectives to make them consistent with our inability to conduct overseas military operations.

How many carriers the Navy must have is not my responsibility to determine. However, I note that the number of overseas airbases available to us continues to decline, and political considerations can prevent us from using some of those we retain. Since there is no known alternative to carriers for providing significant tactical airpower beyond the range of provisioned and protected land bases, and the capabilities of the Soviets to attack us at sea continue to increase, our need for carriers appears to me to be increasing rather than decreasing.

AIRCRAFT CARRIER IN FY 1980 PROGRAM

The Department of Defense Fiscal Year 1980 shipbuilding program includes a request for \$1.617 billion for an oil-fired aircraft carrier with a full load displacement of about 62,500 tons, called the CVV. It is planned to build this ship in lieu of the fourth carrier of the NIMITZ Class, the CVN 71, for which \$268 million was appropriated in FY 1977 for advance procurement of nuclear propulsion plant components.

Since the President vetoed the FY 1979 Department of Defense Appropriations Authorization Act because it authorized

the funds to construct the CVN 71, it is currently planned that the nuclear propulsion plant components will be used as spare parts for the first three ships of the Class, the NIMITZ, the DWIGHT D. EISENHOWER, and the CARL VINSON.

CVV VERSUS CVN 71

The CVV will be about two-thirds the size of the CVN 71; it will be able to operate and service an air wing about two-thirds as large; it will carry about 40 percent of the aircraft fuel and about two-thirds the aircraft ammunition; it will have one-half the number of aircraft elevators, catapults, and propulsion shafts; it will be about five knots slower; and it will require refueling every few days.

The acquisition cost of the CVV without fuel will be about two-thirds the \$2.403 billion acquisition cost of the CVN 71, but whose cost includes the initial nuclear reactor cores which would provide for about 15 years of operation.

When all costs over a 30-year life-cycle are considered, the cost per aircraft is expected to be about the same for the CVV as for the CVN 71, and the CVN 71 would be much more effective.

SEA-BASED AIR PLATFORMS PROJECT REPORT

Last year I summarized to the Committee the results of the Assessment of Sea-Based Air Platforms Project Report issued in February 1978 by the Office of the Secretary of the Navy. I pointed out that the study showed that, overall, the NIMITZ Class carrier would be more cost-effective than the CVV even though:

(1) The costs of nuclear power were included in the analysis but the advantages of nuclear power were omitted.

(2) The engagement analyses were performed on the basis that all carrier forces were deployed on station, and fully replenished at the time the postulated attacks started. Thus, the capability of nuclear powered ships to transit long distances at higher speed, arriving in the trouble area earlier, ready to enter combat without replenishment, was given no

consideration in the analyses. Nor was consideration given to the ability to reposition nuclear-powered ships rapidly and without concern for logistic support; this ability greatly reduces vulnerability to preemptive attack and could be decisive in many actual combat situations.

(3) The analysis assumed that replenishment groups were available whenever and wherever needed, and that replenishment forces were not attacked. Thus, the nuclear carrier's advantage of requiring less frequent replenishment, and its ability to steam at high speed to rendezvous with replenishment forces in safer areas without concern for propulsion fuel, were not considered.

(4) The scenarios postulated in the analyses called for ship speeds within the capability of all ships studied. Therefore the higher top speed of the nuclear carrier was not considered in the analyses.

(5) Nor was weather considered in the analyses. Thus, the greater seakeeping capability of the NIMITZ Class carrier was not considered. In this regard, carrier studies furnished to Congress in 1974 by the Chief of Naval Operations showed that sea conditions in the North Atlantic are such that a carrier of CVV size would not be able to operate aircraft about 21 percent of the time in winter, as compared to about 12 percent for a NIMITZ size carrier—a factor of nearly two in favor of the larger carrier. Further an advantage of nuclear surface warships is their ability to take circuitous routes and use high speed to avoid storm areas during transits. This is possible because of their freedom from propulsion fuel constraints.

Overall, the engagement and cost analyses showed the NIMITZ Class nuclear carrier to be the most cost-effective carrier. When all the advantages of the nuclear carrier that were omitted from the study are actually considered, it seems to me that the nuclear carrier is overwhelmingly superior to the conventional carrier on a cost-effective—or on any other basis.

IMPORTANCE OF CARRIER PLATFORM

A smaller conventional carrier such as the CVV costs less to procure on a ship-for-ship basis than a CVN. However, it would be shortsighted to base the decision on the type carrier to be built entirely on initial procurement cost. The Navy study showed that the initial procurement cost of the carrier is only about 10 percent of the total life-cycle cost of buying and operating aircraft at sea. However, the survivability of aircraft and their effectiveness in combat are heavily dependent upon the platform from which they operate. The study showed that, even without considering the advantages of nuclear propulsion, the nuclear carrier is the most survivable platform. This is so even when the dispersal of forces through building larger numbers of cheaper ships is considered in the analyses. Further, the greater mobility, tactical flexibility, and capacity for combat consumables of the nuclear carrier makes its relative survivability even greater than calculated in the analyses.

NUMBERS OF CARRIERS

It is frequently argued that by buying smaller conventional carriers, like the 62,500 ton conventional CVV, the Navy could have more ships in more places for the same cost.

In this regard, it should be noted that if three conventional CVV's and their air wings were procured in lieu of two NIMITZ Class carriers and their larger air wings, the Navy would get the same number of aircraft and one more ship. But the study also showed that even without considering the advantages of nuclear propulsion, the three conventional ships would cost more, be more vulnerable, and provide less military effectiveness. Further, it would require an additional investment in more carrier escorts and replenishment forces before the three CVV's could be operated in more places at one time than the two nuclear carriers.

Besides the present plan is to build only one more carrier in the foreseeable future. Therefore, the real choice that faces you is what type of ship that one carrier should be.

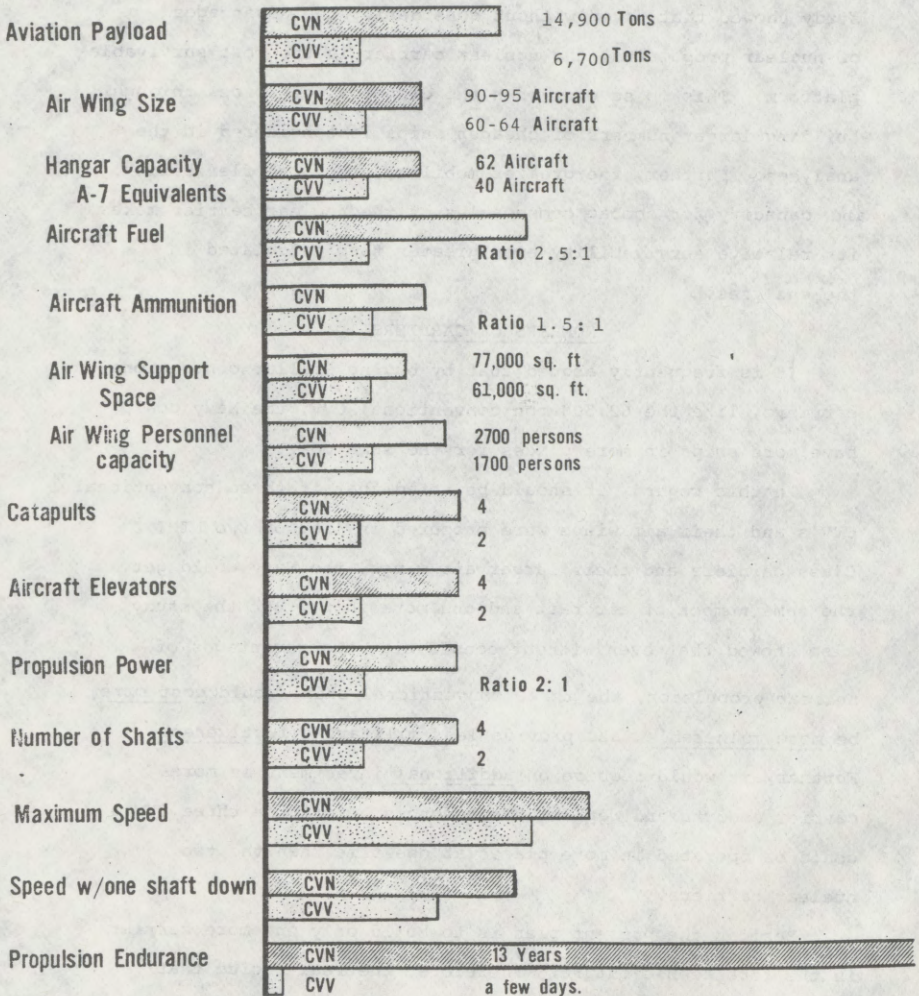
The study I have been describing is not one I made. It was a study commissioned by the Secretary of the Navy in response to a Congressional directive.

COMPARISON OF CVV and CVN 71 MILITARY CHARACTERISTICS

A comparison of CVV and CVN 71 military characteristics and life-cycle costs is summarized in the following chart

1 March 1979

Comparison of CVV and CVN 71 Military Characteristics



CVN/CVV 30 YEAR LIFE CYCLE COSTS

(FEBRUARY 1978 STUDY)

WITHOUT AIRCRAFT

ONE CVN = 1.26 CVV

TWO CVNs = 2.5 CVVs

WITH AIRCRAFT

ONE CVN = 1.38 CVVs

TWO CVNs = 2.75 CVVs

COST PER SEA-BASED AIRCRAFT IS ABOUT THE SAME.

CVN IS MORE COST EFFECTIVE OVERALL

IS MORE SURVIVABLE

CARRIES MORE AVIATION FUEL
PER AIRCRAFT

HAS MORE AIRCRAFT SUPPORT FACILITIES

HAS BETTER SEA-KEEPING ABILITY

IS ABOUT 5 KNOTS FASTER

HAS ALL ADVANTAGES OF NUCLEAR PROPULSION

which is an update of the chart I furnished to your Committee last year to show the latest information about both ships.

MODIFIED JOHN F. KENNEDY CLASS CARRIER

I note that some are recommending a compromise position of building a carrier like the JOHN F. KENNEDY, CV-67, which was the last oil-fired carrier built.

The proponents of this compromise point out that the KENNEDY can operate and support an air wing the same size as the NIMITZ Class carrier air wing, and that it has the same maximum speed and redundancy of aircraft elevators and catapults as the NIMITZ Class carrier. An oil-fired modified KENNEDY is estimated to cost \$1.76 billion in the FY 1980 program, \$143 million more than the CVV.

The KENNEDY was authorized in 1962 for the FY 1963 Shipbuilding Program. At that time the first nuclear surface warships, the cruiser LONG BEACH, CGN 9, and the carrier ENTERPRISE, CVN 65, had been commissioned only a few months. The Navy had originally recommended that both the AMERICA, CV-66, and the KENNEDY be nuclear powered, but the Secretary of Defense "persuaded" the Navy to change its recommendation from nuclear to conventional for these two ships.

By late 1962 the ENTERPRISE had proved her worth in the Cuban Missile Crisis. Many in Congress considered it a mistake for the KENNEDY to be oil-fired and tried to get Secretary McNamara to change his mind. In 1963 the Joint Committee on Atomic Energy held extensive hearings on the subject of "Nuclear Propulsion for Naval Surface Vessels." The Chairman of the Atomic Energy Commission, Dr. Glenn T. Seaborg; the Chief of Naval Operations, Admiral David L. McDonald; Secretary of the Navy Fred Korth; and the Director, Defense Research and Engineering, Dr. Harold Brown, testified that they favored making the KENNEDY nuclear. Secretary of Defense Robert S. McNamara testified against it.

The Joint Committee analyzed the testimony and all the classified studies of the matter furnished by the Department of Defense. The Joint Committee issued a report setting forth their analysis and the basis for their recommendations:

- "1. That the decision to install conventional propulsion in the new aircraft carrier, CVA-67, should be set aside and plans made to install nuclear propulsion in this ship; and
- "2. That the United States adopt the policy of utilizing nuclear propulsion in all future major surface warships; and
- "3. That a vigorous research and development program for surface warship nuclear propulsion be continued."

I recommend that the Joint Committee Hearing Record and the December 1963 Report be read by anyone who is interested in building an oil-fired KENNEDY Class carrier. The arguments we hear today are the same ones made then. The difference is that now we have 15 years more experience with successful operation

of nuclear warships in the Fleet where the advantages of nuclear propulsion have been demonstrated over and over again, and the potential vulnerability of oil supplies has become increasingly evident to everyone.

Following the Joint Committee's December 1963 Report, Secretary McNamara had the Navy make an extensive cost-effectiveness study entitled: "Nuclear Power for Surface Warships, Naval Warfare Analysis Group Study No. 33."

For the first time—and as far as I know the only time—the war-gaming analyses took into consideration the effects of attack on logistic support forces. The study showed that the peacetime costs of a NIMITZ Class carrier over its life would be essentially the same as a KENNEDY Class carrier, and that the nuclear ship would be more effective. The study also showed that when attacks on logistic support forces were considered, losses could be expected to be less if the carrier were nuclear powered.

Following this study and additional successful operational experience with nuclear ships, Secretary McNamara in 1966 changed the three additional carriers planned at that time to nuclear propulsion. That was the origin of the NIMITZ, the DWIGHT D. EISENHOWER, and the CARL VINSON.

When I testified before the House Armed Services Committee in May 1966 in support of the Authorization of the NIMITZ in the FY 1967 Shipbuilding Program, I said:

"When the Navy changed their recommendation from nuclear to conventional propulsion in the two aircraft carriers following the ENTERPRISE, I know that a major concern was that they felt they wouldn't get these carriers if they asked for nuclear. So they asked for conventional. I think they would have asked for an aircraft carrier with sails, if they hadn't been able to get any other. After all a Navy without ships is not a Navy at all....

"In order to carry out his responsibilities, the Chief of Naval Operations certainly must have real ships, not paper ships. In order to get real ships, he must ask for ships that he thinks he can get."

I can see how today some who believe another carrier is

needed, but do not see any point in building the CVV, could turn to a KENNEDY Class ship as a compromise. There is no question that the superiority of a KENNEDY over a CVV is worth the increase in cost involved. But, it is important to remember that study after study made by the Navy over the past 15 years shows that the overall cost of a NIMITZ is essentially the same as the overall cost of a KENNEDY, while the nuclear ship is markedly superior. It should be borne in mind that a NIMITZ Class carrier, with the same overall cost, carries almost twice as much aviation fuel and fifty percent more aircraft ammunition than a KENNEDY Class carrier, as well as having all the advantages of nuclear propulsion. These features increase the fighting capability of the ship and the air wing it operates and supports. They also reduce the vulnerability of the ship and air wing as a weapon system because they reduce dependence on highly vulnerable logistic support forces.

When all is said and done, it must be remembered that the cost of the carrier is only a small fraction of the total cost of operating sea-based aircraft. Yet the capability, availability, and survivability of those aircraft are directly dependent upon the characteristics of the carrier platform from which they operate.

TURNING THE CLOCK BACK

In my view, to build an oil-fired KENNEDY would be turning the clock of carrier technology back over 15 years. To build a CVV would be turning the clock back over 30 years.

If we are to have another carrier, we must use the best technology we have. The ENTERPRISE, the NIMITZ, and the DWIGHT D. EISENHOWER have proven their capabilities in operation. They are clearly superior to any oil-fired carrier. Whatever carrier we build will not join the Fleet until 1987 and will have to operate at least 30 years after that. If we are to spend the money it takes to provide and operate an air wing at sea, it makes no sense not to provide the best platform. I do not understand the arguments that have been presented for

canceling the CVN 71 and substituting either a CVV or a KENNEDY Class carrier in its place.

Of course, the decision is not mine to make, so it is not necessary that I understand the basis for it. On the other hand, under our Constitution the decision is yours to make. Therefore, I urge that you find an explanation that makes sense to you for whatever decision you make in this matter.

NEED FOR NUCLEAR-POWERED GUIDED-MISSILE SHIPS

Some argue that we should not build another nuclear carrier because to do so would require providing nuclear power for the guided-missile firing ships which accompany it. I do not consider that argument valid. Studies furnished to your Committee have shown that each time a nuclear ship is substituted for a non-nuclear ship in a carrier task group, the capability of the force as a whole will improve, even if all the other ships are oil-fired.

However, it is also true that there is an incentive to provide nuclear propulsion in missile-firing ships, whether or not the carrier they accompany is nuclear powered. Further, a nuclear-powered guided-missile ship has the unique capability for independent operations not available to oil-fired ships.

Of course, the greatest gain is made when all the ships in a task group are nuclear. The all-nuclear carrier task group has greater capability to penetrate and counter the projected Soviet naval threat than any other naval surface force we know how to build.

When a nuclear carrier is substituted for a conventional carrier, the range of a carrier task group, with four conventional escorts, is doubled. When two of the four escorts with the nuclear carrier are nuclear, the range of the carrier task group is doubled again. When all the escorts are nuclear, the range of the carrier task group is essentially unlimited.

Each nuclear escort substituted for a conventional escort

also increases task force flexibility and mobility through advantages which are difficult to describe in numerical form.

VULNERABILITY OF REPLENISHMENT SHIPS

For example, none of the comparisons of the relative effectiveness and cost of the nuclear and conventional escorts cited in current Navy cost studies take into consideration losses due to enemy action. One older Navy study, "Nuclear Power for Surface Warships," to which I referred earlier, showed that:

- (1) Losses of underway replenishment ships can be expected to be greater when supporting conventional than when supporting nuclear warships;
- (2) Under several of the threat conditions studied, the number of replenishment ships lost supporting conventional warships was more than twice the number lost supporting nuclear warships; and
- (3) The greater the threat to the underway replenishment ships, the larger is the loss differential to be expected—owing to the larger replenishment force required for the conventional warships.

If we are concerned that the expanding Soviet naval capability will increase the vulnerability of our first-line strike forces, then it is not reasonable to assume that our underway replenishment groups can be operated with impunity. The all-nuclear carrier task group, having essentially unlimited high-speed endurance, carrying more combat consumables which permits longer periods between replenishments, and with the capability to retire at high speed for replenishment in low-threat areas, has far greater capability to conduct sustained combat operations than any other surface naval force we know how to build.

Against a sophisticated naval threat, it could quickly turn out that our ability to conduct sustained combat operations would be controlled by the logistic support available. Under such circumstances, each ship with nuclear propulsion improves

the capability of the entire force. The all-nuclear task group has far greater striking capability than a conventional group.

When logistic supply lines are attacked during a real war, the decrease in the requirement for ships' fuel for the strike forces will have a compounding beneficial effect. The surviving fuel transportation and storage facilities can then all be concentrated on getting fuel for aircraft and other military vehicles to the forward areas. The escorts that would otherwise be required for the tankers which carry ships' fuel could then be assigned to assuring the safety of other supplies.

FIFTEEN YEARS WITHOUT REFUELING

With existing designs of naval nuclear propulsion plants it is possible to provide enough energy for 15 years of warship operation without need to refuel. In contrast, oil-fired naval warships must be refueled every few days. Of what value is an oil-fired warship if it is unable to get oil when and where it needs it?

STUDIES OF NUCLEAR PROPULSION FOR SURFACE WARSHIPS

The studies that have been made of the issue of nuclear propulsion for surface warships have cost millions of dollars and countless man-years of effort, including that of many high-level people. Every aspect of the advantages and cost of nuclear surface warships has been exhaustively studied in minute detail over a period of many years by numerous analysts, civilian and military. These studies have brought out time and again that a nuclear surface warship has a higher initial investment cost than its conventional counterpart, but that when overall costs are taken into consideration the nuclear ships are not much more expensive, but provide greatly increased military capabilities. I do not believe that further studies can produce any more facts.

NO NUCLEAR CRUISERS AUTHORIZED SINCE FISCAL YEAR 1975

This year again the Department of Defense request for naval ship construction authorization does not include a request for construction of any nuclear-powered guided-missile cruisers.

The last nuclear cruiser authorized was the ARKANSAS, CGN 41, in the Fiscal Year 1975 program, which followed by three years the authorization of the MISSISSIPPI, CGN 40. In acting on the Fiscal Year 1976 DOD budget request, the Congress canceled the fifth ship of the VIRGINIA Class, the CGN 42, on the basis that it should be built with the AEGIS air defense weapons system. Each year since then plans for building nuclear powered AEGIS ships have been cut back or deferred. None are now planned.

NEED FOR NUCLEAR-POWERED AEGIS CRUISERS

Navy witnesses have testified for the past several years that the AEGIS system is needed to protect our surface ships against the projected Soviet air threat in the 1980's. AEGIS ships are needed in the areas of highest threat, the same areas where our nuclear carrier task forces will be most needed, and where the military advantages of nuclear power may be essential to their mission. Unfortunately, repeated reductions in the planned program have raised the question of whether our nuclear carrier task groups will ever have the nuclear-powered AEGIS ships they need.

In January 1977, President Ford submitted a five-year shipbuilding program from Fiscal Year 1978 through Fiscal Year 1982 which included two nuclear-powered strike cruisers, CSGN's, and ten DDG-47 Class conventionally powered AEGIS ships. The Ford Administration's Fiscal Year 1978 budget request included funds for the lead DDG-47 Class ship and long-lead funds for the first CSGN planned to be authorized in Fiscal Year 1979.

The Carter Administration subsequently canceled the nuclear strike cruiser program entirely and directed that

instead the Navy adopt an alternative of putting AEGIS in a smaller ship of the VIRGINIA, CGN 38, Class size.

Funds were authorized and appropriated in Fiscal Year 1978 to buy long-lead material needed to support the new Administration's stated plans to request authorization for construction of the first of four ships, the CGN 42, in the Fiscal Year 1979 program. However, in December 1977 the Navy budget request for construction of CGN 42 in Fiscal Year 1979 was disapproved in favor of slipping the ship authorization one year to the Fiscal Year 1980 program. The DOD subsequently slipped the CGN 42 to the FY 1983 program. A few months ago, the DOD deleted any ships of this Class from the current five-year shipbuilding program.

The issue is whether nuclear-powered AEGIS ships are needed to counter the projected Soviet threat. AEGIS is planned as our most capable AAW weapons system. Because AEGIS ships will be expensive, regardless of their means of propulsion, there will never be a large number. In a naval war against an enemy employing sophisticated weapon systems, all strike force AEGIS ships will be needed in the areas of highest threat. It is under just such circumstances that the advantages of nuclear propulsion are most urgently needed to maximize mobility and minimize logistic support. It is into such high-threat areas that the nuclear carrier task forces will be sent in time of war, and they will need nuclear-powered AEGIS ships to accompany them. The AEGIS ships should be nuclear for the same reasons that carriers should be nuclear.

In areas where the threat is great enough to require nuclear carriers and AEGIS ships—our first-line naval strike forces—it is highly unlikely that oilers can survive. When a non-nuclear AEGIS ship runs low on fuel, it will be necessary to remove the AEGIS ship to an area of lower threat to meet the oiler, losing the AEGIS protection just when it is most needed.

Another consideration is that to have a credible nuclear-powered guided-missile ship capability in both the Atlantic and Pacific Fleets, it is necessary to build a reasonable number of nuclear ships so that some

ships are available for immediate deployment at all times. Only nine nuclear cruisers have been authorized over the past 23 years, and none of these has AEGIS.

Unless nuclear-powered AEGIS cruisers are built, our nuclear carriers will have to be accompanied by DDG-47 Class AEGIS ships when they enter the highest threat areas, thus giving up the significant military advantages of the all-nuclear carrier task force in the very areas where nuclear propulsion is most needed. Study after study has shown that the small additional life-cycle cost of the all-nuclear-powered carrier task group is more than justified by the added military capability it would provide.

The decisions you make this year on the naval shipbuilding program will not affect the Fleet until a decade from now. It is always tempting not to make investments for the future when today's problems are so pressing. But where would we be today, if Congress had refused to take the long-range view in the past? Our Forefathers were wise to put the decision-making authority in the hands of Congress. That is the only body in Government where the leaders stay in office long enough to face personally the long-range results of their decisions.

THE NUCLEAR INDUSTRIAL BASE

The current reduced rates of nuclear ship authorizations threaten the industrial base for the manufacture of nuclear propulsion plant components. For example, the levels of procurement of nuclear equipment in both the FY 1979 and FY 1980 budgets result in significant under-utilization of the present industrial base. The procurement level for major nuclear components in FY 1979 is less than 30 percent of the industrial capacity. In FY 1980 it will be less than 20 percent.

Sustained under-utilization of the industrial base at these low levels increases substantially the risk that suppliers will be unwilling to commit resources to Navy nuclear work. If present suppliers divert their resources to other business,

the nuclear industrial base will shrink to levels which may not be adequate for the long term support of the nuclear Navy and for future shipbuilding programs. For example, if the nuclear equipment industrial base were to shrink to capacity levels represented by the FY 1979 and FY 1980 budgets there would be inadequate component vendor capacity to support programs currently projected or under consideration for building nuclear powered ships. Once lost, rebuilding the industrial base will be costly and time consuming and could adversely affect options for future shipbuilding programs.

SHIPBUILDING CLAIMS

The recent settlement of disputes with Newport News, Electric Boat, and Ingalls has virtually eliminated the Navy's shipbuilding claims backlog. Relations with these companies have eased considerably in the claims aftermath. Electric Boat has committed itself to the prompt pricing and settlement of contract changes as they arise. Likewise, while there are still problems, day-to-day business dealings with Newport News have improved.

Understandably, there is a sense of euphoria within the Navy and elsewhere that the claims are finally behind us and that new procurement policies will prevent their recurrence. The danger is that in turning now to the future, the lessons of the past may be neglected or forgotten.

A contract is intended to represent a meeting of minds. Shipbuilding claims have shown how difficult contract enforcement can be, if one party decides not to honor the terms of the agreement. A claims team headed by lawyers may be far more lucrative to a company than a productive work force. By investing relatively modest sums in assembling such teams, shipbuilders can achieve better financial results than their contractual performance warrants.

The Navy has not only tolerated omnibus claims; it has in effect encouraged them. To the contractors it must appear that Navy contract rights are always negotiable; that virtually

any claim will be evaluated, no matter how frivolous or poorly substantiated; and that a generous lump sum settlement can be expected if only the contractor persists.

In finding ways to make liberal settlement offers, the Navy, in effect, ends up creating incentives for omnibus claims. An example is the Navy paying the contractor "litigative cost" as part of the claims settlement. Theoretically, "litigative cost" is the amount the Navy estimates it would spend if the claims were tried. Generally speaking, the larger and more complex a claim, the higher the estimated "litigative cost."

Today, some contractors take for granted their easy access to high level civilian officials within the Navy and Defense Department. These officials do not remain in office long enough to see or be responsible for their actions. Their willingness to deal directly with the contractors, without knowing the facts or taking time to learn them, or consulting their knowledgeable subordinates, greatly handicaps working level Navy officials in administering Navy contracts.

Contracts are premised on both parties acting in their own self interest within rules agreed to at the outset. Today, there is a tendency for working level officials in the Navy to consider their job as finding ways to justify what the contractor wants. Until recently, the burden on lower level procurement personnel has been to convince their superiors that the payment of public funds to contractors was fully justified. This ethic must not be abandoned in the claims aftermath.

The Navy should also guard against new contract policies and procedures to avoid claims, which simply shift risks to the Government, while retaining the appearance of fixed price contracting. This approach may give the appearance of a claims-free shipbuilding program, but would not promote the cost benefits and efficiencies which are supposed to inhere in fixed-price, incentive-fee contracting.

This committee has done much to help strengthen the Navy's system for administering contracts. The committee took the

lead in legislation which now requires contractors to certify their claims against the Government. The committee has also made clear that the claims settlement does not sanction lax standards for Navy contract administration in the future.

These and other initiatives by the committee should be vigorously pursued. In the past, Navy officials have not enforced the Navy's claims certification requirement. Also, contracts have not been administered on a pay-as-you-go basis. I know of no instance where a senior naval official has taken action with shipbuilding officials to cease the submission of inflated claims. Congress should press them to take such action.

The Navy has still not faced up to how the Government can be protected adequately in contract disputes with sole source contractors who threaten work stoppage as a means to exact concessions. National defense should not be a bartering point in contract disputes.

Another problem is posed by companies which deliberately underbid Navy contracts with the expectation of later recovering through claims. Existing procedures for dealing with this, situation are not adequate. Traditionally, the Government has made the award and later been criticized for having done so.

Last year the committee indicated that, after the settlement, it might hold hearings on Navy contract policies and procedures. I strongly recommend that you do so. By pressing those matters now, the committee can do much to ensure that mistakes of the past are not repeated in the future, and that the recent settlement must constitute more than a temporary respite from omnibus claims.

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