TESTIMONY BY CHAIRMAN JOHN A. McCONE, U.S. ATOMIC ENERGY COMMISSION
BEFORE
JOINT COMMITTEE ON ATOMIC ENERGY, U.S. CONGRESS, AT HEARINGS
PURSUANT TO SECTION 202, ATOMIC ENERGY ACT OF 1954
FEBRUARY ~~24~~ 17, 1959

1. The Commission's testimony before the Joint Committee on development, growth, and state of the atomic energy industry, pursuant to section 202 of the Atomic Energy Act of 1954, this year will be in two parts. In order to avoid duplication, and with your permission, we would like to present, for the record, excerpts from the Twenty-Fifth Semiannual Report which describe the progress of industry in 1958 and related Commission activities. My oral testimony for the most part will review first those matters, other than the reactor program, in which the Joint Committee has expressed special interest through Mr. Durham's letter of January 21, 1959. Afterward, I will present the Commission's plans for the most rapid feasible development of economic nuclear reactors for the generation of civilian power.

ADMINISTRATIVE CHANGES AFFECTING REACTOR DEVELOPMENT

2. An AEC-wide study on decentralization, affecting reactor development as well as other programs, has been made. As a result, 22 delegations of authority were made to operations offices: Operations Offices, for example, were given responsibility for administering the access permit program, for promotions in upper grades, for giving assistance in radiation incidents, etc. On 18

proposals, action is pending to accomplish delegation, or to take other feasible action. Ten additional proposals were found to be not matters for delegation, and 46 were not accepted.

3. The Division of Reactor Development was reorganized. The Office of Industrial Development, except for isotope activities, was consolidated with the reactor division. This brings into a single division the important functions of planning and assisting industrial participation in the nuclear field, and the major civilian and military reactor programs that provide principal opportunities for industrial participation.

4. The reactor division's technical units were relieved of many administrative duties, and thus afforded more time for technical programs. Responsibility for all work of general applicability to more than one reactor type was placed under an Assistant Director for Nuclear Technology. KAVANAUGH This will give better balance in administration of the technical programs.

5. Early in the year the Pittsburgh Naval Reactor Operations Office was created and, together with the Schenectady Naval Reactors Operations Office, was assigned naval reactors work as its primary responsibility. The Lockland Aircraft Reactors Operations Office similarly was established with the aircraft nuclear propulsion program as its principal responsibility. Lines of communication, responsibility, and authority were shortened by these actions.

6. In carrying out the reorganization of the Division of Reactor Development, no significant change has been made in overall manpower devoted to reactor development programs.

CONTRACT ADMINISTRATION

7. The Commission took basic action during 1958 on establishment of fees for cost-plus-fixed-fee production and research and development contracts. The Commission confirmed existing practice of allowing a somewhat higher scale of fees for research and development work than for the operation of facilities. The Commission also recognized that the fee for operating contracts should reflect the research and development work carried on at each facility. The Commission adopted a moderately higher scale of fees for research and development work to be performed in private facilities, and confirmed the policy in such cases of reimbursing allocable home office expense separately from the fee.

8. For cost-plus-fixed-fee research and development contracts for operations in Government-owned facilities which are isolated from the contractor's private business, the Commission negotiates combined fee and home-office expense arrangements. This provides for paying those specific expenses incurred at the home office which might otherwise be incurred at the site.

9. Discussions are being held with the Department of Defense with the objective of reaching agreement on a set of cost-reimbursement principles governing both Defense and Commission contracts.

10. The Commission has a firm practice of decentralizing contract approvals. There remain some contracts, however, which because of their inherent novelty may have to be negotiated in Washington. The power demonstration contracts are examples of such contracts--when the delineation of the program and the terms of the contract are intermingled and must be worked out simultaneously.

11. The Commission speeded up headquarters review of contracts negotiated in its operations offices. Responsibility for expediting review was placed in the General Manager's office, and short but realistic deadlines were established for each step. Under this system, reviews should be accomplished in three weeks, with 30 days the outside limit. The system is working very well. In January 1959 the Commission changed its disputes procedure. Use of an advisory board was abandoned and disputes now are referred to the Commission's hearing examiner. This should cut the elapsed time between filing of the appeal and decision on the appeal from the previous average of 18 months a case to something less than three months a case.

12. During the past year, the Commission made available to the public that portion of the AEC Manual which includes most of the policy and procedures relating to contracting and procurement, and contract article forms.

PATENT POLICIES

13. A public hearing was held on patent policies and written comments were obtained. Interim reports have been made to the Joint Committee, and recommendations will be made in ample time for committee study before your scheduled hearings later this spring. Among patent sections of the Act which are receiving review is section 153 dealing with the authority of the Commission to declare a patent affected with a public interest.

TECHNICAL INFORMATION

14. The Commission declassified additional areas of information during 1958. Studies are under way to determine whether further categories of information can be made public without compromising national security.

15. Some 1,400 access permits were in force at the year's end, about the same number as a year previously, to allow use of certain categories of confidential and secret documents for industrial and commercial purposes. Beginning January 1, the Commission ceased to provide investigations free of charge for the security clearances necessary for employees of access permittees other than non-profit educational institutions.

16. Eleven technical books were prepared and published under Commission auspices during 1958, six information meetings were held, and 11 collections of papers presented at scientific and

technical meetings were offered for sale. Twelve scientific works were translated from Russian, German, French, and Arabic. This was in addition to the publication during 1958 of 7,000 unclassified and 2,000 classified reports.

URANIUM PROCUREMENT

17. I wish to discuss briefly further actions taken by the Commission during 1958 to hold uranium production in reasonable balance with requirements while continuing to meet commitments incurred under previous purchasing policies and long-term contracts.

18. Canada began deliveries to the United Kingdom from ores committed to the United States but released for this purpose. An agreement was reached with South Africa placing a ceiling on its deliveries.

19. You will recall that in October 1957 it was announced that the Commission had decided to limit future commitments for the procurement of uranium concentrates that would involve the construction of new milling facilities. This decision was modified in April 1958 to permit a limited expansion of domestic milling capacity to provide markets in five areas having no market, or an inadequate market, for uranium ores developed prior to November 1, 1957. Under this limited expansion program negotiations are substantially complete for concentrate purchase contracts that will provide an additional capacity of 1,750 tons of ore per day for the

central Wyoming area. Completion of purchase contracts that will provide additional milling capacity for Southeast Texas, North and South Dakota, and Nevada is awaiting further information to be supplied by the prospective contractors. Proposals for additional milling capacity for the Colorado Front Range have been submitted and are now under review.

20. On November 24, 1958, the Commission withdrew prospectively a concentrate purchase program for the 1962-66 period, announced on May 24, 1956. The Commission will carry out its commitments with respect to ore reserves developed prior to November 24 in reliance upon the announced program by negotiating contracts for the purchase, during the 1962-66 period, of appropriate quantities of concentrates derived from such ores. These contracts also will contain provisions designed to provide equitable treatment for independent miners, including a fair share of available mill capacity. With respect to ores developed after November 24, purchases of concentrates will be made at prices and terms to be agreed upon, as requirements dictate.

21. Milling capacity in the United States reached more than 21,000 tons of ore per day in December. Nine new mills came into operation; two were closed; in all, 23 mills were operating at the end of the year.

GROWTH OF ATOMIC ENERGY INDUSTRY

22. Next I would like to offer some highlights of the growth of the atomic energy industry during 1958.

23. Industry expenditures on power reactors, and purchase in this country of research and power reactors for installation in foreign countries, provided a moderate flow of business for private firms. Construction of most full-scale nuclear power-plants being built in the United States is privately financed. The total cost to private industry is estimated at about $300 million. During the fiscal year that will end June 30, 1959 private expenditures for construction and fabrication of such nuclear power-plants are expected to reach $70 million, compared with about $30 million the year before.

24. The chief sources of business for atomic industrial and research establishments, however, are the contracts of the Atomic Energy Commission and the Department of Defense. These contracts include design and construction of both civilian and military reactors--the latter chiefly for propulsion--for research and development in a variety of atomic energy fields, and for services and supplies for Federal atomic energy programs. During the 1959 fiscal year, the Atomic Energy Commission and the Department of Defense together are expected to obligate about $570 million to reactor work, divided about 60 percent for military reactors and 40 percent for civilian reactors. Of this total $420 million was

by the Atomic Energy Commission. About $330 million of the total is principally for construction and fabrication of reactors, up about $60 million from the year before. Of this total $155 million is being obligated by the Department of Defense and $175 million by the Commission.

25. There have been some cancellations in the power program during the year. The American and Foreign Power Co. announced the indefinite suspension of its plans to build small power reactors in Brazil, Cuba and Mexico. The Pennsylvania Power and Light Co. and Westinghouse announced the withdrawal of their proposals to build a nuclear power plant under the Commission's Power Demonstration Program.

26. The Combustion Engineering Co. announced the acquisition of General Nuclear Engineering Corp. through an exchange of stock.

27. Power reactor developments contributed to a moderate expansion among supply and service companies of the atomic energy industry in the United States. Five additional companies undertook commercial atomic energy activities for the first time during 1958, performing such functions as processing of normal and enriched uranium, fabricating fuel elements, and disposing of low-level radioactive wastes. Four companies, already licensed to perform one service, undertook new lines of activity.

28. It is the Commission's policy to terminate its own services to industry when similar services become available from commercial

sources. Expansion of commercial activity during the past year led the Commission to withdraw its previous offers to provide gamma-irradiation, to end its encapsulation of high-intensity radiation sources, and to cease supplying a number of special materials.

29. For the first time, during 1958, normal uranium could move in exclusively commercial channels from mines to finished products. The Commission continued as the sole source for enriched and depleted uranium, as it is for plutonium, and uranium 233.

30. All special reactor materials except boron 10 and heavy water now are available from commercial sources, as are all services required by the private atomic energy industry except neutron irradiation, chemical processing of irradiated fuel elements, and disposal of high level radioactive wastes. Private industry has plans to operate two test reactors to provide neutron irradiation--one is already critical, the other nearly completed. The Commission has invited proposals from industry to provide test reactor irradiation services to meet Federal needs, offering to contract for space in reactors for periods up to five years, subject to renewal. We received 11 proposals from industrial, research and educational institutions, and these are being evaluated. It is Commission policy to build test reactors itself only if its needs cannot be satisfied by commercial test reactors at reasonable prices

31. During 1958, the Commission removed restrictions from nonnuclear uses of uranium, and agreed to sell it on an unclassified

basis; announced permission for private sale of uranium concentrates to authorized users here and abroad; filled out the schedule of charges for chemical processing of fuel elements; agreed to lease as well as sell heavy water for new research, medical, and testing reactors, and to consider leasing heavy water or waiving of charges for heavy water in certain power reactor programs. Plutonium-beryllium neutron sources, formerly available only for research, were freed for commercial use.

32. No changes were made during the year in the Commission's pricing policies with regard to determining fair prices to be paid by the Commission for special nuclear material produced in non-Federal reactors.

33. The Commission has not changed from the general policy of recovering full costs for the materials or services it furnishes.

INTERNATIONAL MARKETS

34. Development of international markets is of vital interest, of course, to the United States atomic energy industry.

35. Export of the first power reactor to Europe from the United States was licensed during 1958--the 11,500 kilowatt plant for Mol, Belgium. Two United States companies were awarded contracts to build power reactors in Europe--a 15,000 kilowatt demonstration plant in West Germany which an American company will build in cooperation with a German affiliate; and a 150,000 kilowatt reactor

for Italy. A contract is being negotiated between a Swiss firm and an American company for a 16,000-27,000 kilowatt power reactor for Switzerland. American-built research, training, and testing reactors continue to sell abroad. During 1958 contracts were awarded or bids solicited for 11 such reactors to be installed in eight foreign countries. Foreign spending in the United States last year was estimated at about $35 million for reactors, nuclear equipment of various kinds, fuel element fabrication, and design and engineering services.

36. Seventeen bilateral agreements between the United States and individual nations, which are in force or awaiting ratification, provide for comprehensive cooperation in power reactor development.

37. Early this month, the Commission established a policy of making enriched fuel available to foreign countries on a 10-year deferred payment plan. This was in addition to similar arrangements previously made under the agreement with the European Atomic Energy Community (Euratom). Countries and international organizations eligible under the new policy--those which have appropriate agreements for cooperation with the United States--would pay interest on the unpaid balance of charges for the fuel during the 10-year period. A limit is placed on the total available under this program. The total is in addition to that for Euratom projects, and will provide for projects with a combined generating capacity of no more than 500,000 kilowatts which can be completed by June 30, 1964.

38. The Commission and Euratom are prepared to issue invitations for reactor proposals shortly after the Euratom Agreement for Cooperation comes into force. In December, invitations for proposals under the joint 10-year research and development program were issued and to date the Commission has received inquiries from 35 industrial organizations in the United States.

39. The Joint Committee is familiar with the details of the Agreement which was signed in Brussels on November 8, 1958.

40. International groups are drafting plans for indemnification of public liability which might result from nuclear reactor accidents. The Commission, on request, is assisting in these efforts, and is working also on nuclear ship safety and on ship owners' liability for nuclear ships. The problem of liability has been considered an obstacle by some United States companies interested in selling or building power reactors abroad. The Organization for European Economic Cooperation and the European Atomic Energy Community, are drafting conventions; the International Atomic Energy Agency has appointed an expert panel on which the Commission's associate general counsel will represent the United States. The Commission and the Maritime Administration have been invited to assist in drafting amendments to the Brussels Convention of 1957 on the matter of a limitation of ship owner's liability for nuclear ships accidents.

41. As head of the United States delegation to the International Atomic Energy Agency's second general conference, held in Vienna September 22 to October 4, I assured the agency of our country's full support. We made a number of proposals emphasizing (a) a major program of training, research, and application in the field of radioisotopes; (b) development of international safety standards; (c) an intensified fellowships program; (d) a research program under which United States-financed research projects would be assigned to the IAEA for contracting to research centers and universities throughout the world; (e) a long-range program to make nuclear power available to less-developed countries, and (f) IAEA's development into a major center for exchange of information and sponsorship of conferences.

42. While IAEA has successfully met most of its organization problems, as it moves into an operating program it is encountering new difficulties. We are assisting the agency in overcoming these problems by such steps as providing financial support, offering expert personnel to work on key issues, and negotiating an agreement for cooperation.

LICENSING AND REGULATION

43. The Commission during 1958 improved and simplified its procedures and policies for licensing and regulation of the atomic

energy industry. Protection of health and safety is, of course, paramount. Within that frame of reference, our basic concept has been to avoid a rigid pattern that might prove too restrictive or even unworkable in practice; instead the Commission has sought the maximum feasible degree of flexibility that is consistent with the public interest.

44. The Commission identified additional products such as industrial gages and quality control devices, which contain radioactive materials of sufficiently low level to be adaptable to use under general licenses when manufactured and distributed under a specific license. We also propose to exempt altogether from licensing certain other products containing small concentrations of radioisotopes.

45. Licensing of reactors currently depends on detailed evaluations of each proposed plant. Present regulations prescribe general standards and guides for reactor safety. To assist the designer, the Commission has been working toward the development of more detailed criteria pertaining to site selection, control rods, external containment systems, and control systems. We now have in preparation a revision of the reactor licensing regulations incorporating these criteria.

46. Pursuant to requests of the Joint Committee, we are preparing recommendations covering Federal-State relationships in the area of regulation and licensing. They will be presented to the Committee in the near future.

47. Earlier in the year we established an Office of Hearing Examiner, to conduct hearings on matters assigned by the Commission. The Hearing Examiner reports directly to the Commission.

CONTROLLED THERMONUCLEAR RESEARCH

48. In the field of controlled thermonuclear research, scientists consider that they made progress during 1958.

49. At the beginning of 1958, efforts to attain a self-sustaining controlled thermonuclear reaction in ionized hydrogen gases had attained an effective temperature of only a few million degrees. At the year's end, effective temperature of the order of 10 million degrees had been achieved. Before such hot plasmas will produce more nuclear power than they lose by radiation, their energies must be raised by another order of magnitude--roughly to 100 millions of degrees effective temperature. New experimental machines are being designed and built.

50. Appreciable advances were made in instrumentation and diagnostic techniques. Improved measurements have lead to a better understanding of hydromagnetic instabilities in the plasma and methods for controlling them. Attention is now being turned to the

study and control of another form of collective behavior--plasma oscillations--that can give rise to coherent electromagnetic radiation in the radiofrequency and microwave regions, as well as to instabilities which reduce the length of time plasmas may be confined.

51. As a result of progress in mirror-machine technology, there is renewed interest in cooling of magnet coils as a means of reducing power loss in the coils and permitting the generation of stronger magnetic fields within the machines. Improved energetic ion and electron sources and plasma sources have been developed, and one form of radiofrequency heating, ion cyclotron resonance, has been successfully demonstrated on a small scale.

52. The United States and the United Kingdom completely declassified all information on controlled thermonuclear research. A number of the Commission's experimental machines were demonstrated at the United Nations Second International Conference on the Peaceful Uses of Atomic Energy in Geneva last September.

PROJECT PLOWSHARE

53. The Commission carried out a number of studies during 1958 on possible peaceful applications of nuclear explosives, an area of endeavor we have called Project PLOWSHARE. Industrial concerns have shown interest in some of these. Three projects received preliminary consideration: excavation of a harbor in Alaska,

blasting of large masses of oil-bearing shales in which industry participation would be sought, and a fully contained explosion for manufacture of radioisotopes and generation of heat that might be tapped for power production. Also, mining companies have indicated interest in using nuclear explosives for low-grade ores or mineral deposits materials inaccessible by conventional methods. The studies, aimed at determining technical feasibility and economic desirability, give full attention to solving all health, safety, and conservation problems related to the proposed demonstration tests.

RADIOISOTOPES

54. Industrial use of radioisotopes is continuing to expand. There were 23 percent more licensed industrial users in 1958 than in 1957. The quantity of isotopes shipped also increased--some 37 percent more curies of radioisotopes were distributed in 1958 than in 1957.

55. The Commission during 1958 got under way its program for assisting industry to make broader uses of isotopes and of high intensity radiation.

56. The Joint Committee has seen the SNAP III device--the small atomic battery powered with isotopes which converts the heat of radioactive decay directly into electricity. This is part of the military program of course--carried out by the Aircraft Reactors group of the Commission. Possible industrial uses of this device will be explored.

57. The Commission's activities designed to develop civilian uses of radioisotopes and high-intensity radiation have been assigned to the Office of Isotopes Development, newly established to handle the broadened program.

58. The Commission in 1958 signed 25 contracts for studies to determine how isotopes could be used to assist various industries and for development work on potential uses already identified. In response to Commission invitations, more than 100 proposals were made by 50 industrial and 10 academic organizations. Training programs for industrial users have also been inaugurated.

59. Isotopes development is a relatively small program, so far as costs are concerned. The Commission hopes it may prove to have powerful leverage. Industry's savings from the use of radioisotopes have been estimated at some hundreds of millions each year. The potential is much greater than that. This program will seek to help develop that potential.

CIVILIAN NUCLEAR POWER PROGRAM

60. Now, I would like to present to you the Commission's Civilian Nuclear Power Program. The present status of the program is summarized in the excerpts from the Twenty-Fifth Semiannual Report, pp.16-47.

61. The program for development of civilian power reactors may be considered as having completed its first phase. It was just five years ago that the Commission, with the approval and support of the Joint Committee, launched the first formal civilian nuclear power program. I believe that efforts during the past five years have paid off in remarkable progress. I believe we have had a good program, both in terms of technical progress and in terms of participation and cooperation of industry.

62. There have been waves of optimism and pessimism as the development effort has progressed. There now seems to be a rapidly improving basis for projecting the technology to actual achievement of some of our short range program objectives. As this basis for projection continues to improve and as there is less uncertainty in our extrapolations of nuclear power technology, there will be less need for pursuing a multiplicity of projects primarily for greater assurance that a specific goal will be achieved.

63. As the Committee knows, the last year or so has been a period of evaluation and reappraisal insofar as our civilian

nuclear power program is concerned. Various groups both inside and outside of Government have made valuable contributions to this process. In addition to the attention given to this problem by the Commission and its staff, including the Commission's statement before the Joint Committee on June 3, 1958, I would mention particularly your Committee's staff report on a "Proposed Expanded Civilian Nuclear Power Program," the comments regarding it from representatives of equipment manufacturers, the utilities, and nuclear specialists, and the survey on "Status and Prospects of Nuclear Power" conducted by a committee from the electric utility industry and distributed by the Edison Electric Institute. Imaginative programs for achieving economic nuclear power within the next few years also have been put forward by individual manufacturing companies prominent in reactor work.

64. In October of last year, I called upon an eminent group from the business and scientific communities, constituted as an Ad Hoc Committee on Reactor Programs and Policies, to advise the Commission. A very fine report was submitted by this group last month.

65. The Commission and its staff have considered these reports and recommendations, as well as other information at its disposal, at great length and with very great care in order to formulate a statement as to what its civilian reactor policies and programs should be. I have such a statement to present to your today. While we acknowledge with gratitude the help we have

received from all the groups I have mentioned, I would emphasize that this statement is an expression of the Commission's own convictions:

PROPOSED NUCLEAR POWER PROGRAM

A. Objectives:

66. The objectives of the national civilian nuclear power program are to:

(1) Reduce the cost of nuclear power to levels competitive with power from fossil fuels in high energy cost areas of this country within ten years.

(2) Assist friendly nations now having high energy costs to achieve competitive levels in about five years. This assistance is to be extended mainly through clearly defined programs of cooperation.

(3) Support a continuing long range program to further reduce the cost of nuclear power in order to increase the economic benefits and extend these benefits to wider areas.

(4) Maintain the U.S. position of leadership in the technology of nuclear power for civilian use.

(5) Develop breeder type reactors to make full use of the nuclear energy latent in both uranium and thorium, recognizing that U-235 alone may not be sufficiently plentiful to meet our needs over the long range.

B. Responsibility

67. It shall be the responsibility of the Atomic Energy Commission to provide positive and vigorous leadership in the

national efforts to achieve these goals. In exercising this leadership, the Commission will make full use of the technical talents and capabilities of its own laboratories, and of all segments of industry which can make substantive contributions.

68. In assuming leadership in this, the Atomic Energy Commission recognizes that various public and private utility and industrial groups will carry out ever-increasing developmental, construction, and operational activities, and the AEC will give full consideration to such work in the development of the program to meet the over-all objectives.

69. In general, the technical work which must be carried out to translate an idea into a plant producing commercially competitive power may be divided into three phases.

Phase I - Research and Development

70. During this phase of the work the technical feasibility of a concept is established through activities such as laboratory work, technical analyses, critical experiments, test radiation, reactor experiments, experimental reactors, design studies and evaluation. Much of the work done during this phase is general research and development which is applicable to many different concepts but, as this research work progresses toward the construction of experimental reactors, it becomes more specific and less general.

71. The Commission will be responsible for assuring that all necessary work in this phase is carried out in a manner and on

a schedule that is consistent with meeting the objectives of the program. In discharging this responsibility, the Commission will give full consideration to industrial programs in this field.

Phase II - Prototype Construction

72. When the efforts under Phase I have shown technical feasibility, and when it is clear that a given concept or modification thereof offers real promise of accomplishing one or more of the objectives of the program more effectively, more rapidly, or at a lower cost than seems to be possible by other means, it may be necessary or desirable to build a prototype reactor. These prototypes will have the dual purpose of producing power and important and essential technical information. They will provide data on plant construction costs, and statistically significant information on efficiency, performance characteristics and other operating factors in a manner which will permit reliable projection toward central station power plants. The size of these prototype reactors will be dependent upon individual circumstances. They would be of a size consistent with the objective of developing information at minimum cost and in the shortest possible time.

73. Emphasis on prototype reactors should accelerate the rate at which technical data can be developed and thus should accelerate progress in nuclear power technology. It is important, however, that prototype reactor projects be carried out in a manner which brings to bear the special talents of various segments of industry, including utility operating practices.

74. In order to assure meeting program objectives, the Commission must have full responsibility for this phase of the program. It will determine what reactor concepts meet the criteria for construction, will select the approximate size and conceptual design best suited to accomplishing the basic objectives, will determine schedules for construction and operation, and will assure that the unit will be operated in a manner which will be most useful to the program.

75. In Phase II, as in the research and development phase, the Commission will take into account the efforts of private industry.

76. In recognition of the importance of industrial participation in this phase of the program, the Commission will consider giving financial assistance toward the capital cost of prototype reactors to utilities willing to construct and operate such reactors under conditions which assure that the objectives of the Commission are being met.

77. To implement Phase II of the program, the Commission would:

(1) Determine that a reactor concept meets the criteria for construction of a prototype. In making this determination, the Commission would obtain the advice of various segments of industry and the scientific community through advisory groups.

(2) Select the size reactor best suited to accomplish the desired objectives.

(3) Develop general designs and specifications in sufficient detail to give guidance to proposers and to insure that proposals will be responsive to the Commission's needs with respect to such things as the type and size of the reactor.

(4) Announce that a prototype reactor of the type specified should be built to advance the over-all program, and invite proposals from the utility industry for its construction. The invitation would be directed to both privately and publicly owned utilities. In addition to all other necessary facts, the invitation would establish: the time for submission of the proposal; the technical specifications of the plant, the minimum obligations which the utility must assume with regard to design construction, and operation; the types of financial assistance considered, including assistance on capital costs of the plant; and other facts pertinent to the proposal. The invitation would state that if satisfactory proposals were not received, the Commission, within the limits of authority and funds, would undertake construction of the reactor at a Commission site.

78. In addition to projects resulting from specific invitations of the Commission in accordance with procedures outlined

above, we believe the utility industry will wish to make unsolicited proposals which would lead to the construction of nuclear power plants. The Commission may determine that the projects proposed also would make significant contributions toward the achievement of the Commission's goals and objectives. In the event of such a determination and within existing authority and funds, the Commission will provide assistance in the form of research and development and waiver of use charges for such reactors.

Phase III - Construction of Commercial Units

79. When the results of Phases I and II of the program indicate that it is possible to construct nuclear power stations which will produce electricity competitively with fossil fuel plants in certain areas of the country, the forces created by growth of demand for electric power normally can be expected to stimulate the construction of commercial nuclear power plants on their strict economic merits. In this phase of the program, it is expected that industry will assume the primary responsibility for the program.

C. General Program to Meet Objectives

80. The Commission considers the objectives stated for the national civilian nuclear power program to be attainable and important to this country. The Commission believes that the general framework just described for carrying out a program to meet these objectives is consistent with their importance and

compatible with American industrial patterns. The Commission takes very seriously its responsibility to provide positive and vigorous leadership in the national efforts to achieve these objectives.

81. In order to meet these stated objectives, the Commission must carry out:

(1) A program of research on the fundamental properties of materials vitally important to reactors;

(2) General research and development programs, including where necessary, loop experiments, critical assemblies and reactor experiments, on the several reactor concepts which show technical promise;

(3) More specific research and development programs, including experimental and prototype reactors which, because they appear to have either (a) simple, safe and reliable design; (b) high specific power or power density; (c) low cost fuel cycle; (d) high thermal efficiency; (e) favorable neutron economy; or (f) other special advantages offer reasonable probabilities of making important contributions to the production of low cost power. It will be the policy to provide in this way in the public domain the basic knowledge and information necessary as a foundation to nuclear power development.

82. This knowledge and information has value completely separate from its relationship to nuclear power development.

New materials, instruments and instrumentation systems are being developed which are useful in a variety of applications.

83. Achievement of program objectives will require reduction in both capital costs and fuel cycle costs. Capital cost reduction requires special attention to simplication of design without loss of safety or reliability. This component of cost also will be aided by improvements in power density and specific power, and by increased thermal efficiency.

84. One of the most important factors in the production of low cost nuclear power and one that has a greater and greater relative impact as the capital costs of reactors is lowered, is the cost of producing, fabricating, and shipping fuel and of handling and processing spent fuel. For this reason, the Commission will enlarge upon its previous effort and place major emphasis on an intensive program aimed at solving the problems of the nuclear fuel cycle. This program will obviously give adequate consideration to the needs of the specific projects under construction, but it will place major emphasis on such things as materials research, general fabricating techniques, standardization of fuel, and the possibility of incidental income from by-product use of radioactive isotopes from the spent fuel.

85. The Commission is now offering to provide certain services to the nuclear fuel cycle, such as processing of irradiated fuel. We are doing this as an interim measure and intend to do so only to the extent necessary in the absence of such services from industry

under reasonable terms. It is to the interest of both the Commission and the utilities that industry should provide these services.

86. The objectives of the civilian power reactor development program are stated and the technical program is oriented primarily toward the generation of electricity. It is recognized, however, that potential civilian uses of nuclear energy include providing heat and/or radiation for industrial processes and heat to warm buildings.

87. Industrial processes of various kinds in the United States actually consume considerably more heat energy than is used for the generation of electricity. Required temperatures cover a wide range from around 400°F for pulp and paper mills, for example, to two or three thousand degrees for some chemical or metallurgical processes. Low temperature heat for industrial processes or space heating can be produced by reactors currently under development. The technical feasibility for using reactors for high temperature process heat has yet to be determined.

88. While the technical feasibility of providing space heat from reactors is clear, this application may not have great civilian significance in the United States at this time because of limited facilities for distribution of central station heat.

MERCHANT SHIP PROPULSION

89. Closely related to the civilian power reactor program is the work on nuclear propulsion of merchant ships. The first nuclear-powered merchant ship is the NS Savannah, a joint project

of the Commission and the Maritime Administration. Its operation, beginning in 1960, will give us first-hand experience with the many new problems we can anticipate in commercial operation of nuclear-powered ships. It will not be a competitive vessel, being subject to the economic penalties which attend any pioneer demonstration project.

90. In addition to the development and construction of the pressurized water nuclear plant for the Savannah, the Commission is engaged in the necessary support programs related to its early operation. This work involves crew training, development of health and environmental safety, development of maintenance procedures, design of shore support facilities, and efforts devoted to the establishment of construction standards and operating regulations. In addition, the Commission will give technical support to nuclear aspects of the Maritime Adminstration program.

91. Design studies in progress by the Commission for future merchant ship reactors include investigations of the boiling water reactor system and a longer range program for development of a gas-cooled-reactor, closed-cycle propulsion system. In addition, developments in reactors for central station use will make a direct contribution to propulsion reactors.

CONCLUSION

92. This concludes my summarizing statement. I have sought to discuss the matters on which the Joint Committee indicated

special interest, in addition to certain other areas related to development of the atomic energy industry. We have included some highlights from the Twenty-fifth Semiannual Report, extracts from which were submitted as our written testimony.

93. We will be pleased to present any other information which the Committee may wish, and my colleagues on the Commission, the General Manager, and the heads of the Commission's staff divisions concerned with industrial development of atomic energy are present and at your service.