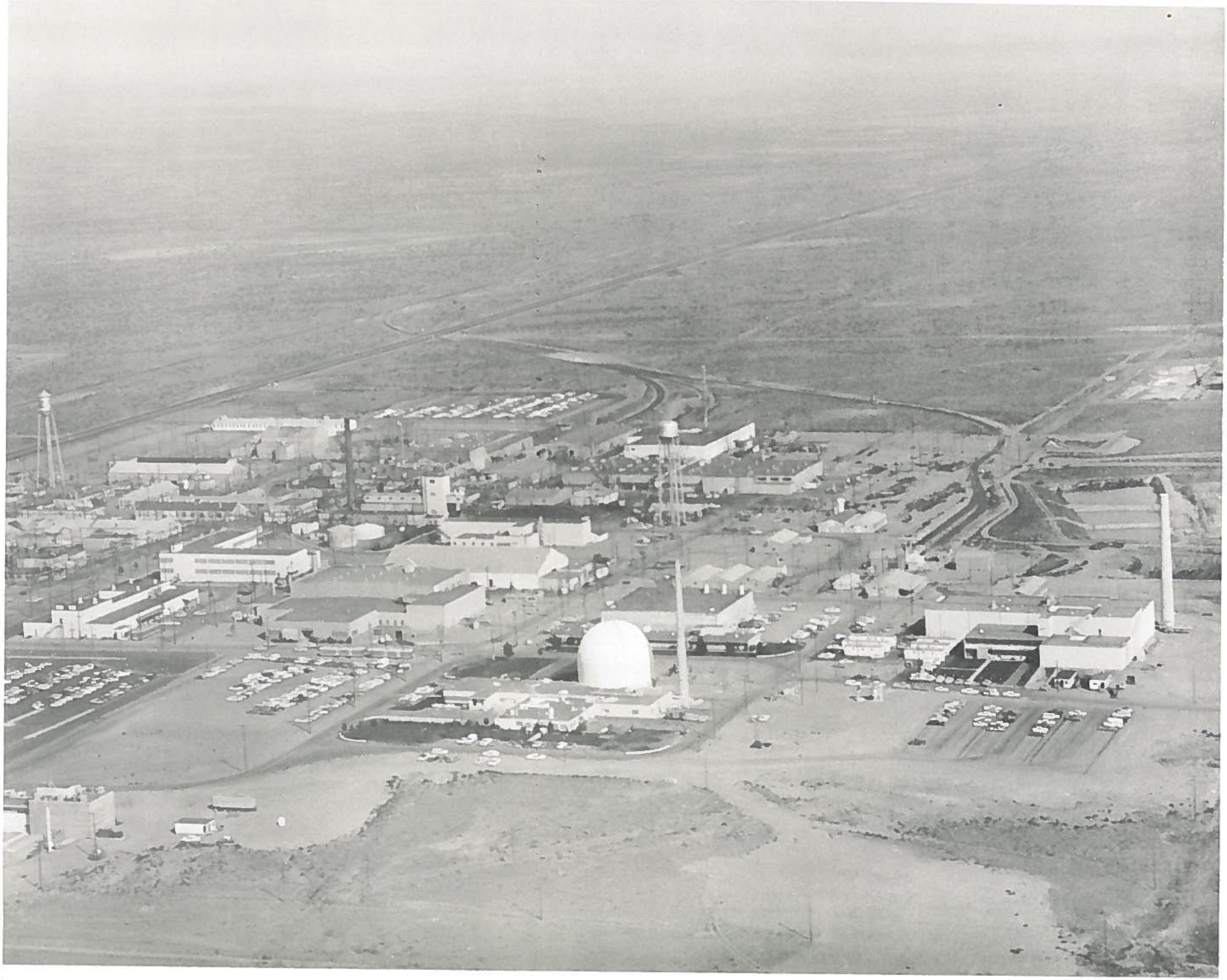

The AEC's Pacific Northwest Laboratory facility, operated by Battelle-Northwest, carries on much of the research related to peaceful use of plutonium. The white domed structure in the foreground is the Plutonium Recycle Test Reactor which is being used in studies aimed at making use of plutonium as a fuel in power reactors. The laboratory also is engaged in research related to "fast reactors" which will manufacture more fuel than they consume.

Neg. No. PNL0673071-5

The world's largest dual-purpose nuclear plant at the Hanford Project is shown in an aerial view. The Atomic Energy Commission's plutonium-production reactor is at the right. Steam generated by nuclear heat in the reactor is transported by pipe to the generating facility at the left. Public utility districts banded together to finance and operate the generating plant which has a capacity of 800,000 kilowatts.

Neg. No. 45226-5

AEC
UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

NOTE TO EDITORS AND CORRESPONDENTS:

Attached for your consideration and possible use is the third of a series of articles on major AEC installations and laboratories.

We plan to provide an article on an AEC installation or laboratory on an approximately once-a-month basis until a total of nine or ten major AEC sites is covered. Each article will be appropriately illustrated by one or more multilith prints supplied for your use. If your publication requires glossy prints you should write to Elton Lord, Deputy Chief, Audio-Visual Branch, Division of Public Information, U. S. Atomic Energy Commission, Washington, D. C. 20545.

We hope you find the articles of interest. We would appreciate your comments and/or a tear sheet on any use you may make of the material.

John A. Harris, Director
Division of Public Information

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON, D.C. 20545

AEC NEWSFEATURE

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Editor's Note: The Atomic Energy Commission, charged by Congress with the development and control of the Nation's nuclear energy program, owns an $8.7 billion complex of laboratories, production, manufacturing and testing plants and equipment scattered throughout the country. This series of articles describes some of the work done and under way at these installations and how it relates to individual citizens today.

Idaho Falls, Idaho -- Four ordinary light bulbs burned in an isolated building in the desolate Idaho sagebrush country on the morning of December 20, 1951.

The bulbs were commonplace enough, but there was nothing ordinary about the power that was lighting them on this winter's day more than a decade and a half ago.

The energy that made them glow came from the EBR-1, the first nuclear reactor to be built at the Atomic Energy Commission's National Reactor Testing Station, an hour's fast drive from this bustling southeastern Idaho community.

The experiment was the first practical demonstration of obtaining usable power from a nuclear reactor the world had ever seen.

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The next day the EBR-1 -- for Experimental Breeder Reactor No. 1 -- produced enough power to light the entire facility.

Everybody was abundantly sure, in the late 1940's, of what could happen when the new-found energy of the atom was suddenly unleashed in all its fury. Two atomic bomb explosions over Japan in World War II had left no doubt about this.

But nobody was quite sure what could happen when man began to use nuclear reactors to control this energy and release it gradually for non-destructive purposes.

How should you build a reactor, anyway? What materials and methods should be used? Would reactors really work? If they worked, would they be safe?

Scientists and engineers over the country were busily seeking the answers to these questions by slide rule and theory. But when they got through with their calculations and actually built a reactor, how would they know they were right?

The AEC established the National Reactor Testing Station in 1949 to do just what its name implies -- test reactors -- and thus help engineers and scientists to prove whether they were right or wrong.

The location chosen for this purpose could hardly have been improved upon.

Situated on a mile high plateau in the Snake River Valley, the NRTS covers an enormous tract of 894 square miles that is more than three quarters the size of Rhode Island. Dotted by towering buttes, the land is a sweeping plain of lava, sagebrush and vast silences where time seems to move in eons.

Mastodons roamed the area 25,000 years ago. Antelopes are its only permanent inhabitants today. It was clear that if something did go wrong with an experimental reactor, the remoteness of the Idaho desert could be relied upon to contain the consequences.

Today, the National Reactor Testing Station is one of the Atomic Energy Commission's principal centers for developing the peacetime uses of atomic energy.

It has, by any count, the world's largest collection of power, propulsion, research and testing reactors and related equipment. More than 40 of these facilities have been built there at a cost of nearly $500 million.

It has been called a sagebrush college of reactor knowledge unduplicated anywhere.

And it has been described by visiting scientists, including leading figures in the Russian atomic energy complex, as a "must" on the itinerary of any serious nuclear scientist.

The First Nuclear Submarine

A plaque on the side of the EBR-1 now commemorates it as the first reactor to provide power for actual electrical generation and the four light bulbs are treasured mementoes of this historic achievement.

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Despite the light bulb experiment, however, it was to be another use of nuclear energy that was to be developed first at NRTS and to lead indirectly to construction of the first civilian nuclear power reactor.

Nuclear fuel is both compact and long-lasting. A pound of uranium is a piece no bigger than a golf ball and has the potential energy of approximately three million pounds of coal. Even with today's so-called light water power reactors, which use only a fraction of the uranium in their fuel cores, comparatively small amounts of nuclear fuel will last a long time.

Additionally, uranium "burns" without the use of oxygen and without giving off smoke or other combustion products. No air is needed to stoke the fires of nuclear fission, the atom splitting process that produces nuclear heat.

Obviously, such a fuel would be ideal for submarines which, in the 1940's, were severely limited in underwater range by their oxygen requirements and the constant need to recharge their electrical batteries. Thus, the construction of the Navy's first nuclear submarine, the USS Nautilus, was authorized by Congress in August, 1950.

"The Nautilus," said former President Truman in signing the authorization bill, "will be able to move underwater at more than 20 knots. A few pounds of uranium will give her ample fuel to travel thousands of miles at top speed. She will be able to stay underwater indefinitely. Her atomic engine will permit her to be completely free of the earth's atmosphere. She will not even require a breathing tube to the surface."

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Work to make these predictions come true began at the NRTS early in 1951. Construction of a prototype submarine reactor took place in two submarine hull sections specially erected at NRTS to simulate conditions which would be found on the USS Nautilus. Gradually, amid a maze of pipes, wires, motors, valves and instruments, the reactor began to take shape.

On May 31, 1953, the prototype reactor was brought to power. A few weeks later it staged a 66-hour full power run equivalent to a non-stop underwater trip from Newfoundland to Ireland at top speed.

Then, on January 21, 1954, the actual Nautilus was launched with a similar reactor in her hull and the U. S. nuclear Navy was born. The ship was to make naval history in 1958 by traveling 1,830 miles under the polar ice cap from the Pacific to the Atlantic Ocean.

Developing Civilian Power

Meanwhile, the design and development of successful submarine reactors were providing the technology for a plant that could demonstrate the feasibility of nuclear energy for full-scale electric power production.

The result was the Shippingport Atomic Power Station built by the AEC, Westinghouse Electric Corporation and Duquesne Light Company near Pittsburgh, Pennsylvania, as the nation's first nuclear power station. Shippingport went "on line" in December, 1957. Today after a decade of steady operation, Shippingport is still supplying large quantities of power to the Pittsburgh area.

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Among the 40 reactors and supporting facilities erected at the NRTS are three test reactors which also have played a significant part in civilian nuclear power development.

These include the Materials Testing Reactor, or MTR, completed in 1952 to test reactor construction materials and operation methods. Its purpose was to make sure that these materials and methods were safe to use and to find this out in weeks or months instead of the years it would take under actual power reactor operations. Almost every power reactor in existence in the world today owes some debt to knowledge gained from the MTR.

Newer and larger companion facilities to the MTR are the Engineering Test Reactor, which began operation in September, 1957, and the Advanced Test Reactor, which became operative in July, 1967.

What has been the result of all this effort?

Sixteen civilian nuclear reactors now are operable throughout the United States. They have a combined generating capacity of 2.8 million kilowatts -- enough to meet the daily household electrical needs of about 700,000 American families.

Twenty-one more power reactors, with a combined capacity of 14½ million kilowatts, are under construction and 41 new nuclear plants, with 33 million kilowatt total capacity, are on order by the utility industry.

Twelve more nuclear generating plants, with over 10 million kilowatts of capacity, have been announced by utilities for orders in the near future.

"The use of nuclear power for generating electricity," declares Dr. Glenn T. Seaborg, Chairman of the Atomic Energy Commission, "is beginning to make some return on the millions invested by both Government and industry on its development.

"Further, it is beginning to give promise of substantial savings to the individual consumer because of its competitiveness with other sources of power.

"Estimates are that within coming decades the cost of both nuclear power and other power resulting from competition by the atom could bring about savings to the public of more than $1 billion a year."

Toward Increasingly Efficient Reactors

A primary goal of the AEC's continuing power program is the development of reactors which will make more efficient use of the uranium fuel in their cores than present day power reactors are able to do.

The ultimate objective is to achieve so-called "breeder" reactors which actually will produce more fuel than they consume.

One way to accomplish this seemingly magical feat is to use radiation from an operating reactor to turn a non-readily fissionable type of uranium called U-238 into a readily fissionable artificial element called plutonium.

The plutonium then would be used as reactor fuel.

The National Reactor Testing Station has played and is playing an important part in this effort.

The Experimental Breeder Reactor No. 1, the reactor that powered the light bulb experiment, was the first to demonstrate that this kind of breeding is actually feasible. It did so in a series of notable experiments in the 1950's.

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The reactor was retired in April, 1964, and made a Registered National Historic Landmark in August, 1966, during a dedication ceremony led by President Johnson.

Its successor, the Experimental Breeder Reactor No. 2, or EBR-2, was designed to further demonstrate the feasibility of the breeding concept. EBR-2 is currently the key irradiation test facility in the AEC's Liquid Metal Fast Breeder Reactor program -- the Commission's principal approach to the development of the fast breeder reactor concept.

Once attained on a commercial scale, breeding will permit essentially all of the uranium in our nuclear fuel resources to be used for energy instead of a tiny fraction of it, as is now the case.

Other Reactor Programs

The reactors evolved for the submarines and for Shippingport were pressurized water reactors; i.e., reactors in which the water used to remove heat from the reactor core is kept under pressure so that it will not boil.

The pressurized water is led to a chamber where the heat that is has picked up from the core is transferred to water in a secondary system of piping. Water in the secondary system then is allowed to boil to make steam to make a turbine generator or a propulsion system go.

An important family of reactors known as the BORAX reactors was develcped at NRTS beginning in 1953 to demonstrate the feasibility of an opposite kind of reactor. These are boiling water reactors; i.e., reactors in which water is allowed to boil within the reactor vessel so as to feed steam directly to

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a turbo-generator or a propulsion system.

Both types are in wide use in the U. S. civilian nuclear power program today.

Other NRTS reactor activity has included development of small portable power reactors designed for military use under field conditions; work on advanced submarine reactors and reactors for naval surface vessels, including the carrier Enterprise, the cruiser Long Beach and the frigates Bainbridge and Truxtun; a nuclear aircraft program; and a power reactor designed to use an organic liquid instead of water to remove heat from the core.

Ensuring Reactor Safety

Making sure that propulsion, power and other reactors are safe is as important an aspect of NRTS activities as developing them in the first place.

On July 22, 1954, BORAX-I, the first of the boiling water prototypes, was deliberately operated beyond normal limits to observe the effect of an uncontrolled burst of power upon it.

The result was a spectacular outpouring of steam and water from inside the reactor core. The tremendous heat which was developed melted the fuel into a twisted mass of metal and the reactor was destroyed. But there was no bomb-like explosion nor spread of radioactive debris.

Since the BORAX-I demonstration, other tests of reactor behavior have been conducted in four reactors built especially for this purpose. These have been called SPERT reactors -- for Special Power Excursion Test.

More than 2,000 tests under abnormal operating conditions have been carried out in these facilities. These have included tests in which power within the reactors was raised from flashlight battery level to the equivalent of Hoover dam output within fractions of a second.

So far, the experiments have demonstrated that it is extremely difficult to make reactors destroy themselves. The evidence indicates, rather, that reactors tend to shut themselves down under extreme power surges.

Engineers agree that the worst possible accident in today's water-cooled power reactor would be loss of reactor coolant water through a major piping break.

They agree also that, in such a case, the major damage would be a meltdown of reactor fuel if the fuel is not protected by engineered safety systems. If the safety systems are employed, damage to the fuel would be limited to rupturing of some fuel pins, and the comparatively small amounts of radioactivity released would be confined by the reactor containment and other safety systems that are an integral part of civilian power reactors.

To make assurance doubly certain, NRTS now has under construction an approximately $25 million Loss of Fluid Test facility which will test these theories.

In LOFT the reactor's primary coolant system will be intentionally breached during power operation to simulate the worst accident condition and test the ability of the safety systems to prevent major fuel meltdown.

Even though such an accident is extremely unlikely, the significantly larger sizes of commercial nuclear power plants now being built necessitate designing ways to prevent or reduce the potential release of radioactivity. The major safety devices being developed include core flooding systems, which flood the reactor core with water to prevent fuel melting, and spray system, which reduce pressures within the containment shell and possibly, by chemical additives, "wash" the radioactivity from the containment atmosphere before it can escape.

Other NRTS Programs

A nuclear power reactor builds up quantities of radioactive materials called fission products which must be periodically removed from its fuel core if the reactor is to continue to operate economically.

When the build-up reaches a certain point, the spent fuel is removed from the reactor to a plant where chemicals are used to dissolve it and to separate the fission products from the unused uranium.

An engineering triumph at NRTS is the $56 million Idaho Chemical Processing Plant which has developed a continuous dissolution process that greatly expedites this chore. The plant, which has attained international recognition for this and other advances, has been salvaging unused fissionable uranium -- worth about $300 an ounce -- from reactor fuel elements since 1953.

Another NRTS plant, called the Fuel Cycle Facility, has been built to demonstrate the practicability of melt-purifying salvaged fuel and refabricating it -- on the spot -- into new fuel elements in a fully-integrated, closed cycle plant operated by remote control. The process is a first in reactor technology.

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Still another Idaho first -- and one of the most important -- is the Waste Calcining Facility, built to reduce highly radioactive liquid wastes from the chemical reprocessing operation into more easily manageable and safer solid forms.

These take up about one tenth the storage space needed for liquid wastes. Savings thus made possible in the handling of fuel element wastes are expected to help reduce the cost of nuclear power still further.

Statistics

The National Reactor Testing Station, managed by the AEC's Idaho Operations Office in Idaho Falls, employs approximately 5,000 people, including Government personnel and workers for six contracting companies which operate the facility for the AEC.

The largest single employer in Idaho, the site has combined payrolls and supply and equipment purchases that pour some $60 million into the Idaho economy each year.

The population of Idaho Falls has risen from 19,000 in 1949, when the NRTS was established, to nearly 40,000 today. Some 30 nearby communities where NRTS workers and their families also live have grown similarly.

The population rise has stimulated the growth of new businesses and services to meet the needs of new residents and has had a similar effect on the growth of schools, hospitals, churches and similar facilities in this southeast corner of Idaho.

Additionally, the station and its technological programs have afforded Idaho young people, particularly college graduates, new opportunities to find highly remunerative and satisfying jobs at home.

For all these reasons it sometimes is suggested that the atomic symbol share equal billing with the famed Idaho potato on the state's automobile license plates.

Mostly, the suggestion is made lightly or in jest, but there are many who think that the idea may not be so far fetched after all.

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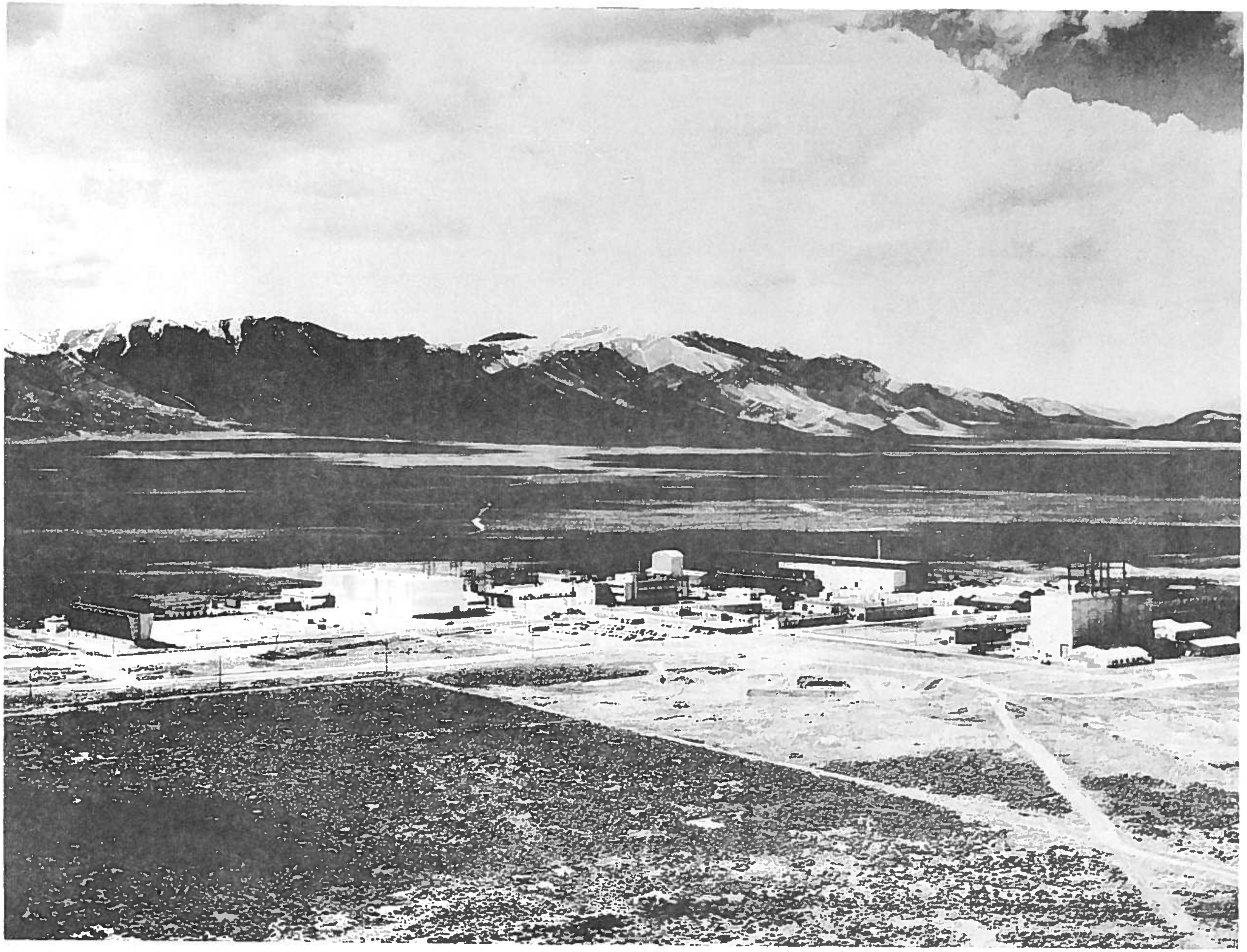

National Reactor Testing Station, Idaho--Aerial view of the Naval Reactors Facility at the Atomic Energy Commission's National Reactor Testing Station in Idaho where the Nation's nuclear navy was cradled beginning in the early 1950's.