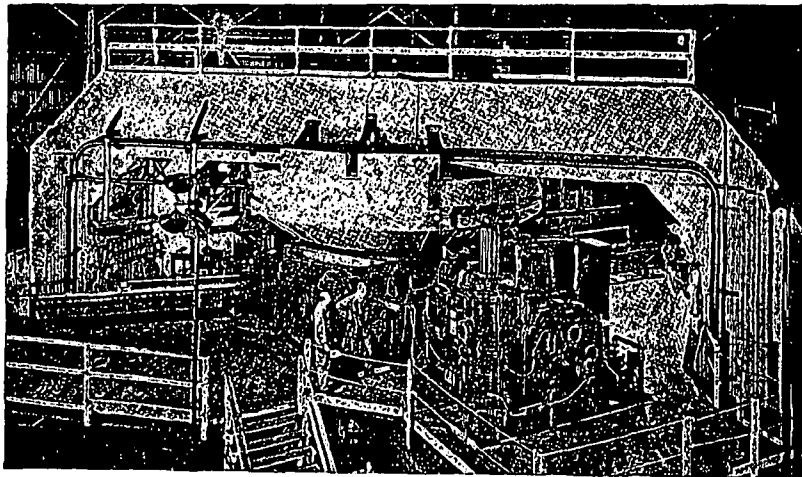




3 World's greatest "atom-splitting gun" for research is this plant cyclotron at Berkeley (Univ. of Calif.). Charged subatomic particles whirl at astronomical speeds in chamber under upper 184-in. polepiece. Huge magnet weighs thousands of tons.

rather than enriched uranium. Most important, the piles will run cold rather than at a high temperature, which would permit utilization of their tremendous power output—even though this means throwing another million kilowatts or so (as heat) into the Columbia River.

On this job, AEC's overriding objective is a quick and sure increase in plutonium production, with no chances taken. Advancement of the nuclear art is a very secondary objective.

Construction of the new plant at Hanford was one of the first decisions made by the Atomic Energy Commissioners when they took over from the Army. But through much of last year, the project was seriously bogged down.

Last September the bottleneck was broken. General Electric Co subcontracted the design of the chemical separation plants to Kellogg Corp., the M W Kellogg subsidiary that designed K-25 at Oak Ridge. At the same time another subcontract was placed with Standard Oil Co (N. J.) to work out alternate designs for several particularly tricky phases of the chemical plants. Still a third alternative is being explored by the Clinton Laboratory at Oak Ridge.

Today, design is well advanced. GE's construction subcontractors already have preliminary work under way. By the end of the year construction will be going full blast, and it'll continue at a high rate until it begins to taper off in 1951. Material procurement for the new plant is already moving.

HOW ABOUT ATOM POWER?

The key fact about development of useful power from atomic energy is that no one in the U. S. needs atomic power very badly.

What atomic energy could provide in the near future, most technicians guess, is a practically unlimited source of electric power which would be a little cheaper, perhaps (at the busbar) than power from coal—more expensive, almost certainly, than hydroelectric power. Its more peculiar economic characteristic would be that, as far as fuel is concerned, it would cost about the same anywhere—on top of the Andes or in New York City.

No Urgent Need. In a nation that possesses a 2000-year reserve of coal, such a prospect is not terribly exciting—economically speaking—to anyone outside the fuel business. Conceivably, it might change the cost factors in plant location of some U. S. electro-process industries—moving them closer to raw materials or markets. However, the University of Chicago's Cowles Commission, which has been making a study of transportation-free 4-mill power, thinks not.

It is considerations like these, rather than technical factors, which set the time scale for useful atomic energy. You can find competent technical people who are confident that on a work-it-out-as-you-go-along engineering basis they could deliver to you, if you wanted it, a commercial-size reasonably economical power plant along about 1952.

But the AEC doesn't want it much. The commission is scheduling its power work to produce an economic plant some time around 1960. Throughout the Sixties it looks for steady installation of additional plants, so by 1970 atomic energy might be supplying 20-25% of the country's power needs.

Atom Plants Abroad? The rest of the world, however, is not likely to be so casual about power possibilities. The Cowles Commission thinks that in the central European plain—the Balkans and western Russia—there's a combination of developed industry, fuel scarcity, and expensive transportation that makes atomic power attractive.

The coal-starved British, who have budgeted about \$120 million for atom work, are believed to be stressing power development in their program.

So the first substantial power plants may well appear beyond U. S. borders.

The one exception to U. S. indifference about power plants may turn out, curiously enough, to be the Air Forces. Their Nuclear Energy for Propelling Aircraft project is built on the long-jump psychology that went from a wiggle on an oscilloscope in 1939 to Hiroshima in 1945. With Fairchild Engine and Airplane Co as principal contractor, the object is to try to build right away an atomic power plant for an airplane.

Pile—Present and Planned. The only nuclear reactor in existence today that is capable of delivering its energy output in usable form is the fast neutron reactor at Los Alamos, N. M. This

is fueled with pure plutonium, employs no moderator, is essentially a controlled bomb.

This reactor, which went into operation in November 1946, delivers its energy at a fairly high temperature, suitable for power generation. It is described at Los Alamos as "a watch-dog model of a power plant."

The second high-temperature pile due to come in is one at the Brookhaven National Laboratory on Long Island. This pile is now under construction and should be completed next year. It may actually deliver a little electrical power; AEC hasn't decided yet.

The decision is more a public relation than a technical one. The Brookhaven pile is simply a quickly designed tool to produce neutron beams and perform irradiations. It is pretty much a copy of the existing pile at Oak Ridge—air cooled, carbon moderated, fueled with natural uranium. It will operate at a higher power level, however, than Oak Ridge's 1000 kw, and its cooling air will emerge hot enough to generate steam. The limit on its temperature is the heat-resistance of the aluminum jackets that protect the uranium from corrosion.

Space is being left in the design for a heat exchanger. But any power generated won't even be enough to run wind-tunnel-size blowers that force cooling air through the pile.

The first reactor that can reasonably be considered a pilot plant for power generation is the Zinn pile at the Argonne National Laboratory in Chicago.

Construction work on this only awaits final AEC approval. As a matter of fact, Argonne was ready to start a year ago. It will take a year and a half to two years to build.

The Zinn pile's primary purpose will be research, but it is being designed to do a workmanlike job of getting the power out in usable form. It will be a fast-neutron reactor using concentrated fuel, will operate at a fairly high power level, and at a temperature comparable to that of a steam plant.

Two reactors specifically designed to produce electrical power are on the AEC docket, but neither is in a very active condition. One is the Daniels pile, first projected by the Manhattan District in 1946, and then scheduled for completion this year.

The other straight power project is the General Electric reactor scheduled to be built at the Knolls Atomic Power Laboratory near Schenectady. No information has been furnished about this pile except that it will eventually run

at a high enough power level to provide a practical demonstration of the operating problems to be expected in a commercial-size plant.

During the past year a number of the technical problems standing in the way of power production have come close to solution.

Pile Technology. On the problem of heat-transfer fluid, of which much was heard a year ago, it now looks as if the Smyth Report's suggestion of liquid sodium, alloyed with potassium to lower its melting point, would turn out well. Sodium doesn't absorb neutrons, does not become seriously radioactive, has good thermal properties. It does react violently with water. However, a special heat exchanger—complicated but workable—has been developed to obviate trouble from this source.

Nor does the problem of structural materials for reactors now look as appalling as it did a year ago. Metallic titanium is being considered as a major load-carrying material that could resist pile temperature, which may eventually run as high as 2000 to 2500 deg F, some think.

AEC metallurgists are studying structural properties of a lot of unfamiliar metals, such as beryllium and zirconium, that in the past have been interesting mainly as alloying agents. Some of these have nuclear properties that make them valuable in themselves.

Some of this work is already producing valuable byproducts. Discovery of ways to roll and extrude beryllium, for instance, has resulted in improved windows for X-ray tubes.

Similarly, the elaborate chemical engineering studies involved in the design of the new Hanford plutonium plant are expected to work out separation methods basically applicable to power plants as well as to plutonium producers.

Fuel Breeds Fuel. During the past year, too, declassification of information on the breeding problem has clarified one fundamental question: Is nuclear fuel so scarce that atomic energy must always be regarded as a special-

purpose affair to be rigidly conserved? Or is it plentiful enough to be regarded as a major power resource?

Uranium itself is a fairly plentiful metal, but only one part in 140 is naturally fissionable. If that were all, atomic energy would soon be a rarity.

But when fissionable U235 is consumed in a reactor, producing power in the process, some of the U238 is transmuted into fissionable plutonium. This increases the supply of fuel.

Then the question is: When you burn a pound of U235, how much plutonium do you get? Suppose you got only half a pound. Burning that half pound would produce a quarter pound, and so on. You'd end up able to use only one part in 70 of the total uranium. Still not good.

But suppose you get a pound of plutonium out for each pound of fuel burned. Then you can eventually utilize all the uranium. And if you could get out more than a pound of plutonium, you'd have a "breeder pile" that would constantly produce extra fuel for use in other piles.

The same question applies to thorium, which is more plentiful than uranium. Exposed to a chain reaction, thorium is transmuted to fissionable U233. If one-to-one breeding is possible, this fact adds thorium to the potential energy supply. Otherwise it is just a scientific curiosity.

What About Thorium? So what about breeding? Theoretically, it is possible. When a U235 atom splits, it throws out, on the average, something over 2.2 neutrons. One of these is needed to split another U235 atom and keep the chain reaction going. If another neutron is used to transmute a U238 atom into plutonium, that leaves a margin for losses—if the losses are small enough.

AEC's guarded comments indicate that in present piles the neutron losses are too great to permit breeding. But it is believed that the new piles now on the drafting board would be efficient enough to breed fuel.

If it works out, that makes atomic energy a thousand-year resource.

NONMILITARY DIVIDEND

One immediate nonmilitary dividend from the atom program is the availability of cheap, plentiful radioisotopes ("tagged atoms"), basic tools for measurement and observation. They are being used today in nearly every branch of science and, interestingly, in wide areas of industrial experiment.

To cover out-of-pocket cost to the government, AEC makes a nominal charge for the isotopes. For cancer work, they are furnished free.