ment Center in Tullahoma, Tenn. The sea-level testing will include 12,000 developmental and acceptance tests between 1973 and 1979. The Air Force work will be done between 1974 and 1976.

Three companies—Pratt & Whitney, Rocketdyne and Aerojet-General—are competing for the engine development contract. □

ACCELERATORS

A crucial year

This appears to be a critical time for the technology of accelerators. Conventional techniques of constructing particle accelerators have been pushed as far as they can be pushed, says Dr. Allen Schwettman of Stanford University. For future development particle physicists will have to look to superconducting techniques (SN: 8/10/68, p. 139) or electron ring accelerators (SN: 7/12/69, p. 35). He believes that a superconducting accelerator will be successfully demonstrated this year.

Dr. R. B. Neal of the Stanford Linear Accelerator agrees that this is a crucial year for superconducting accelerators. The major questions, he says, are likely to be answered this year, but the answers could be yes, no or maybe.

Both men spoke at a symposium on superconducting linear accelerators this week at the 1971 Particle Accelerator Conference in Chicago. The panel included representatives of the other major laboratories involved in experimentation on superconducting accelerator techniques: Drs. Harald Hahn of Brookhaven National Laboratory and the University of Karlsruhe in Germany, Henry Halama of Brookhaven, Michael Kuntze of the University of Karlsruhe, Viet Nguyen of the Saclay Laboratory in France and Perry M. Wilson of SLAC.

It appears that the major worries involve whether superconducting techniques, which have been successfully demonstrated in small experimental models, can be successfully scaled up to working accelerators. Optimists, like Dr. Schwettman, say yes. Others, more dubious, see serious difficulties.

Superconductivity is the ability of certain metals at temperatures near absolute zero to pass electric currents without resistance. Superconductors could be used either in the magnets used to bend and focus the beams of particles being accelerated or in the waveguides that hold the high-frequency radio waves that do the actual accelerating. Superconductors could make accelerators more economical, smaller and ultimately more energetic since they would operate without heating and with virtually no power loss.

That superconducting radio frequency waveguides will work has been demonstrated experimentally in small sections (SN: 6/22/68, p. 601). To make an accelerator a number of small sections have to be put together. The small cavities of the experiments, says Dr. Kuntze, are equivalent to single crystals of niobium, the metal most often used. What happens, he asks, at grain boundaries when two are put together?

Another problem is that the testing was done at frequencies much higher than those needed for actual accelerators. The reason, as Dr. Schwettman explains it, is that the only furnaces available for fabricating the waveguides were made for high-frequency work. Since such a furnace costs about a quarter million dollars it was impractical to request a new one just for a few experiments.

Several persons on the panel worry that when waveguides are made for lower frequencies they will not accelerate particles as well as the high-frequency ones. Dr. Schwettman says there is no reason in principle why performance should suffer at low frequencies, but the skeptics respond that practice doesn't always follow principle. The waveguide question is primarily of importance to linear accelerators.

Yet another important question is the effects of impurities in the metal and of bumps, pits and whiskers in the cavity surfaces. The cumulative effect of these, when several cavities are put together, could be much greater than their effect in the small test units.

It is apparent that these and other questions will be answered soon. Two actual superconducting accelerators are nearing completion, one at Stanford and one at the University of Illinois.

The Stanford machine will be a linear accelerator with an ultimate energy of 2 billion electron-volts. It has been under construction since 1967. At present, says Dr. John Turneaure of Stanford, construction is complete except for fabrication and placing of the waveguides. Within a year, he says, they hope to have enough sections in place to accelerate particles to 200 million electron-volts.

At the University of Illinois a test beam has already been delivered by their smaller superconducting accelerator. Dr. A. O. Hanson calls it a "wee beam of one million electron-volts" but says they are delighted with it. The machine is designed to accelerate in stages. The actual accelerating unit gives particles 30 million electron-volts at a pass. The particles can be recycled enough times to come out ultimately with 600 million electron-volts. As tests continue it may begin to answer the questions about the feasibility of niobium waveguides. □

GROWING CONFLICT

Utilities and the environment

Conservationists have grown increasingly critical of the electric power industry because of the thermal pollution and sulfur oxide emissions of power plants (SN: 8/29/70, p. 187) and indications the utilities are doing little about their problems. They point out the utilities may even be exacerbating the problems with promotional campaigns that cause demand to exceed supply. A prime question has been whether President Nixon, in his new environmental fervor, would be willing to battle the utilities, a traditional supporter of conservative Republicanism.

The question is beginning to be answered in the affirmative. In his 1971 environmental message, the President proposed a power plant siting law which he must have known the utilities would oppose. Then last week, at a science writers' energy seminar at the National Academy of Sciences, an Administration representative and a utility official spoke—and disagreed on almost every point raised.

The two contenders were S. David Freeman, energy policy staff chief in the President's Office of Science and Technology, and W. Donham Crawford, president of the Edison Electric Institute, a utility trade organization.

The two men differed remarkably in their views of the current energy crisis —if it is a crisis. The electric power industry, Freeman said, has been characterized by rapid growth, abundant supplies and little attention to the environment and to diminishing reserves of fuel. As a result, he said, the country has faced growing utility-caused environmental problems, plus periodic power shortages. There is little doubt, he claimed, that there will be serious brownouts on the East Coast this summer.

Crawford replied flatly that there is no national power crisis. "On an overall basis, reserve generating capacity is on the upswing." Where there are problems, they are small and local, he added.

Freeman blamed the problems—as he sees them—not so much on environmentalist opposition to power plant construction, a prime whipping boy of the utilities, as on a number of other factors, especially promotional policies. "Utility sales departments are doing better than production departments," he said. Other problems, include, he said, poor quality control by electrical equipment manufacturers and consequent decreased efficiency of power plants; a plateau or even a regression in steam plant efficiency as the plants are built larger and larger; substitution of ener-