Siting the SSC: Criteria and procedure

It must be 20 years or so since physicist John P. Blewett suggested building a huge particle accelerator in a ring around Greater Berlin as an international project to ease international tensions. These days it seems the United States is deciding to build an accelerator about the size that Blewett was talking about. The apparatus is called the Superconducting Super Collider (SSC). It will be the most powerful accelerator of subatomic particles ever built and is not likely to be equaled or surpassed for a very long time, if ever. Following the President's formal approval of the project Jan. 29 (SN: 2/7/87, p.84), Secretary of Energy John S. Herrington last week announced the procedures the Department of Energy will follow in selecting a site.

The location will most certainly not be Greater Berlin. At a press conference at Department of Energy (DOE) headquarters in Washington, D.C., Herrington said that financial contributions from foreign governments, which the U.S. government intends to solicit, would not affect the choice of site. A location within the continental United States is contemplated, he said.

Herrington outlined a selection procedure in four major steps. Interested parties, mainly state governments, will have until September 1987 to present proposals. A committee selected by the National Academy of Sciences (NAS) and National Academy of Engineering (NAE) will evaluate the submissions against the site selection criteria and recommend in unranked order the best sites. In response to questions, Herrington said there would be no set quota of finalists; the NAS-NAE committee would narrow the selection to "a group" but not to a previously fixed number.

If it is on schedule, the NAS-NAE committee will pass its recommendations to the DOE's Energy System Acquisition Advisory Board, which would have until the end of 1988 to decide on a finalist. The name of the finalist will be passed to the Secretary of Energy for a final decision in January 1989.

Important site selection criteria will come from the design of the accelerator. The SSC will accelerate two beams of protons to energies up to 20 trillion electron-volts (20 TeV) each and collide them with each other head-on for a total energy of 40 TeV.

Protons are made of quarks, which are held together by one of nature's strongest and least understood forces. With 20 times the energy available at the most powerful present accelerator, the Tevatron at the Fermi National Accelerator Laboratory in Batavia, Ill. (SN: 2/7/87, p.87), the SSC will study quarks and their interrelations and other aspects of the ultramicroscopic structure of matter.

Thinking about the possibility of something like the SSC began around 1970. Serious planning began about three years ago, and on Oct. 1, 1984, Universities Research Association, a consortium of U.S. and Canadian universities that manages Fermilab under contract to the DOE, assembled a central design group under the leadership of Maury Tigner of Cornell University. The design group works at the Lawrence Berkeley (Calif.) Laboratory (LBL), and there is a certain historical fitness to this, as that is the laboratory that grew out of Ernest O. Lawrence's invention of the cyclotron in 1930. The SSC will be the cyclotron's most advanced descendant.

As one member of the design group, Stanley G. Wojcicki of Stanford University, pointed out during an interview at LBL, the group works in complete independence of the site selection procedure, which is in the hands of completely different people. Yet what it does produces criteria that will affect site selection, and it is just now trying to finish its second report on the subject of siting criteria — the first one was done about a year ago. Wojcicki says 25 to 30 states have shown an interest. At his press conference Herrington listed six that have mounted very serious programs to get the SSC: California, Colorado, Illinois, Texas, Utah and Washington.

According to Wojcicki, a "very simple-minded" description of an accelerator divides it into three parts: an accelerating section or sections in which radio waves impart energy to the protons; a confinement system that forces the protons to move in a circular path so that they go through the same accelerating sections again and again; and an injector, a preaccelerator that delivers the protons to the main apparatus already energized to some degree.

Two of these general components, the confinement system and the injector, could have a bearing on location choices. The actual accelerating system will be fairly conventional, using mainly well-known technology. The confinement system consists of magnets, and it is the large dipole magnets that bend the path of the protons so that they go into a circle that are critical to the overall size of the SSC.

The "superconducting" in the SSC's title indicates that these will be superconducting magnets, energized by coils wound with a wire that conducts electricity without resistance. Otherwise the cost of power and the amount of lost heat required to produce the necessary magnetic fields would be prohibitive. This property of superconductivity appears only at very low temperatures, so the magnets will have to be cooled to the temperature of liquid helium, 4°K.

The designing of these bending magnets actually began before the central design group was organized. There were two main structural questions to answer, Wojcicki says. Two pipes will carry protons around the ring; in one pipe they will move clockwise, in the other counterclockwise. The first question was whether both pipes should be contained in the same magnet and cryostat (cooling chamber) or whether each pipe should have its own magnet and cryostat. The former option ("two in one") has some cost advantages; the latter ("one in one") has flexibility on its side.

The magnets consist of coils of wire carrying electric current, wrapped around iron cores. The second question was whether these should be "coil dominated," with the coil supplying most of the magnetic field, or "superferric," with the iron producing most of the field and the coil serving mainly to energize the iron. Proponents of the superferric design said it would be easier and cheaper to build, but it would require a much larger circumference for the SSC than the coil-dominated design. The decision went in favor of one in one, coil dominated, and the designers are now engaged in seeking the optimum version of this design.

What the decision means is that a larger number of potential sites may be viable, but the expected circumference of 83 kilometers or 52 miles still encompasses a lot of real estate. All the territory inside the ring need not be dedicated to the SSC, but still, putting the land together will be a problem. Herrington said the interested states will have to do this, and the winner will have to present the land to the federal government as a gift.

The injector for the SSC, which must supply protons at 1 TeV, could also influence site selection. The Tevatron at Fermilab does this, and Wojcicki calls it "an existence proof" for the SSC injector. It would not be difficult to build another, but the SSC could also use the existing one. Using it would save about $300 million of the expected $4.4 billion cost of the SSC, Wojcicki says, but some of that might be lost again in the cost of tunneling, which might possibly be higher in Illinois than at some other site. At his press conference Herrington rather vehemently denied that the Tevatron's existence gives Illinois an edge.

So far the SSC design study has been funded at about $20 million a year. For fiscal year 1988 the administration will ask Congress to authorize $35 million. Thereafter the annual appropriation would rise. Critics have said that funding the SSC will hurt the rest of the government's science budget, but Herrington insists that this need not be so. He points to a concurrent request for a substantial increase in the authorization for the National Science Foundation as evidence that the administration does not intend it to be so. *— D. E. Thomsen*