Project Pioneer: Dennis Horn helped make AEDC the premiere site for aerothermal testing

After earning a bachelor's degree in mechanical engineering and a master's in theoretical and applied mechanics from the University of Illinois, Dennis Horn began a remarkable engineering career.

He began his work at the U.S. Air Force's Arnold Engineering Development Center's (AEDC) in 1958, after working for a short time as a mechanical engineer for General Electric. He started his career at AEDC by testing ramjets in the Engine Test Facility (ETF), but he quickly became associated with arc heaters.

Arc heaters provide unique aerothermal test capabilities for evaluation of thermal protection materials, airframe components, and integrated systems designed for reentry and hypersonic flight.

The AEDC arc-heated test facilities utilize a high voltage, electric arc discharge to heat air to total temperatures up to 13,000 degrees. High pressure test flows are achieved by confining the electrical arc discharge in a water-cooled channel capable of withstanding high chamber pressures. The combination of high-enthalpy test gas and high plenum pressure makes possible heat flux simulation representative of flight at speeds in excess of Mach 20 at high dynamic pressures.

Horn started his work on arc heaters when he became part of a special projects group that first looked at using electric arc heaters to provide higher temperatures for turbine engine testing in ETF. Then another group was formed to study the feasibility of developing a high velocity low density wind tunnel.

"The part that I was involved with was looking at electric arcs as the driver to investigate throat cooling for this low density tunnel," Horn said.

Soon AEDC was approached with the idea that the arc heaters could be used for material testing on both nose tips and heat shields. With Horn's help, the AEDC 5 Megawatt (MW) Arc Heater Test Unit became one of the primary arc testing units in the U.S. and achieved a standardized design, which functioned successfully for 20 years.

During the early 1970s, he played a similar role in the operational testing of the AEDC Dust Erosion Tunnel, beginning with the initial feasibility study using arc drivers and continuing through the design, construction, shake-down, and a long period of intensive user testing. He developed special test techniques, concentrating on methods of improving dust cloud characterization.

Horn then began the development of a high pressure segmented arc heater, a new type of arc heater introduced at AEDC in the early 1970s. The initial design for the heater was provided through an outside contractor and was sent to AEDC for evaluation. Horn and his team started development of the segmented arc heater by redesigning critical components of the heater, and in its reformation it became known as the AEDC 5 MW segmented arc heater.

After 15 years of technical involvement with arc heated test units, he became widely known for his development and troubleshooting of arc heater facilities and improving testing techniques. He became the primary cultivator and technical expert for developing and advancing the segmented arc heater from a two MW laboratory research device to the premier high-performance test facilities used today.

Reentry and erosion testing continued in the 5 MW arc heater test units until the mid 1970s, when Horn designed a new high pressure segmented arc heater called H1, were the power levels were increased to 25 MW.

"It was the first large high pressure segmented arc heater in the country and possibly in the world," Horn said.

During the early shakedown of the new H1 arc heater, the improved performance and flow cleanliness attracted users to the facility well before development was completed. Horn provided continuous and intensive surveillance of the heater operation, fine-tuning and modifying heater components and operating techniques.

"We continued to develop that arc heater over the next 10 to 15 years and we were able to test reentry materials, both nose tips and heat shields, using much larger test samples," he said. "We had gone from five megawatts to 25 megawatts, and we continue to operate H1 today. It is still our [AEDC's] primary bread and butter facility for high temperature materials testing."

After the development of H1, Horn began directing his energies and capabilities to further advance the state of the art in arc technology.

"My focus has always been on technology and heater development, as opposed to testing," he said. "During the period from 1981 to 1988, I was a supervisor of both testing and technology for the arc heaters. After that I focused primarily on arc heater development and technology."

"In 1990 we got the go ahead to design and develop the H3 segmented arc heater. We were able to operate that heater [H3] to 120 atmospheres pressure and power levels up to 68 MW after only two years of development."

Horn also said that AEDC has now installed a new model positioning system in the H3 arc heater facility.

"H3 will provide still larger flow fields," he said. "Hopefully during this fiscal year we'll be able to begin customer testing there."

Horn said the arc heater research and testing that is done here at AEDC is unique.

"It is basically the only place where this type of high pressure research and development is going on," he said. "NASA has some lower pressure arc facilities and there are one or two private companies that still operate electric arc heaters, but within the Air Force this is the only location."

Nearly all the design and large arc heater development at AEDC has been centered around Horn's initiative and although he officially retired in 1997, he still works on the base as a part-time employee.

"I've been out here in some small way every year since 1997," he said. "Now I work just a couple days a month, mostly consulting and also doing some component design."

Horn attributed much of his success in arc heater technology to the tremendous support from the Air Force and fellow employee's at AEDC. He has made substantial contributions to the nation's aerospace ground testing capability and was one of the first six scientists honored as an AEDC Fellow in June 1989.

In his spare time he enjoys studying and photographing wildflowers. He is a member of the Scientific Advisory Committee for Rare Plants in Tennessee and the vice president of the Tennessee Native Plant Society. He was awarded a Certificate of Merit by the State of Tennessee in 2003 for his conservation efforts.

AEDC Fellow Dennis Horn is pictured working in the center's Arc Facilities. The Arc Facilities are the highest-pressure arc-heated facilities in the U.S., providing unique, high-enthalpy environments for testing materials, such as candidate materials for nose tip, leading-edge, heat shield and window applications for re-entry vehicles and hypersonic missiles.