Sandia engineer Willis Whitfield, whose invention made possible the modern electronic age, revisits Labs

Statue prototype approved by clean room inventor

By Neal Singer

The idea seemed so simple to Willis Whitfield that he didn't think it was an invention. He couldn't believe someone hadn't thought of it. To keep a room very clean, let air be the janitor — a "janitor" sweeping the premises every six seconds.

The modern electronic age as we know it began in the early 1960s when Willis, a Sandia engineer, envisioned using fans not only to send outside air through filters into a room but also to remove the air in equal measure through exhaust pipes in the far wall.

The air had to move slowly enough to be imperceptible, but fast enough to avoid aimless whorling.

Later he varied the design of the "clean room" to insert air from the ceiling and exhaust it through the floor. This meant that with an assist from gravity, particulates dropping from a device being cut or sanded or soldered would more readily "go with the flow" to be immediately cleansed from the room.

The omnipresence of the technique today in hospital surgery units, electronics fabrication plants, and laboratories makes it easy to take the invention for granted. At that time, things were different.

"I was amazed at the high level of interest [generated], chiefly from hospitals," said Willis during a visit back to Sandia last month (see photo, *Lab News*, Jan. 21). "They were very nervous about infections, and rightfully so."

So-called clean rooms of that era had no control over their own air, and depended solely on masks, gowns, and janitorial services.

Major corporations like General Motors — aware that dust was an increasing problem as circuit sizes decreased — built rooms with sloping walls in misguided, expensive attempts to minimize free-floating particulates. They also paid excessive attention to keeping doorknobs clean.

"They were looking at the wrong things," said Willis softly. "I said we could build a room out of drywall and latex paint. Some of these people almost passed out."

1,000 times cleaner

The difference in cleanliness between the old way and new was immediately apparent when Willis' group checked for dust contamination in their prototype clean room. "We turned on the particle counter and it just stopped counting. We thought there was something wrong with it," he recounted to a small group of Sandia management who gave him a tour of the Microelectronics Development Laboratory on Jan. 14.

The Sandia prototype facility was 1,000 times cleaner than any room ever measured.

THE LEGACY — Bill Jenkins (1920, left) shows Willis Whitfield a scale model of the life-sized statue of him that will be placed in a central courtyard of the MESA complex. The sculpture was crafted by former Sandian Neil McEwan, now a professional sculptor in Arizona.

THEN AND NOW — During a tour of the Microelectronics Development Laboratory to see how Sandia has put his clean room invention at the very heart of its most important work, Willis Whitfield pauses in front of a video screen showing him as a younger man stepping through the door of his first clean room. (Photos by Bill Doty)

In his recent visit, Willis described these events to Don Cook (1900), Marion Scott (1700), Regan Stinnett (1903), Bill Jenkins (1920), Tom Zipperian (1740), and a few others who wanted his permission to create a life-sized statue of him for the MESA project as it nears completion.

Don Cook said simply, "We want a statue of an engineer at our largest engineering complex."

Carol Sumpter (1702), who provided Willis an extensive description of current MEMS efforts, was more emphatic.

"My whole career in microsystems was enabled by what you did," she told him.

"You're very kind," he said.

His modesty never failed him. After listening for an hour to descriptions of microsensors, synthetic aperture radar, photonic lattices, MEMS devices, and self-assembling nanostructures, as well as a multidisciplinary approach aimed at summer students in the MESA Institute, he joked, "Now I know what Rip Van Winkle felt like when he woke up," referring to the literary character who awakened after a sleep of 20 years.

Accurate even in metaphor, he in fact retired 20 years ago in 1984 after a career at Sandia lasting 30 years.

Nevertheless, in his youthful leather jacket, pressed brown slacks, and polished brown shoes — if you ignored his white hair and the crosshatches of time on the back of his neck — he looked like a new recruit available for hiring, as at least one director mentioned privately. His attention never wavered. "What's intriguing to me, as an old electrical engineer, is the measurement of these things," he said of the tiny devices he was shown.

'I read the *Lab News*' to keep up

When Carol asked him, nearly an hour into a walking tour, if he wanted to sit down, he said, "No, please go right ahead." Later he said, "For a guy 86, it's quite a pleasure to be invited back. I thought everyone had forgotten about me."

The *Lab News* asked Willis how he kept up on technical matters, since he seemed familiar with many terms used in the private briefing.

"I mostly read the *Lab News*," he said.

Emboldened, *Lab News* then asked just what was "laminar" about the so-called "laminar flow clean room" — the usual term used to describe his group's invention.

"Nothing," said Willis, who described the word as a preexisting marketing term and a catchy name. "The air is just unidirectional."

Marion Scott wondered why Willis wasn't more of a worldwide name than he is. "If I was any more famous, I couldn't stand it," Willis quipped. More seriously, he said, "It's a specialized field. Clean rooms kind of slipped in the back door. It started as an ordinary room, like an office, with a HEPA filter and people in caps and gowns."

He was famous at the time of his invention, joining with luminaries like astronaut Neil Armstrong to give talks, but over time, worldwide interest in the originator of the background environment to all of today's electronic advances seems to have diminished.

Sandia's interest is in not seeing this contribution forgotten.

The Friday morning event, put together by Dan Fleming (1900), came about when retired director Dick Clausen reminded Sandia VP Pace VanDevender (1000) that the 40th anniversary of the invention of the clean room was coming up. Knowing of Don Cook's plans to have a statue of Willis installed at the MESA facility as an inspiration to its engineers, Marion Scott suggested that Dan invite Willis to visit. Regan Stinnett, who attends the same church as the inventor, seconded the invitation and participated in the tour. Dan picked up Willis from his Northeast Heights home and — ever the Sandian trying to eliminate any possible problem — left Willis' cell phone with MDL secretary Nancy Campanozzi, so that his wife could reach him, should she need him.

Bill Jenkins explained a model of the MESA facility and presented the foot-tall statue model, approved by Willis. The model was crafted by Neil McEwan, a former Sandian now a sculptor in Arizona. It shows a young man standing by a large, hip-high block, one leg draped casually over the block. Current plans are to inscribe it with two quotes.

One was suggested by John Stichman (2000), VP and chief engineer for Sandia's nuclear weapons program, from President Dwight D. Eisenhower: "Engineers build for the future, not merely for the needs of men, but for their dreams as well. Thus, inherently the engineer's work is a fearless optimism that life will go forward, and that the future is worth working for."

The second possibility are Willis' own words, simple and prophetic:

"I thought about dust particles. Where are these rascals generated? Where do they go?"

The idea of adding the statue of an engineer to the MESA complex also was suggested by John Stichman, says Don Cook: "It was John who laid out the challenge to me one day, saying, 'While there are many statues to inventors and scientists around the country, I can't think of one of an engineer.' When John said that, I said immediately that we'd put one in at Sandia as part of the MESA project."

The statue will serve as an emblem of MESA and Sandia as a premier engineering facility.