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EQUIPMENT MAINTENANCE ON ABNER

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The article by Russ Chauvenet in the August 1977 CRYPTOLOG provided an excellent perspective of how the programmers viewed ABNER. Sam Snyder's followup letter in the November 1977 CRYPTOLOG provided additional insights on the construction of the equipment. I believe it would be remiss not to cover at least a few points concerning some aspects of the equipment maintenance on the ABNER Serial 1 system.

When AFSA, NSA's predecessor at Arlington Hall Station, first determined in the very early 1950s that it was getting into the electronic computer arena, it was readily determined that there was no source of qualified engineering or electronic computer-maintenance personnel to be enticed into service at the Agency. In addition to hiring a few civilian electronic engineers and technicians, it was decided to attempt to get some expertise in this area by seeking military officers. A survey indicated that the training that came closest to meeting the Agency's requirements was given at the Ground Electronics (Radar) School at Keesler Air Force Base. A levy was placed on the USAF/AFSA for one officer in the top third of each of ten succeeding graduating classes. I was "fortunate" enough to be selected as the first officer from the first class. Upon arrival at Arlington Hall, I was assigned to the computer maintenance for ABNER. People like [redacted] now Chief T2 (as well as L. Morgenweck, E. Biggerstaff, and [redacted] all of whom are still at NSA), were old hands at ABNER maintenance, having already spent about 6 months working side by side with the development engineers and programmers in anticipation of the computer's becoming operational.

ABNER I, Serial 1, the first NSA application of "serial dynamic logic" circuitry, presented new problems for isolating malfunctions. The computer, including the consoles and peripherals, came close to being a maintenance nightmare. All of the electronic D.C. power supplies were of the laboratory type, with variable voltages. They were not overly stable and they generated a tremendous amount of heat. Electrosonic mercury delay lines were used for the 1024 words of memory (512 words per cabinet, or 64 delay lines per cabinet). The only pluggable components in the whole machine were the diode/resistor gates (there were 25,000 1N34 diodes) and the 6AN5 vacuum tubes that were used for digital pulse amplifiers. There were about 1500 6AN5s, all being used close to their design rating, and they had an MTBF that did not endear them to the maintenance personnel. More importantly, all the digital pulses were processed through various lengths of electronic delay lines. The latter were all wire-bound on very delicate metallic-plated fiberglass rods and hard-wired into the system. Likewise, all the pulse transformers were hard-wired into the system and when we were so fortunate as to locate a faulty delay line, pulse transformer, or diode isolating/gating circuitry, it took at least a half-hour or more to replace the suspect component if it was not a tube or a plug-in gate.

Perhaps more important than the hardware replacement problem was the fact that there were almost no electrical or software diagnostics for the machine. The R&D programmers had developed a few "exercise" routines, but the usual "maintenance" technique was to attempt to run an operational program and, when it didn't work, Maintenance was called in to see if we could find the trouble. This was the standard practice in other "computer laboratories" in the United States during this early computer era. Over a period of time, of course, we did develop some diagnostics. Many problems, however, occurred with the electromechanical input and output equipment and with the operations console itself. These faults would, of course, bring everything to a grinding halt, since then we could not even get data into or out of the machine. We were also hampered because the response time of the oscilloscopes was so slow that it was difficult to "see" some of the pulse trains, and delayed-sweep oscilloscopes were not yet in use.

When production operations started in 1952 there was no time allocated for preventive maintenance. All the maintenance time we were allowed was that necessary to correct faults. In general the machine was used during the day shift by the R&D personnel who were continuing to develop some facets of the equipment and, in some cases, to improve reliability. During the evening shifts it was used by the programmers who were just developing some of the initial programs (Russ Chauvenet was among the best of these) and the attempt was made during the midnight shift to run on an operational basis the few programs that worked. All three of these "customers" (the R&D engineers and programmers; the operational programmers; and the operators) provided a unique technical as well as human-relations challenge to the maintenance crew.

As time went on, things of course improved. The maintenance people still thought the

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equipment was poorly designed; the programmers were probably the happiest of the lot; the R&D engineers were glad to get on to newer things; and the operations people suffered through with all of us. As Art Salemme wrote in the October 1977 *NSA Newsletter*, most of us lived in the Buckingham area and it was not uncommon to work on the machine for several hours at a time, come home and get something to eat (with logic equations and microseconds still going through our brains), and wander back down to work to see if we could try one more idea in the attempt to fix the machine. Maintenance down times of 4 to 8 hours were very common and on occasions lasted up to 4 or 5 days. This was not so much a reflection on the quality of maintenance personnel (I would like to think), as a reflection of the complexity of the design, the newness of the whole concept, and the absence of statistically reliable preventive maintenance procedures and software diagnostics. In many cases, whenever we were sure the input and output equipment and console were working, we would write down our own diagnostics to try and locate a sticky logic problem in the machine. As each new computer application program was written, it was not uncommon to find logic errors in either concept or wiring, even after the first year or two of operation.

After approximately a year of such interesting endeavors, I was considered qualified to become the maintenance chief on a special-purpose machine, DELLA, being constructed by R&D using the same type of digital logic and components (albeit with many more plug-in components used), that was expected to come into operations. DELLA was to be located at Nebraska Avenue and I soon began the joys of carpooling from Arlington to NSS and lost contact with ABNER just as it came into its own as a highly productive piece of computing/analytical equipment.

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