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Clyde Davenport continues his review of the history of computing at the Y-12 National Security Complex.

At the time, the PDP-15/35 demonstration project was the most significant of its type anywhere in the Y-12 Plant, and it had major influence, over time. It drew such interest that a series of major computerrelated projects were set into motion, and flowed from the above in a logical, ever-widening sequence. Below, we shall briefly summarize the more important milestones.

It started innocuously enough. For good or ill, the demonstration project tagged me with my Department's "computer go-to guy" label, then subsequently the same for the Development Division at large. I began to write a series of online, small data analysis, filtering, numerical analysis, and plotting routines for Division researchers, to be done on the PDP-15/35 computer.

Word got around, and people began to ask for more. I explained the situation to Division management, and they provided funds in 1977 such that I could purchase a DEC PDP-11/60 computer (the next generation after the PDP-15/35) and drop user terminal lines into all Division Staff and R&D offices. This was such a hit that it was soon replaced by a higher-capacity PDP-11/70 (1979). It was the first such general-use, online system in the Y-12 Plant.

The capability for E-mail and word processing functions caught the eye of Division managers, and they began to incorporate them into their operations. On the scientific computing side, there were no general-use software packages available at that time for these computers.

I wrote a collection of general-use routines, such as data filtering, plotting and graphing, curve fitting, and similar items. In all, I wrote in excess of a half-million lines of code. See C.M. Davenport, "Applications programs and software resources on the PDP-11/70 computer," Report Y/DW-304, Revision 1, Union Carbide Corporation, Y-12 Plant, May 10, 1983.

By 1981, Division management began to realize that if they had a computer of sufficient capacity, they could put all of their business records online, and gain enormous advantage. The Department of Energy contracting agency required rigorous documentation of each and every project, study, or activity carried out by the Development Division. From proposal, to planning, to execution, tracking, audits, and so on to the final documentation, large volumes of records were generated.

Additionally, Division R&D people began proposing ambitious experiments that could not be supported by the PDP-11/70 system. Something more was required. I believe that Division management discussed the problem with their Department of Energy contracting managers.

As a result, in 1983 Bill Dodson, the Development Division manager, directed me to form a study team, with individuals from each Department and Staff position, and write a Long-Range Plan for addressing the Division's Automated Data Processing (ADP) needs. I did so, straightaway. It called for \$2M in equipment, software, and installation costs.

See the result in C.M. Davenport, "ADP plan for for the Y-12 Development Division," Report Y/DW-470, Union Carbide Corporation Nuclear Division, December 14, 1983.

I thought the Plan would be used only as an informal guide for computer resources for individual R&D projects within the Division, as they came up. However, Division management (apparently) immediately submitted it *in toto* to DOE Albuquerque as a budgetary line item! Apparently, DOE reviewed the Plan,

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approved it almost verbatim, and provided budgetary funds to begin the installation in certain areas. Ordinarily, a budget request of this magnitude would receive extensive scrutiny.

Up until this point, I had handled all aspects of the computer(s) purchase specifications, acquisition, setup, and operation, including computer security. Mercifully, the Division hired Joe Foust to handle system management and operation. I continued with computer security and Authorized Derivative Classifier (ADC) duties.

In one sense, this could not have come at a better time, inasmuch as the DEC VAX mid-sized, 32-bit word length, networkable computer was coming on the market, at unprecedented low cost vs. performance. In another sense, it was an uncertain time, because the first, very-rudimentary, personal computers were appearing, and it was not yet apparent that they would ever have any serious impact.

The Plan called for *two* VAX computers, to be put into two, separate systems: one for unclassified work, and one for classified work. The VAX computer provided a full suite of office and enterprise software support, plus provided the memory capacity to handle large scientific and engineering calculations.

Separate classified and unclassified terminal lines were dropped into every office and lab in the Division. I ported my scientific computing routines from the PDP-11/70, and wrote many more numerical analysis, image analysis, and modeling and simulation routines, eventually approaching an estimated one million lines of code.

I thought that would be the end of it, and that the new technology could now accommodate any Division need. True, it could, but that was not the end of it.

Apparently, DOE provided budgetary money such that the *entire* Y-12 Plant could implement the Plan! It was implemented almost verbatim, with only one significant elaboration: Separate, classified and unclassified computers would be set up to service each of the various Divisions in the Plant, but they would be separately integrated into two overarching Plant-wide systems, tied together via two separate DEC plant-wide networks. Engineering handled acquisition and installation, and the individual Divisions handled their own system management and operations.

This Plant-level computer activity fell under the purview of Technical Director Bill Wilcox, but he had not been included in its planning. When it was brought to his attention, he ordered a halt to all work, pending his review and approval. He ordered that a Return on Investment (ROI) analysis be performed for each individual service or system that had been mentioned in the program planning documents. I did the ROI analyses. Apparently, the Plant also provided their wants and needs, and the work was allowed to continue.

By early 1986, the Plant networks were substantially in place, and the Plant had begun to strategize about the best way to create a comprehensive, fully-integrated, Enterprise software environment. They formed a task group, led by Michael Cuddy, to select an approach.

In their initial discussions with the DOE contracting agency, there was reluctance to fund without thorough study and evaluation, and some way to obtain outside review. The Cuddy task group found a way.

It so happened that the Society of Manufacturing Engineers (SME) annually gave an award for the best Computer Integrated Manufacturing (CIM) strategy, called the CASA-LEAD award. Applicant strategies would be thoroughly evaluated by industry experts.

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It was a coveted award, and competition was intense. It was absolutely crucial to get by the "first cut" of applications. Who would do the Y-12 writeup? I have an old e-mail from that time, from Michael Cuddy to Bill Dodson, asking Dodson for my help, saying "After discussing our approach, everyone concluded that the best person to help us with that would be Clyde Davenport and his skill in writing."

Of course, I helped, and Y-12 won the award in June 1986.

One important, fundamental element in the CIM strategy was a near real-time inventory of nuclear materials. The Dynamic Special Nuclear Materials Control and Accountability System (DYMCAS) was bought online in 1982.

See the report S. W. Combs, Y/DG-17077, "Near real-time accountability system at the Oak Ridge Y-12 Plant."

This would have been impossible without modern computer technology, and brought kudos from DOE Washington. The sequence of events flowing directly from the PDP-15/35 demonstration project in 1970-73 came to full completion.

Thusly did the above sequence of computer technology projects introduce online, interactive, networked computer services throughout the Y-12 Plant, including Production Operations, Engineering, and Plant Management. Considering the scope, this was in the forefront of such systems, anywhere.

After I retired in 1999, at the Awards Night celebration of Year 2000, I was *post facto* given the Company's highest award for technical achievement, based on the above.

Clyde will next bring us the third and final installment of the history of computing resources at the Y-12 National Security Complex.

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C. Davenport with a typical DEC PDP-11/45 shop floor computer

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Original Demonstration Project PDP-11/35 computer

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C. Davenport with a typical 1980's desktop workstation