History of Computing Resources in the Y-12 Plant – part three

(As published in The Oak Ridger's Historically Speaking column the week of September 11, 2019)

This final part of Clyde's excellent documentation of advances in computing at Y-12 includes an example where I was personally involved and where we shared a DOE Award of Excellence as a direct result. It is an early "expert system." Today it would be called "artificial intelligence" but we knew it was a learning system and using a great deal of data prioritized maintenance work, we just did not presume to label it as "artificial intelligence.".

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Finally, we shall briefly discuss three computer-related projects that had a positive effect upon DOE Headquarters thinking when the 1992 Nuclear Weapons Complex downsizing took place.

For the first example, in late 1979, I did the conceptual design and prove-in of a pilot plant for testing small pressurized weapon parts to very high pressures (up to 8,000 psi) with helium. The rise in pressure had to be tightly controlled, with a linear rise. The conceptual design of the overall automated system was quite like that for the electron-beam welder, at least in the main particulars.

The technique for achieving a smooth, linear rise in pressure was unconventional, to say the least. I had to understand and exploit the characteristics of the main helium flow valve, which was operating in the limits of its on-off capability.

Once the pilot plant was working, I turned the project over to a PhD Electronics Engineer and a PhD Computer Scientist so that they could go out into the Plant and set up a Production facility for high-pressure testing. This was something that was not generally available elsewhere in the Nuclear Weapons Complex.

It was well-received. The development team for the Production unit all received a DOE Award of Excellence for their work.

See the report, C.M. Davenport, "An automated vacuum and gas flow control system," Report Y/DW-203, Union Carbide Corporation Nuclear Division, a presentation given at the Sandia National Laboratory, March 10-12, 1981.

In the second example, around 1986, the Department of Energy commissioned Y-12 to develop an expert system software program to assess the relative importance of maintenance work requests, consistent with DOE policy, operational safety, and radiation safety. I worked closely with D. Ray Smith of the Maintenance Division to identify the priority factors for Maintenance work, plus their relative weighting.

Ray's input was also crucial in evaluating the final program. By 1988, we had a working product, which was named the Maintenance Importance Generator (MIG) program. (I well remember working with Clyde on this project. It was my first formal interaction with him and also my first attempt to automate the prioritization of maintenance work. The system worked really well and allowed us to focus resources on the most important maintenance work. - Ray)

The MIG program played a significant role in keeping the Y-12 Plant active and in operation after the fall of the Soviet Union, in December 1991. The U.S. Government believed that there would now be much less need for nuclear weapons, so they could severely downsize or close some or all of the production plants.

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DOE formed a Tiger Team to go around to the production sites and look for some managerial failing, and summarily shut them down. The Team went first to the Rocky Flats Plant in Boulder, Colorado. Rocky Flats made all of the weapon primary units and handled most of the plutonium operations in the Nuclear Weapons Complex. Plutonium is extremely hazardous to handle, and there was a history of serious accidents. There were maintenance failings. The Tiger Team severely castigated the Rocky Flats management, and used that basis to permanently shut down the Plant.

The Tiger Team came next to the Y-12 Plant, which is the main production facility for weapon secondaries and uranium processing. The Team apparently were going to use the same strategy on Y-12 as they did at Rocky, i.e., maintenance failings. They gathered all of the Maintenance Division managers in a room, and threw down the gauntlet. They said, in so many words, "Your maintenance operations are disorganized and haphazard. You don't even have a clear view of what needs to be done next. Prove to us that we are wrong, or we are going to close the Y-12 Plant."

Dale Allen, the Y-12 Maintenance manager, immediately responded with a demonstration of the MIG program, which gave a complete overview of the maintenance workorder backlog (more than 40,000 workorders!), organized by safety considerations and DOE policy. There was some sputtering and bluster, but in the end, Y-12 remained open.

This would not have been possible without the computers and networks to gather the maintenance records and analyze them electronically. (I also well remember this event accurately recalled by Clyde. Dale Allen was my manager, and friend, and he well understood the value of the computerized system Clyde had designed! It literally did save the day for us then! - Ray)

For the third example, sometime around 1992, DOE Headquarters formed the Defense Nuclear Facilities Safety Board (DNFSB), to go around and do routine safety audits of the various Nuclear Weapons Complex sites. They would come in, do a walk-through of Operations areas, and question management about various practices.

If they found a deficiency, they wrote it up as a Finding, and the Plant would have to correct the problem. In December 1994, they made a routine visit to the Y-12 Plant. One of their Findings was that "The Y-12 Plant workforce was seriously aging, highly-skilled technical staff were retiring, and their irreplaceable knowledge was being lost.

Therefore, a Knowledge Preservation Program should be set up to capture and preserve this specialized knowledge." All NWC sites received similar Findings

I addressed this problem by interviewing around 375 Production and Engineering experts, and putting the results online in a (classified!) archive. Others later added more. From this start, the Plant added such things as the existing, written production procedures, training materials, and the operating policies documents.

On November 3, 2011, the *Oak Ridge Observer* newspaper reported that the NNSA had designated the Y-12 effort as a National Center of Excellence for Knowledge Preservation. Again, this would not have been possible without the computers and networks to gather the expert knowledge and present it online.

Lastly, I reiterate that I did not single-handedly accomplish the above projects. The Y-12 Plant is a large facility, full of accomplished science, engineering, and technical staff. - Clyde Davenport

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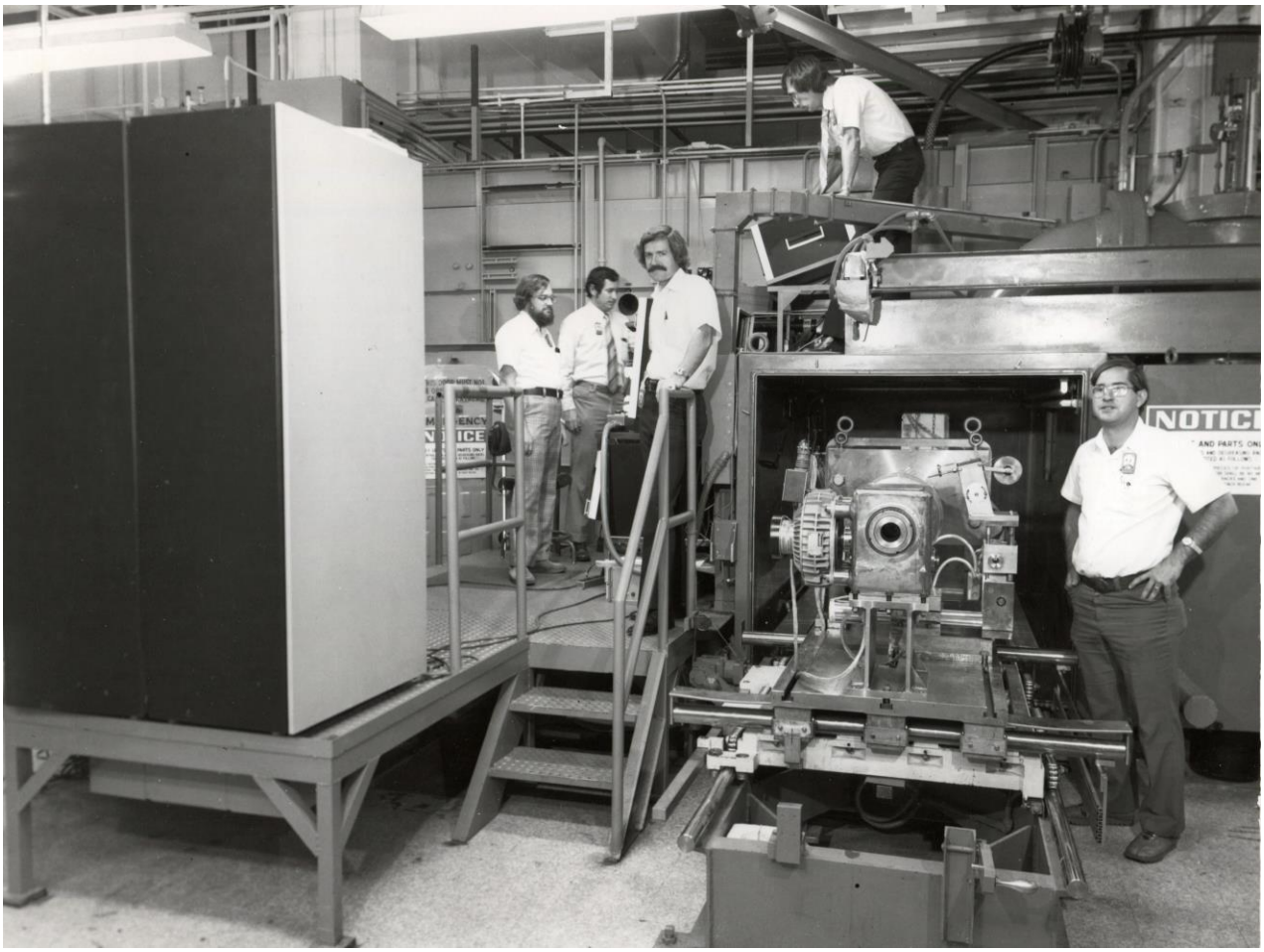
Thank you, Clyde for an excellent summary of computing at the Y-12 National Security Complex and for recalling some of the key turning points in its history. You have been a good friend and working companion and I sincerely appreciate the effort you have made to document this aspect of Y-12 history. Future generations will find your summary valuable when researching Y-12 history.



A major computerization effort of an Electron Beam Welder automation upgrade accomplished by the team of Paul Turner, Gary Bowers, Clyde Davenport, Jim Burkhart and L. Greene

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DOE Award of Excellence for the Maintenance Importance Generator "expert system" presented to Clyde Davenport, Ray Smith, and Deanna Barnett by Margaret Morrow and Jeff Bostock…

A fond memory for me!

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