New control systems for aging Siemens cyclotrons

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Introduction
When properly maintained, cyclotrons often remain in operation for 20 years and more. However, as the years pass the control systems in particular become challenging to support. The I/O cards and other hardware eventually become obsolete, making spare parts difficult or even impossible to find. And the knowledge and ability to reload and configure the software also gets lost as operating systems and media storage technology change.

This obsolescence is true of the Siemens RDS-112 cyclotron, which is controlled using a 486 computer, connected to an external STD card rack containing up to 15 I/O cards. These I/O cards were last manufactured in the 1990’s, and the iRMX-based control programs malfunction on computers newer than a 486 processor.

A control system upgrade for the RDS-112 cyclotron has been developed by PET Technical Consulting Inc. This commercially available control system reduces operator training time, requires less maintenance, and supports new targets and custom product processes.

Material and Methods
The availability of high channel count I/O cards, and the decision not to support the old CPCU synthesis units, means the entire STD card rack can be replaced with 5 National Instruments (NI) I/O cards. The replacement computer is an industrial grade rack mounted PC with RAID 1 mirrored pair hard drives in front panel access quick swap bays.

Two NI PCI-6509 Digital I/O cards connect directly to the RDS electronics, channel assignments are mapped using software configuration. Three NI PCI-6229 Multifunction I/O cards connect to the RDS electronics through a cable breakout interface plate, the terminal blocks are wired as needed to map the channels.

The new control software was created using National Instruments LabVIEW. The new control sequences have a core based on the original RDS-112 FORTRAN control programs. Then hundreds of improvements were made to simplify operation, increase flexibility, minimize user involvement and mistakes, and clearly display key parameters and fault conditions.

System control has been combined into a comprehensive Graphical User Interface, with controls and indicators grouped together onto sub-system pages. Commands that once needed to be typed-in have been replaced with a clickable control for each function. Bar graphs display target and slit currents. Status is obvious with red faults against normally green indicators. Audio alarms cue the operator for process interaction, warn if target current or pressure drifts from setpoint, or if faults occur with power supplies, vacuum, or water cooling. Improvements in sequences and beam algorithms have reduced the time to achieve full beam on dual targets from 10 minutes down to 3 minutes.

Results and Conclusion
This new control system has been installed on (5) five RDS-112 cyclotrons used for commercial isotope distribution. The total combined operation time of these systems after receiving the upgrade is now over 17 years, during this time the control system operation has been nearly problem free.

UPDATE: The Siemens RDS-111 cyclotron is controlled by a VME computer that is now end-of-life. The VM30 and VM42 CPU boards and many of the I/O modules are no longer manufactured. PET Technical Consulting is developing a control system replacement for the RDS-111 cyclotron with expected completion in 2014.

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