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COMPUTER CONTROL IN A.G.S. EXPERIMENTAL AREA

I have looked into the use of the CAMAC system in regard to its possible application to the various devices on the experimental floor. I have not been able to finish the study. I do not know, for example, what it would cost to actually adapt the separators to the CAMAC system or what such a CAMAC system would cost. I do have a rough idea of the cost of the CAMAC system however. This note is an attempt to put down some of my thoughts of the use of CAMAC.

First of all, I think it is too bad that the A.G.S. did not use CAMAC from the beginning. Its biggest drawback, the use of a 66 pair cable, does not warrant its abandonment to a serial type system of lesser versatility. The CAMAC system is a universal system used by all the other laboratories; CERN, NAL, Los Alamos, Berkeley, and Rutherford for not just physics, but for machine control and monitoring as well.

The advantage of CAMAC are as follows:

1. There is a wide range of CAMAC modules available commercially and more being added all the time. A power supply controller, for example, providing for magnitude control to 0.025%, ON-OFF control, interlock reset, and 4 bits of status information cost $750.

Any vendor will design and build a special module to a specification. No specialists are needed.

2. The CAMAC system can be easily repaired and understood.

3. There are 12,000 separate operations possible per CAMAC crate and seven crates per cable.

4. A computer-CAMAC buffer system (branch driver) can be purchased for about $3,000 (for the PDP-11). Changing the computer does not make the CAMAC

system obsolete. Only the buffer system needs replacement.

5. A "handshake" type of timing is used, which means that there should be no timing problems.

6. A command cycle of 1 user is possible.

7. One of the most important advantages is the LAM or "look-at-me" signal. This signal is generated by a module when the module needs attention by the computer due to parameters or controls out of limits. Because of this signal the computer does not have to cycle through all of the points all of the time. These signals can also be given a priority rating.

In general, I think the cost of the CAMAC system is high. From a NAL report of 3 years ago they estimated the costs at $150 per crate slot plus $300 per module average. I believe these costs may be more than double when all things such as cable, branch drivers etc, are taken into account. Jay Marx told me that the CAMAC system in the Yale trailer consisting of $\sim 2\frac{1}{2}$ crates of equipment cost $50,000.

NAL reported also for a system involving 2 mini computers, 18 crates, and 220 modules that 2 engineers, 1 programmer and 12 support people were needed to set up and test the system.

I would imagine that the Datacon system costs would approach those of the CAMAC system if all costs such as development, testing, fabrication, and overhead were taken into account.

In thinking about the application of a computer system to the equipment on the experimental floor, I slowly came to the conclusion that we don't need it and can't afford it anyway. What we do need possibly is a monitoring system which will scan the important parameters on some devices on the floor but not control anything. This system needs no computer, can be bought cheaply, and can probably use existing read-out devices such as digital voltmeters.

We will always need some watch-standers to take care of those problems which come up. Even with a computer control system which will be programmed to start up the beam line magnet power supplies, someone will be needed to check out the power supply that won't come on when directed because of a sticky flow switch or a dirty relay contact. This person might as well turn on all the supplies.

In any case to adapt most of the devices to computer control will take us

too long, too many people, and cost too much in hardware to allow this to be done. I don't believe any other laboratory is proceeding in this direction in regard to the equipment on the experimental floor.

Suppose we do decide to go completely computerized. How shall we proceed? First of all, we should never abandon over ability to control a device manually. If the computer is down for a short time, we can continue runnning in the manual mode much the same as we do now. Further, the manual mode is needed for trotrouble shooting.

Secondly, all of the controls should be of the memory type. That is, the reference signal should always be a part of the device, not of the computer.

Thirdly, we should begin by controlling only those functions that are presently used. We should not add to the problem of a change-over by requiring a more complex system than necessary. More functions could be added later when the operation settles down. An important aspect of this is that much more of an existing system is usable and fewer changes are necessary. I believe, for example, that the CAMAC system could operate a magnet power supply through the exisitng connector on the front of the supply presently used for the remote cable.

Further by using the digital voltmeter read outs we can eliminate most of the noise and isolation problems since the DVM integrates.

I had anticipated setting up a CAMAC system on the test separator along with the magnet power supply there. I was going to ask HEEP for a crate, crate controller, and a few appropriate modules. Some modules I expected to buy. I had hoped to be able to get a feel for the operation of a system like this, first by using a manual controller, then by tieing into a PDP-11. This might still be done by someone.

I believe that both the CAMAC and the DATACON II systems can be made to control and monitor any device that we wish to put the time and effort on. I also think that the CAMAC system can be applied sooner and with less people. For certain, we wouldn't be held up by the DATACON experts.

These are rather randon thoughts, not too well organized or too well thouthought out. I put them down for what they are worth. I will pass along my notes

and references to Bob Hulliger who has always expressed an interest in remote monitoring of separator equipment.

Leo Redmond has been very helpful by supplying literature, catalogs, and verbal information. He had offered his help in setting up a test system.

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