6. MEASUREMENT AND COMPUTATION COMPLEX

Work performed in 1995 was focused on two main activities:

- design of electronics and software for the spectrometer measurement and control systems at the IBR-2 and IBR-30 reactors;
- development of the FLNP measurement and computational infrastructure.

A distinguishing characteristic of this year is that, in addition to current work on the modernization and operation of the measuring modules of the spectrometers based on CAMAC equipment and personal computers, a number of electronic blocks and software packages for the new generation of systems for experiment automation were developed on the basis of VME equipment and workstations integrated into the local computational network. These systems, compared with those already in operation, should exhibit qualitatively new measuring (in particular, for the IREN installation) and operational parameters and will ensure parallel (including remote) control over data acquisition and accumulation, information processing and visualization as well as for varying the conditions at the sample.

Methodical questions, including analysis of the current state and the development of systems for acquiring, accumulating and processing data coming from the spectrometers and information service of FLNP, and assessments of the required resources as well as specific technical solutions, are considered in the relevant project which is scheduled for realization in 1996-98.

An essentially new requirement voiced by physicist users is the creation of a unified set of hardware and software for the entire complex of Laboratory spectrometers, centralized archives of experimental data, and unified means for analyzing and graphically presenting data. Implementation of this requirement will simplify the operation of the spectrometers and essentially facilitate the transition to the user policy at the experimental setups.

In 1995, a large amount of preparatory work in all lines of activity considered in the above-mentioned project was completed.

Detector electronics. The main tasks in the field of detector electronics are the improvement of the parameters of preamplifiers, shaping amplifiers, discriminators, ADC and other spectrometric devices, and the change-over to up-to-date components.

In 1995, the detector track electronic units for the new detector system of the NERA-PR spectrometer (fifty SNM-65 rectangular helium neutron counters), were designed and constructed. The detectors, along with their electronics, were tested and the basic parameters were measured. Analogous systems were also developed for the NSVR spectrometer. At present, construction of the units is under way.

A considerable amount of work was carried out at HRFD: adjustment and startup of the electronics for two multi-section scintillation detectors; measurement of the Li-glass parameters; study of the character of noises and pickups, and working out the methods to reduce them.

The prototype of the charge-sensitive preamplifier for the Si-detectors of the spectrometer with oriented nuclei was designed and constructed. The unified spectrometric amplifier and high-speed analog-digital converter are in the development stage. Computer simulation and calculations of the basic parameters of the detector electronics for the position-sensitive gas detectors were made.

Unfortunately, for a number of reasons, mainly because of mismanagement, tests of the position-sensitive annular detector of the YUMO spectrometer were not completed. This work

needs to be completed in the shortest possible time and the decision made whether to replace the detector or to design new electronics.

Systems of data acquisition and accumulation. The initial stage of the project to develop a unified VME-based data acquisition and accumulation equipment for the FLNP spectrometers has been accomplished. The module based on the high performance TMS320C40 signal processor has been proposed as a basic module, which would provide a universal standard for the construction of data acquisition systems for any spectrometer. At the present time, the functional potentials of the module are being considered and technical details are being revised and verified. The development of a number of unified blocks for data acquisition systems is also in progress.

In 1995, a set of electronic blocks in VME standard (TDC-6 time-to-number converter, histogram memory with a capacity of 2 Mbytes and a memory address conversion block, and detector number encoder with 16 inputs) was built for the acquisition and accumulation of low resolution spectra at HRFD. The blocks were regulated and adjusted both jointly and separately. The basic blocks for the VME-systems of the NERA-PR spectrometers have also been constructed. The VME-module processor, based on the T800 transputer, was designed and constructed for the DN-12 spectrometer, and a set of micro-programs for data acquisition and accumulation was written.

The development stage is complete and engineering specifications were prepared for constructing the following VME blocks:

- digital rate meter;
- encoder of the 128 units point detector number;
- RTOF-analyzer based on the TMS320C51 digital signal processor;
- block for controlling experiments;
- block for registering ultrasonic signals.

For the DN-12 and DIN-2 spectrometers, the detector number encoders with 32 inputs (CAMAC) were made and adjusted.

Multi-dimensional measuring and accumulation systems for the ROMASHKA, KASKAD and PARKS spectrometers and the UCN gravitational spectrometer were updated and put into operation.

Control systems of the equipment for the spectrometers. The main tasks on which the specialists from the department for electronics, computers and networks focused their efforts, were unification of the control systems for executive mechanisms (step motors for goniometers, neutron scanners, rotating platforms, *etc.*) and the standardization of temperature regulators. The Euroterm temperature regulators which had been previously ordered were received and, at the moment, they are being brought into service at NSVR, HRFD, *etc.*

The control system for the step motors on the basis of the VD-OUT32 VME-units has been designed, and at present, work is proceeding on the installation of the system at the NERA-PR spectrometer. A stand for testing the software for these systems has been made.

At the REFLEX spectrometer, the CAMAC-based control system for executive mechanisms was put into service. The system is based on the employment of a commutator-power amplifier for alternate control of the step motors. An analogous module in VME standard has been constructed for NSVR. The 16-channel input/output register with a comparator to control the shutter and phase of the beam chopper has been integrated into the VME equipment at the NERA-PR and NSVR spectrometers.

At NERA-PR and DN-2, the equipment for controlling the LTC and DRC refrigerators has been modernized. At HRFD, the neutron scanner was connected to the control system. A number of analog electronic blocks have been designed for the high-pressure chamber (NSVR) and the REFLEX setup (current sources, switches, preamplifiers, *etc.*). Work to upgrade the control systems of the neutron beam choppers has been started.

A considerable amount of work on the development of the systems for correlation analysis of the power pulses of the IBR-2 reactor, and for measuring the movable reflector vibrations was completed.

Software for data accumulation and control systems of the spectrometers. Work is now under way on designing unified software for the data accumulation and control systems on the basis of VME-standard equipment. The testing software for the VME units (interface for controlling step motors, time encoder with the memory for accumulating spectra, register for controlling the setup) has been developed. In addition to the previous methodical developments, the specification for designing the control and interface modules was worked out, as well as the basic principles for design and realization of unified software for the automation systems, which will be used in the new generation systems being realized at the NERA-PR and HRFD spectrometers. When designing the software for the entire system, an object-oriented approach will be employed.

The software for the spectrometer measuring and control systems in service today were also improved.

The software of the SPN-1 and REFLEX spectrometers was complemented by new possibilities for the analysis of accumulated data. In particular, the software for processing intensity profiles in graphic mode and of spectra by formulas, for auto-saving, editing, and processing the parameters which characterize the essential spectrometric information, were enhanced. Furthermore, additional modes for data analysis were realized and the means for keeping a protocol of users' jobs were developed. For the UGRA spectrometer, the program for processing experimental data and calculating cross-sections, with the possibility of correcting for hydrogen, was written.

Work to create the software for the DIFRAN spectrometer was completed. The resulting program for controlling the spectrometer maintains the operation of two accumulation channels, provides remote control over the mechanical parts of the spectrometer via a special communication line (the computer is placed at a distance of about 500 m from the spectrometer) and utilizes automatic modes to accumulate spectra for different relative positions of the sample and the detector. The program also monitors the level of neutron beam intensity, and stops accumulating data if the intensity drops below the allowable limit. In this case, the user can continue measurements by using a special command.

The MAK program used at the DIN-2 and IZOMER spectrometers was significantly improved. Additional subroutines made it possible to install this program for conducting measurements at the NERA-PR and KDSOG spectrometers. The software for the NSVR spectrometer was also developed.

Development of the SUN-cluster and network infrastructure. Throughout the reported year, work on the development of the FLNP local computational network and SUN-cluster software was in progress.

In 1995, five new workstations (one SPARCstation 5 and four SPARCstation 20's), four X-terminals, and four black and white and two color network printers housed in the Laboratory's main buildings, were connected to the network. Work to optimize the local network was

conducted. One central segment, including the main servers and workstations with general access software, and two segments for SD CMP and SD NP oriented to serve those computers whose functions are to control experiments, data acquisition and processing from the spectrometers at the IBR-2 and IBR-30 reactors, were formed.

The software of the FLNP computers was modified and adapted to use the network printers and was complemented by additional functions which enable one to control the users' access to the mentioned devices (in particular, to the color printers) and the number of sheets printed by each of the users. It also allows the users to print via NFS from their PCs.

The SUN-workstation cluster was equipped with a FAX-server and three modems enabling access to computers via telephone lines. The JukeBox laser disk archive system with a total capacity of 40 Gbytes was also connected and the appropriate software was provided. The PV-Wave program package for analysis and graphical representation of data was installed on two powerful workstations. Programs for converting the data formats used at currently operating spectrometers into PV-Wave compatible formats were created. In addition, the Open GENIE program package for spectra processing and viewing developed at RAL was adapted for SUN computers. The Viewlogic and ALTERA program packages for computer-aided electronics design were purchased and installed.

In the reported year new versions of free software used intensively by the FLNP users were installed as well. In particular, these are the ELM, XRN, FWVM, Netscape, and EMACS program packages with the integrated Ispell spellcheck system.

In addition, new versions of ANSI C, C++, F77, GCC translators and the CERN LIB library (v.94b) were installed. In the near future, the XNTP time synchronization system will be loaded on the SUN-workstation cluster.

Seventeen papers were published and two dissertation theses were defended in 1995.