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PROGRESS REPORT

ON

THE PULSED PROTON BEAM TRANSPORT SYSTEM FOR IHEP-SERPUKHOV

by

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1. BEAM TRAJECTORY AND INSTALLATION LAYOUT

1.1 Alignment Co-ordinates

The detailed installation alignment co-ordinates for the magnets and monitoring detectors of the beam line have been worked out and presented to IHEP based on the following target co-ordinates :

$$X = 119.7588\text{'m}$$
$$Y = 46.9396\ \text{m}$$
$$\varphi = 0.233\ \text{rad}$$

which are final according to the decision and confirmation by the meetings October 1968 and February 1969 respectively.

Consequently the mechanical parts are being designed and constructed with dimensions matched to the present set of computed alignment co-ordinates.

1.2 Beam Optics

Further studies and computations have been made on the optics of the external beam for the defined restricted range of target positions including the position finally selected.

Estimates have been made of the effects of non-linearities in the magnetic field distribution of the pulsed lenses and deflectors. The effects of magnetic field fluctuations due to instabilities of the pulsed current supplies have also been evaluated. Satisfactory results are indicated provided the expected error limits are not exceeded.

Computations for alternative focus conditions are in progress in order to study the best way of accommodating a larger beam emittance than the $\pi \cdot 10^{-6}$ rad.m for which the system is being constructed according to the original specification. The increased value of $2\ \pi\ 10^{-6}$ rad.m measured at 70 GeV/c, 10^{12} protons/pulse, announced in the February 1969 meeting can of course not be accommodated without accepting other sacrifices.

1.3 Beam Line Installation

An outline design of the beam line installation supports has been worked out and sent to IHEP in April for approval especially concerning the dimensions of the space reserved for the remotely controlled magnet position adjustment mechanisms which IHEP may require to install at some stage. We have presently not decided to provide these devices.

The requirements and layout of the radiation shielding have been variously discussed in joint meetings. The importance of easy access to all parts of the external beam line has been stressed and admitted. Following the basic study presented by IHEP in February, more detailed installation drawings are now urgently required especially for the region upstream from the target to ensure that there is no interference between installation parts that might require modifications and programme delays.

Precise information is also urgently needed on the new layout in SS 28 including the modifications required for the other neighbouring beam channels.

2. PULSED MAGNETIC DEFLECTORS AND QUADRUPOLE LENSES

The construction of the 12 pulsed magnet units has been progressing but not as fast as originally hoped for. The firm with which we started the order for the model magnets in the middle of last year did not perform satisfactorily and did not produce the necessary result by the end of March and at this time we therefore switched to another company. The magnets are now being manufactured by Lintott Engineering Ltd., U.K. and we expect to start tests and magnetic measurements on the first magnet at CERN towards the end of the year. Further deliveries are planned for early 1970.

3. PULSED CURRENT SUPPLIES

3.1 D.C. Power Supplies

The first 100 kW d.c. power supply unit is practically ready assembled and tests with the final power assembly are now in progress

at the laboratory of the manufacturer Lintott, U.K., but further development work on the control electronics is required in order to achieve optimum precision and stability of the charging voltage. It is expected that the first complete power supply will arrive at CERN around the middle of the year. Various tests, measurements and possible modification will then be carried out at CERN before continuing the manufacturing of the further series of units later in the year. All power supplies are expected to be ready for testing at CERN by the middle of 1970.

3.2 Energy Storage Capacitors

The prototype H.V. energy storage capacitors are presently being manufactured by Ero-Starkstrom, Germany and are due for delivery to CERN in July. A reliability test will then be carried out before continuing manufacturing of the final series later in the year.

3.3 High-Current Discharge Switching Assemblies

The discharge switching assemblies were first ordered with Miles Hivolt, U.K., but due to an internal reorganisation of the company the order had to be transferred to the collaborating firm Southern Transformer Products, U.K. This has caused some delay and the first switching unit will not be ready for testing until late in the year. In the meantime one or two full scale model circuits are in preparation as temporary replacements for system tests.

3.4 Low-inductance H.V. Pulse Cables

Following an enquiry offers have been received for the low-inductance H.V. pulse cable according to our specification. The cable has not been ordered since the possibility of using an arrangement of parallel IHEP standard cables is being considered but we have not yet all elements required for the decision.

3.5 Control Electronics

Most of the control electronics was defined last year, part of it has been ordered and is being manufactured and certain standard items have already arrived at CERN.

4. BEAM MONITORING

The basic beam monitoring requirements have been reconsidered and we recommend a system essentially according to the original proposal.

For the practical realisation of the system only preliminary preparations have been made for certain selected parts. According to our original plans the visiting IHEP collaborator should make an active and major contribution to the work on the beam monitoring system for the external beam line since most of the items involved require close and continuous personal attention at all stages particularly during and after installation. In fact major adjustments or modifications are normally required after the components have been installed in the final environment and realistic testing can only be made during actual beam operation. These development tests with the beam will tend to be more lengthy (due to long waiting periods for beam time, access limitations in the radiation area etc.) than the period we plan to stay at IHEP. For practical reasons the bringing into operation of this equipment should therefore be carried out by the permanent laboratory specialists responsible for the later operation and maintenance preferably after having followed the development from the beginning. With the exception of certain preparations the execution of the monitoring system is therefore being suspended and delayed until the visiting collaborators join our group.

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