**Status and Quality Assurance System of the Project on the Construction of the DC-280 Cyclotron of the Factory of Superheavy Elements**

***I. Kalagin***

In May–June 2018 the autonomous launching and tuning works (LTWs) of the main systems of the DC-280 cyclotron are carried out as they are completed. At present we undertake autonomous LTWs of the injection, the accelerator, and the vacuum systems in interaction with the power supply, control, water cooling and compressed air systems. More detailed information will be presented in the oral report.

The DC-280 cyclotron was constructed in compliance with the Quality Assurance System under standard GOST RISO 9001–2000. The system focuses on the project structure management and sets up a process for choosing a project supervisor, operations support service supervisors, and theme leaders (Fig. 1). Moreover, types of official documents are identified (technical reports, technical assignments, drawings, etc.). The procedures for their preparation, processing, storage, and classification are determined (Fig. 2). Further stages involve the following (Fig. 3):

* The required calculations and mathematic modelling are done. The analysis of potential engineering proposals are analyzed. Prototypes are made. Cyclotron complex is equipped. Equipment spacing layout inside the building is done.
* Engineering specifications for manufacturing the required products and systems are developed. They comprise quality assurance and on-site product acceptance requirements.
* A test programme, test protocols, product and system passports are developed and defined. Quality assurance methods employed by a specific manufacturer are used and analyzed. Post-process quality check monitoring is conducted by the Department of Technical Monitoring (DTM). DTM certificates are processed, and current on-line process quality control activities are performed.
* Following the manufacture of products and systems, FLNR representatives do the acceptance inspection, issue acceptance protocols and certificates.
* The incoming inspection of products is done prior to their installation at FLNR. Protocols are issued. The testing of products and allied equipment in conditions that correspond to the real ones under which current facilities operate can be done, if necessary. Protocols are issued.
* Products and systems of the FLNR DC-280 cyclotron are installed.
* Autonomous LTW programmes for the mounted systems are developed. These include test programmes of the installed equipment.
* Autonomous LTWs are carried out without ion acceleration. Protocols and certificates are issued. A complex LTW programme for the DC-280 cyclotron with the acceleration of testing ions is developed.
* The processed documents (programmes of autonomous and complex LTWs, workplace safety instructions when undertaking LTWs, autonomous LTW protocols and certificates, etc.) are sent to the Federal Medical and Biological Agency of Russia (FMBA) along with the project documentation for obtaining permission to undertake complex LTWs.
* Based on document processing results, the FMBA issues an expert review on the DC-280 cyclotron and grants a permission for further complex LTWs.
* The FLNR staff carry out complex LTWs with the acceleration of testing ions and issue the DC-280 cyclotron complex operability protocols and certificates. The FMBA staff carry out dosimetry measurements and epidemiological studies (microclimate, illumination, noise and vibration levels, etc.) during complex LTWs in the rooms and halls of the cyclotron, issue protocols and certificates. The DC-280 cyclotron complex operability certificate is issued.
* The FMBA issues a sanitary and epidemiological conclusion certificate on the DC-280 cyclotron for work approval at the cyclotron.
* Act of commissioning of the DC-280 cyclotron complex is issued.

The FLNR plans for 2018: to conduct autonomous LTWs of systems in May–June; to obtain the FMBA expert conclusion certificate for the DC-280 cyclotron and the permission for complex LTWs in September; to carry out complex LTWs in September–November; to obtain the FMBA sanitary and epidemiological conclusion certificate for carrying out works at the DC-280 cyclotron; and the commissioning of the cyclotron at the end of 2018.

**Project Supervisor**

**Deputy Project Leader**

**Science and Technology Head**

**Head of Project Funding and Administration**

**Chief of Communications responsible for the relations with Chief Design Engineer of SHE Factory building**

**Head of Design and Engineering Works**

Calculations and mathematical modelling

Theme No. 1

Ion source

Theme No. 2

Axial injection system

Theme No. 3

Cyclotron magnet

Theme No. 4

Vacuum system

Theme No. 5

Accelerating system

Theme No. 6

RF feeding of accelerating system

Theme No. 7

Beam extraction system

Design of accelerator units and systems

Theme No. 8

Transport channels

of accelerated ion beams

Theme No. 9

Control and power supply system

Theme No. 10

Water cooling and pneumatic system

Theme No. 12

Experimental setups

Theme No. 11

Vacuum chamber, internal probes

Technical production support

Accelerator configuration Equipment spacing layout inside the facility under construction

Administrative and financial group

Group of material and technical supply

Organizational and technical group

**Radiation Safety Supervisor**

Fig. 1

**DC-280 documentation**

**Register**

**Financial documentation**

**Internal information (general):**

Acts and certificates

Instructions

Orders

Quality standards compliance instructions

Letters

Action plans

Layouts

Orders

Minutes of meeting

Technical protocols

Service records.

**Register**

Input data

Technical documentation on project themes

Explanatory notes

Technical assignment

Technical guidelines

Technical reports

Engineering specifications conditions

Theme No.1

Theme No.2

Theme No.3

Theme No.11

Theme No.12

**Register**

**PS**- Project Supervisor

**FH**- Head of Project Funding and Administration

**SH**- Science and Technology Head

**AH**- Head of works on assembly site preparation

**DH**- Head of Design and Engineering Works

**PS**

**FH**

**SH**

**AHH**

**DH**

Fig. 2. The structure of the DC-280 documentation catalogue

Calculations, mathematical modelling, analysis of potential engineering proposals, prototyping, configuration of cyclotron complex, and equipment spacing layout

Engineering specifications for the manufacture of products and systems, quality assurance and product acceptance requirements

Test programme, test protocols, product and system passports

On-site quality assurance: post-process quality check monitoring by the Department of Technical Monitoring (DTM); DTM certificates processing; and current on-line process quality control

Acceptance inspection of manufactured products and systems by FLNR representatives

Incoming inspection of products prior to their installation at FLNR

Testing of products and allied equipment in conditions that correspond to the real ones under which current facilities operate can be done, as necessary.

Installation of products and systems at FLNR

Autonomous LTW programmes for assembled systems, including test programmes of the installed equipment

Autonomous LTWs without ion acceleration. Complex LTW programme for the DC-280 accelerator

Project documentation sent to the Federal Medical and Biological Agency of Russia (FMBA)

FMBA expert conclusion certificate for the DC-280 cyclotron and permission for complex LTWs

Complex LTWs for the DC-280 cyclotron with the acceleration of testing ions. FMBA dosimetry measurements, sanitary and epidemiological studies

DC-280 cyclotron complex operability certificate

FMBA sanitary and epidemiological conclusion for the approval of works at the DC-280 cyclotron

**Act of commissioning of DC-280 cyclotron**

Fig. 3