



JOINT INSTITUTE FOR NUCLEAR RESEARCH
Veksler and Baldin laboratory of High Energy Physics

FINAL REPORT ON THE INTEREST PROGRAMME

EqDb Manual Preparation

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Abstract

The project aimed to create a user guide for inputting new items into the Equipment Database (EqDb) used in the Nuclotron-based Ion Collider Facility (NICA) project. NICA is a project by the Joint Institute for Nuclear Research (JINR) located in Dubna, Russia, and its new nuclotron-based particle accelerator will be used to study quark-gluon plasma. The EqDb is an Oracle relational database used in the the multi-purpose detector of NICA to store information on various equipment and parts. The guide was written in \LaTeX and its content based on the existing EqDb manual, a *New Component Registration* flowchart provided by the project supervisor and own research into Oracle databases as well as the EqDb.

1 Introduction

Equipment Database (EqDb) is a type of elastic online system, which assists the design, assembly, installation and operation of equipment used in the NICA project [1]. At the moment, the EqDb is used for the MPD (Multi-Purpose Detector) detector located at the JINR (Joint Institute for Nuclear Research) in Dubna. NICA (Nuclotron-based Ion Collider Facility) is a new particle accelerator currently being built at the Joint Institute for Nuclear Research (Dubna, Russia). After putting the NICA collider into operation JINR scientists will be able to study quark-gluon plasma, which is the state the universe was in shortly after the Big Bang [1].

The main task of the EqDb is to support logistics and the construction of devices necessary for the proper operation of the MPD detector. Roles of this tool in the NICA project are component registration as well as storage of document data and organizational structure [2]. In the EqDb, documents relevant to the project can be stored and organized alongside the prices, locations and amount of equipment. A potential use of the EqDb is also to create a calibration database for the detector. Furthermore, the database can keep track of every person and institution that has brought any contribution to the project.

The interface of the database has a clear and intuitive layout. It opens with a Home page presenting basic information about the EqDb, such as version or system messages. On the left-hand side there is a menu with multiple tabs that lead to the main pages of the Database. For some of them one can find subpages to access more specific places in the database. The main pages are Components, Documents and Organisational Structure. These three are shown in a tabular format, with rows for each element and detailed columns for every feature of the element. A big advantage of the EqDb is that it does not necessarily have to store additional data such as scans or images. Instead, it can hold links to storage clouds or websites where all these details can be looked up. However, scans and images can be stored if such a need arises.

The Components section is essential to this database, being the core around which the EqDb is developed. It collects details about each component used in construction, assembly, and operation of complex equipment [2]. One of the most important columns from the Components is the Part Id, which summarizes the key data about the element, such as the system it is part of and the collaboration group responsible for it. Each Component can be modified by clicking on the pencil icons on the left-hand side of its row.

The Documents section contains all invoices, purchase documents, technical documentation, technical drawings etc. The Organisational Structure tab shows all the people involved in the project, and their role, institution and location. Finally, the Metadata and Help sections provide support when one needs a concise definition and some examples about the most used terms in the database.

2 Project goals

The main goal of the project was to create a user guide for the registration of new objects into the Equipment Database. Such user's guide is essential in order to allow scientists and engineers working on the NICA project to easily work with the EqDb without having to understand the inner workings of the database. Furthermore, this project provided an in-depth understanding of the Equipment Database, how it works, the way it was created and how to optimize it. Not only did this grant insight into the amount of work that has been put into creating such a structure, but also emphasized all the organizational and administrative work that is required for such a big project like NICA.

Additionally, honing professional skills like managing a project, holding a presentation and formal communication was set as a secondary goal.

3 Scope of work

The EqDb manual preparation is a project meant to establish a user manual for the Equipment Database in the NICA project. To outline the process of using this manual and the EqDb for the registration

of new objects, a separate user guide was written. The process extended over a 4-week period of time, using Zoom as the platform for virtual meetings twice a week. Access to the essential materials was provided through a cloud drive and shared *Overleaf* projects.

4 Methods

To develop a basic understanding of equipment databases, the detector construction database in the ALICE project was viewed [3]. Next an initial familiarisation with the EqDb took place through adding personal information, like name, institution and location, as well as linking these to each other.

The written procedure on how to add a new object into the database was based on the provided flowchart. Using this chart and relevant information in the EqDb user manual, the different steps to this process were explored in the EqDb itself. This allowed for a detailed description of individual steps which were recorded in the procedure.

The whole project was realised using \LaTeX on *Overleaf*, as it simplifies professional formatting. Thus, at the beginning we had to get acquainted with this document preparation system, for which the online guide *Overleaf: Learn \LaTeX in 30 minutes* was used[4]. Afterwards, we learned by experience, researching the \LaTeX functionalities as the need for them arose.

Along with the work on the user guide, the supervisor provided us with a series of lectures on various topics. Towards the beginning these were related to equipment databases and the NICA project, but the later ones focused on professional skills. The presentation on formal communication concerned the proper structure and wording of emails, presentations and phone calls. Management of a changing project was another topic highlighting the effective agile method, including the scrum framework. During this lecture and the lecture on time management, various platforms (e.g. Google Drive, Trello, Prezi etc.) for organising notes, graphic design and data storage were introduced and compared. The effect of motivation and how to stay motivated and effective, was also considered in the presentation on time management.

5 Results

The principle result of this project is a user guide which thoroughly explains the steps needed for the registration of a new object in the EqDb. To ensure wide understanding, it has been written in plain but precise language. Moreover, it provides in-depth explanations of the various parts of the registration procedure, which includes the descriptions of where the different sections of the database can be found on the website so that a complete novice can navigate the Component section of the EqDb efficiently. To simplify access to different sections of the guide, the procedure flowchart has been put at the beginning. A user can follow the process based on the flowchart until a certain step needs clarification and then refer to the corresponding section of the document. This way a more experienced user would not have to read through the entire guide but only the applicable sections.

The entire guide can be viewed in appendix A.

6 Conclusions

The work on the EqDb and its manual is still an ongoing one. While the guide in its current form provides a complete and accurate set of instructions on the object registration, this could promptly change as the EqDb is being improved. Thus, the document will likely need periodic revisions to ensure it contains up-to-date information. Nonetheless, it forms a solid foundation for future versions.

7 Acknowledgments

The team would like to thank the Joint Institute of Nuclear Research for offering the "International Remote Student Training". This programme allowed the team to gain knowledge of the structure and use of the Equipment Database in the NICA Project.

References

- [1] Joint Institute for Nuclear Research. *Nuclotron-based Ion Collider Facility*. URL: <https://nica.jinr.ru/>. Last Accessed on December 5th 2020.
- [2] M. Peryt and T. Traczyk. “Equipment Database Data Model”. In: *Acta Physica Polonica B Proceedings Supplement* 11.4 (July 2018).
- [3] W.S. Peryt et al. “Detector Construction Database System for ALICE Experiment”. In: *Computing in High Energy and Nuclear Physics* (Mar. 2003).
- [4] Overleaf.com. *Learn LaTeX in 30 minutes*. URL: https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes. Last Accessed on November 30th 2020.
- [5] Agnieszka Domalewska and Stefana A. M. Faur. *Final Report on The INTEREST Programme - Wave 1*. 2020.

Appendix A

1 Flowchart of New Component Registration

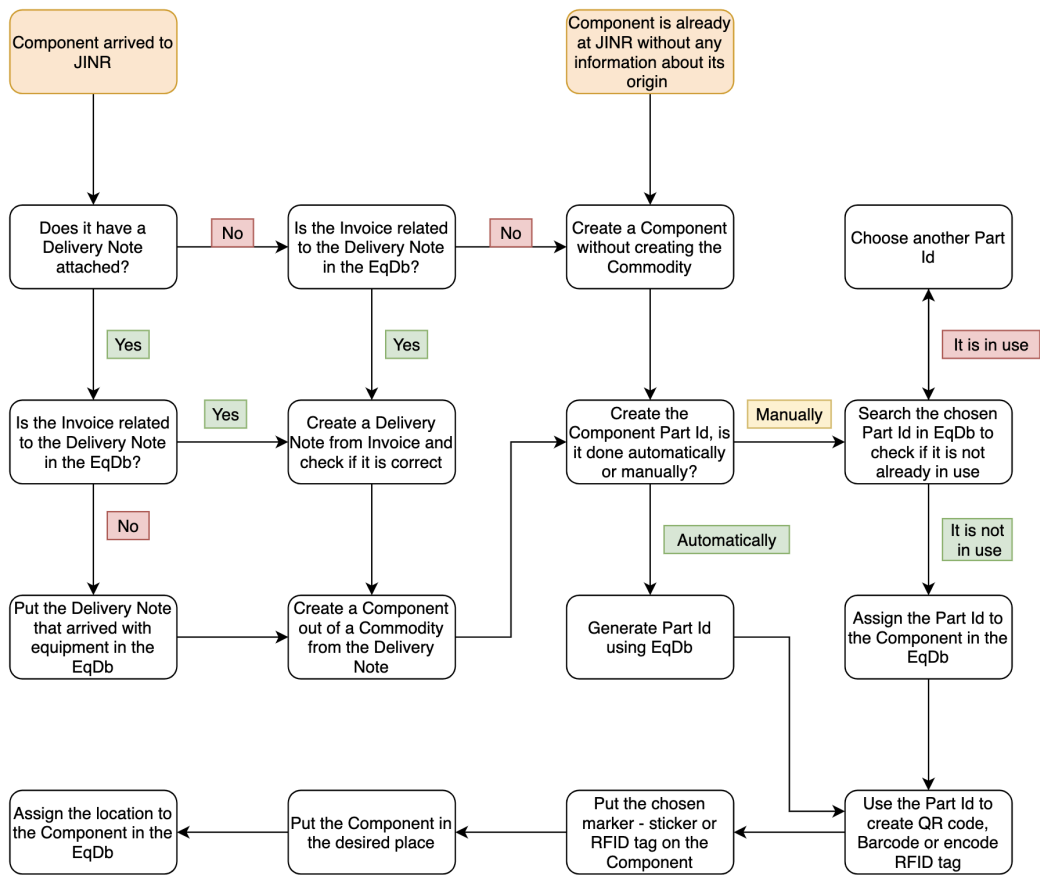


Figure 1: New Component registration procedure flowchart; from the EqDb User Manual

2 Introduction and Purpose

This document aims to provide a brief and understandable guide to using EqDb for registration of items (hereon referred to as *Components*) used at NICA (JINR). It follows closely the procedure outlined in the flowchart above (in roughly the same order) and can be seen as a supplement to it, to be used when a particular step needs more explanation. As such, the content of this guide is purely practical, not aiming to explain how the database operates or why it operates in a particular way. For that, one should search more technical sources on Oracle databases and published papers on EqDb.

Since this guide uses the EqDb user manual as a source material, we have put references to the specific sections of the manual whenever a more detailed explanation can be found there. The references take a form of: [X.Y *keywords*], where X and Y are numbers specifying the applicable section of the manual and the *keywords* come from the name of the section (this is in case the numbering of the sections in the manual has changed from when this guide was written).

3 New Component: Delivery Note

Note: If there is no *Invoice* nor *Delivery Note*, skip directly to the Component Registration.

When a new Component arrives, first make sure to locate its *Delivery Note*. If there is one, the next step is to check the EqDb for the corresponding *Invoice*. To find it, log into the database and select the Documents tab on the left-hand side of the page. You can then search for the *Invoice* of the Component using the information from the *Delivery note* (this could be done by inputting the name of the Component, its manufacturer, date of delivery etc.).

If such *Invoice* exists, you can input your *Delivery Note* into the database by selecting **create** on the purchase documents page, choosing *Delivery Note* from the drop-down list, adding a date and then once again pressing create. In the detailed form page that will be shown, select **Corresponding Invoice** and find the *Invoice* of the Component. Following that, input the rest of the necessary information in the header of the form and in the *Components* list below. Once done, press **save** in the bottom right corner. [4.2 *Purchase Documents*]

If the *Invoice* for the new Component is not in the EqDb, follow the same steps as in the paragraph above but do **not** connect any *Invoice* to the newly created *Delivery Note*.

If the *Delivery Note* was not attached to the new Component, look for its *Invoice* in the database (Documents page) and use it to create a *Delivery Note* as per the method described above.

4 Component Registration

4.1 New Component with a *Delivery Note*

From the toolbar on the left of the EqDb website go to Register Component. Next press **Create Component** button in the upper right. Input the necessary information into the box that appears and press **create**. You will then be shown a more detailed Component information section. In it, you will be able to connect the Component to the existing commodity (which in turn is itself connected to the *Delivery Note*) by using the **Related commodity** drop-down list. Afterwards, you will be able to create the Component's *Part ID*, as described in the next section. [3.4 *New Component*]

4.2 Component Already at JINR or New Component without a *Delivery Note*

As in the case described above, you have to first go to Register Component on the EqDb website. Then press **Create Component** and input the necessary details. Unlike in the previous subsection, you must not connect the Component to any commodity in the page that follows the creation of a Component. Once you make sure all information inputted is correct, you can create the *Part ID*

5 Creating a Component Part ID

Creating a Component *Part Identifier*(*Part Id*) can be done automatically using the the EqDb or can be done manually. In both cases the *Part Id* follows the same structure [3.4 Structure of Part Identifier in the EqDb User Guide].

Excerpt from the *EqDb User Guide*:

3.4 Structure of the Part Identifier

The Part Identifier is 16 – character alpha-numeric code composed of 7-character prefix-fields and 9-character sub-detector fields.

Table 1 contains an example of the Part Identifier and its position numbers which are described below.

NICA Part Identifier – Structure and Position Assignment																
	PREFIX – FIELDS							SUB-DETECTOR – FIELDS								
Part Id	M	T	O	F	W	U	T	9	1	2	3	4	5	6	7	8
Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Table 1: NICA Part Identifier – Structure and Position Assignment

PREFIX – FIELDS :

Position 1 – EC (Experiment's Code); e.g. "M" for MPD experiment.

Position 2-4 – SD (Sub-Detector) or SS (Sub-System) code; provide some information on the part origin and its sub-detector association.

Position 5-7 – GC (Group Code); carries information about producer of the part of the sub-detector or the sub-system.

SUB-DETECTOR – FIELDS :

Position 8 – M (Method Code); specifies if the element's Part Id was attributed "by hand" (symbolised by 9) or automatically by the EqDb (symbolised by 0).

Position 9-16 – SN (Serial Number); contains only digits from 0-9 in every position; can be assigned automatically by the EqDb or if necessary, by the Manufacturer or supplier for external use, for example by a subcontractor. The general rule is that the use of serial numbers should be sufficiently documented by each manufacturer, by keeping a number journal for the part relationship and through EqDb.

Note: What is referred to as *Serial Number* in Position 9-16 above, is not the same as the serial number given to the *Component* by the manufacturer. The serial number given by the manufacturer can be input into the EqDb however, the *Serial Number* in Position 9-16 of the *Part Id* is the *Object Id* given in the EqDb.

5.1 Automatic generation of Part Id

Once a *Component* is created you can find it in the drop-down menu on the left-hand side of the EqDb under **Components**. The quickest way to find the created *Component* is to click on the field **Component Name** or **Object Id** to search for the specific *Component*. Another good identifying method is looking at the **When Changed** section. Once you have identified which *Component* you created, click on the yellow pencil icon in the left column. Next click on the **Create Part Id** button, which is located towards the bottom right of the page. Select the correct **Experiment Code**, **Subsystem** and **Group** from the drop-down menus, and click the **Apply Changes** button towards the bottom right. These will generate the *Part Id* with your specifications in the PREFIX – FIELDS. Position 8 (first field in the SUB-DETECTOR – FIELDS) will automatically display a "0" as the *Part Id* was generated using the EqDb and Positions 9-16 will display the *Object Id*, which was given to the *Component* by the EqDb when it was added to the system.

5.2 Manual generation of Part Id

To create the *Part Id* manually follow the position set up as specified above in the excerpt from the EqDb User Guide. To find the correct abbreviations for the PREFIX – FIELDS have a look at *Naming and Numbering Convention for the NICA Projects*[1]. Remember to put a number "9" into position 8 to specify that the *Part Id* was created manually.

Once you have created the *Part Id* manually, go to the EqDb and select **Components** in the drop-down menu on the left-hand side. Type in your manually generated *Part Id* into the search field and click **Go**. If there are no search results, this is a valid *Part Id* for your *Component*. If there is a search result for this *Part Id* then change at least one number in the Positions 9-16 and check again if a different *Component* already has this *Part Id* assigned to it. Repeat this step until you have a unique *Part Id*.

To assign this manually created *Part Id* to your *Component* go to the EqDb and find your *Component* in the drop-down menu on the left-hand side of the EqDb under **Components**. Click on the blue pencil icon in the **Object** column next to the desired *Component*. Type the manually created *Part Id* into the **Primary Code** field (which can be found towards the top left) and click **Save**.

6 Creating a Physical Identifier

A software called *Dymo Connect* will be used for creation of most physical tags. You can download its app on most Android and Apple phones. However, you will need to connect to a tag printer to be able to use the app and create new physical IDs. [3.5 *Bar and QR code stickers*]

6.1 Bar Codes

In the app, select **Add** → **Bar Code**. For bar coding in Properties choose *Code 128 Auto*. For bar code data input the *Part ID*, as was previously determined. Finally, choose *extra small* in the Layout section.

6.2 QR Codes

In the app, select **Add** → **QR Code**. Following that, choose *text* as the Format and use text field to input the *Part ID*. The Layout should be set to *Auto*.

6.3 RFID Tags

As of writing of this guide, there is no standardised way of creating an RFID Tag for EqDb *Components*. You can use any method preferred as long as the Tag properly encodes the *Part ID*.

6.4 Marking the Physical Component

Having generated a Physical Identifier, you have to print a label sticker. The label must contain at least one type of an identifier, but as long as it is big enough, you can put more than one identifier on it. In either case, the label should be large enough to be able to scan it from 1 meter away and the identifiers should cover most of it (although you could also put information like date on it).

When placing the sticker on the Component ensure it easily findable. At the same time, it should not be placed somewhere where it could fall off, wear off quickly or cover important spots of the Component.

Once the Component is properly identified, you can put it in its designated location. Afterwards, you must update its *Located* property in the EqDb to reflect its current position. To do this find the *Component* in the drop-down menu on the left-hand side of the EqDb under **Components**. Click on the blue pencil icon in the **Object** column. Under the **Groups**

and classes section go to the **Object Class** table and click on **Add Row**. In the new row select click on the **Object Class** field and select **LOCATED - Objects located at some location** from the drop-down menu. Then click **Save** above the table. Exit the window and find your *Component* again in the list of **Components**. Now click on the blue pencil icon in the **Features** column. In the **Object properties and associations** panel click on **Add association** and select **LOCATED - Objects located at some location** from the **Object class** drop-down menu. In the **Feature** field select the location from the drop-down menu and click **Create**. In the next field that opens you can specify the location in the **Additional details on location** field if you wish to do so, and then click **Save**.

The **Additional details on location**, it can always be accessed and changed through drop-down menu on the left-hand side of the EqDb under **Components** → blue pencil icon in the **Features** column of the desired *Component* → yellow pencil icon next to **LOCATED_AT** in the **Object properties and associations** table.

To change the location of the *Component* go to drop-down menu on the left-hand side of the EqDb under **Components** → blue pencil icon in the **Features** column of the desired *Component* → yellow pencil icon next to **LOCATED_AT** in the **Object properties and associations** table → **Delete** button on the bottom right and then create new location as described above.

7 Understanding Terminology: Simple Example

Explanations of terminology can be found under the *Help* section on the left hand side in the EqDb.

For visualisation here is a simple example of the Component procedure and its necessity:

Imagine you ordered 10 chairs. These 10 chairs will then be one *Commodity* in an *Invoice*, as these virtually exist (as they were ordered), but are not physically present. Once these chairs arrive at the desired location 10 *Components* will be created from the information given in the *Invoice*, as what we ordered has not changed, but they are now physically present. At the same time, the *Components' Delivery Note* will replace the *Invoice* as the primary documentation. If the 10 chairs were already physically present, it

is not necessary to create a virtual *Commodity*, and *Components* can directly be created.

Furthermore, while the 10 chairs are considered to be separate *Components*, an uncountable commodity (e.g. paint) would be considered a bulk *Component*. Such a *Component* would not receive a *Part ID* but its container (e.g. a bucket) would have one assigned.

The *Components* are then made identifiable with a *Part Id* each. This helps to track each *Component* (each chair). With a *Part Id* a *QR Code*, *Bar Code* or *Encode RFID Tag* can be created to attach to the object (e.g. chair). This way all 10 chairs stay distinguishable and are connected to the information in the EqDb. Once the *Components* (the 10 chairs) have been placed in the desired locations, the *Location* of each chair should be *Assigned* in the EqDb, so everyone who has access to the EqDb can track the current location of each chair.

References

- [1] V. Golovatyuk et al. *Naming and Numbering Convention for the NICA Projects*. Nuclotron-based Ion Collider Facility.