Hydraulic Investigator 3

User Manual ver. 2.0

About us

SPX FLOW designs, manufactures, and markets Johnson Pump brand pumps.

The tradition in the pump industry goes back to the 19th century and combines technological know-how with long lasting quality pumps. Johnson Pump is one of a few pump producers in the Netherlands for centrifugal pumps. We have our own Research & Development department and a test bed to perform all relevant tests required. The design standards for our centrifugal pumps are EN (DIN), ISO and API.

Serving a multitude of industrial engineering sectors, as well as the global horticulture, shipbuilding, water treatment and automotive markets, Johnson Pump has always put customer needs first. Supplying an expansive portfolio of pumps (based on positive displacement and centrifugal mechanisms), plus all the necessary accessories. Through close interaction with the global customer base, Johnson Pump can provide focused solutions that exactly match specific application requirements. This is facilitated by our modular approach to design - which allows greater interchangeability between component parts, thereby simplifying logistical aspects (thanks to the ordering and storing of fewer part numbers) and allowing a wider array of different pump variants to be covered using a smaller inventory. The Johnson Pump portfolio covers internal gear pumps, impeller pumps and circulation pumps. All these items deliver strong performance and continued reliability.

Besides the Netherlands we are represented in several European countries and the USA by SPX FLOW sales offices, as well as through distributors and agents world-wide. Production facilities are in the Netherlands, Belgium, Poland, the U.S.A., and India.

For more information about Johnson Pump products please visit https://www.spxflow.com/johnson-pump/.

Contents

About this manual 4
Structure of this manual 4
Recommended display settings to use HI-3 application 4
Guidelines to use this manual 4
Chapter 1 - Introduction to HI-3 5
1.1. Introduction 5
1.1.1. Centrifugal pumps 5
1.1.2. HI-3 5
1.2. List of Abbreviations 5
Chapter 2 - Using the HI-3 6
2.1. Application URL and Login Screen 6
2.2. Main Screen 10
2.3. Q-H Selection Tab 12
2.4. Procedure to select a Pump 13
2.4.1. Selection Criteria 13
2.4.2. Impeller diameter 15
2.4.3. Adjustment of absorbed power 16
2.4.4. Pre-selection options 16
2.4.5. Activating and proceeding with the selection 16
2.5. Interpretation of the selection results 18
2.6. Pump Selection Tab 18
2.7. Graph Tab 20
2.7.1. Graph section 20
2.7.2. Data section 21
2.7.3. Temporary Data Storage & Allocations 25

About this manual

This manual is a user guide to the Hydraulic Investigator 3 (HI-3). It contains a concise description of the software.

Structure of this manual

The structure of the HI-3 - user manual is described below:

Chapter 1 – Introduction to the HI-3, contains a brief introduction of the software.

Chapter 2– Using the HI-3, gives step-by-step instructions for operating the software.

Recommended display settings to use HI-3 application

Resolution - Full HD (1920x1080)
Scale - 100%
Note *- Change in recommended settings cause the UI looks odd. To make use of better experience use the recommended settings.*

Guidelines to use this manual

The conventions used in this manual are given below:

Bold	Bold Text denotes User Roles, the names of Buttons, Tabs or Screens.
Paths	Paths in this manual are denoted using backslashes (\) to separate drive names, directories and files, as in `C:\dir1name\dir2name\filename`

Chapter 1 - Introduction to HI-3

1.1. Introduction

1.1.1. Centrifugal pumps

Centrifugal Pumps are the most common and well-established pumps on the market. They come in many different models and can transfer fluids with high efficiency over a wide range of flows and pressures. We offer several series of centrifugal pumps, many of which comply with ISO, DIN, and API standards**.**

1.1.2. HI-3

HI-3 is the web-based pump selection software for centrifugal pumps. It indicates the hydraulic performance per pump type with different impeller diameters and standard speeds. The power absorbed, the required NPSH and the efficiency can directly be read. The pump type and the impeller diameter are based on the duty point capacity and head specified by the user. The pump performance curve established is within the tolerances according to EN ISO 9906 Grade 3B.

1.2. List of Abbreviations

The following abbreviations have been used in the software and in this document:

- **API – American Petroleum Institute**
- **BEP – Best Efficiency Point**
- **CS – CombiSump**
- **DIN - Deutsches Institut für Normung**
- **Eff – Efficiency**
- **EN – European Norm**
- **H – Total developed Head**
- **HI-3 – Hydraulic Investigator 3**
- **ISO – International Organization for Standardization**
- **MEI – Minimum Efficiency Index**
- **NPSH – Net Positive Suction Head**
- **NPSH req. – Net Positive Suction Head required**
- **P – Power absorbed**
- **Q – Capacity**
- **TSM – Technical Sales Manual**

Chapter 2 - Using the HI-3

2.1. Application URL and Login Screen

Url: https://hiapp.spxflow.com. Use this URL to launch the application. Which will take you to the screen below.

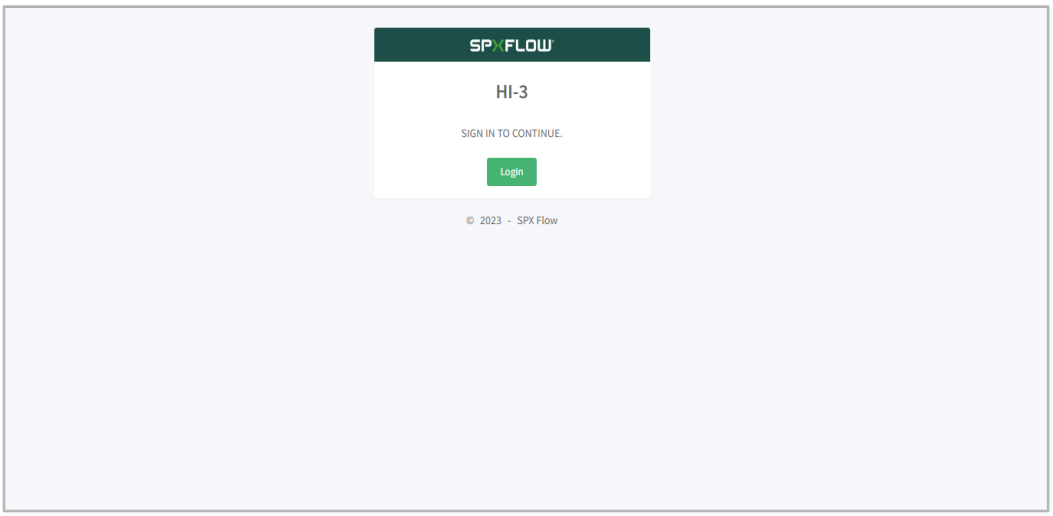


Figure 2.1: Entry Screen

Hitting the login button gets you to the SPX FLOW login page as shown below, where the user is supposed to enter their login ID and password. The SPX FLOW Employees can hit the SPX FLOW button to login using their SPX FLOW account as below.

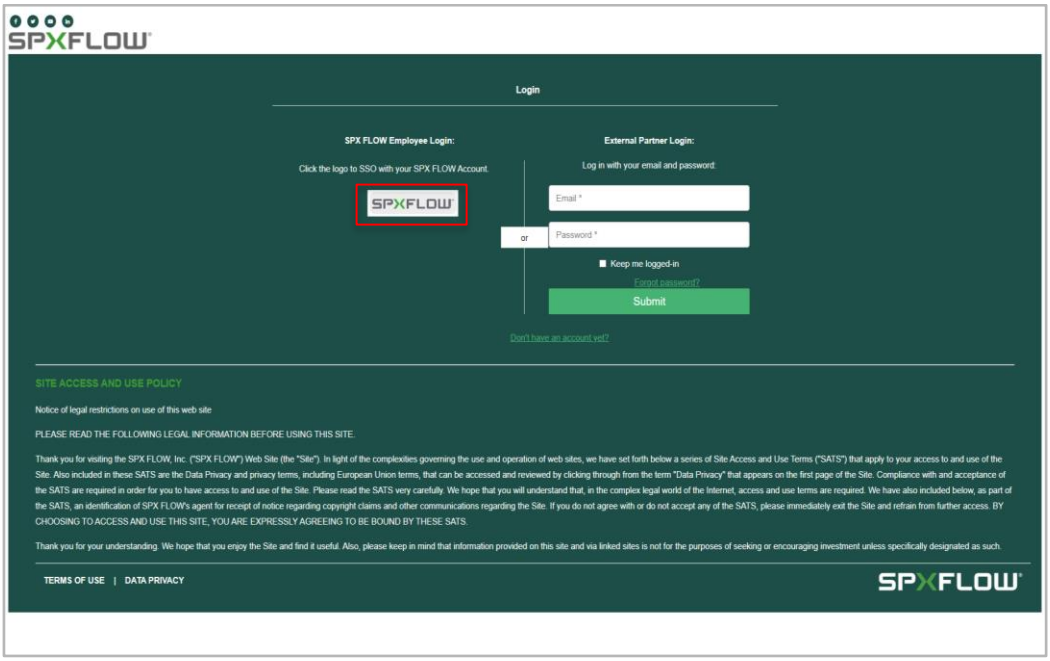


Figure 2.2: Login Screen

If the user has no Login ID/SPX FLOW account, then he needs to create a new Login ID and password by clicking "Don't have an account yet?"

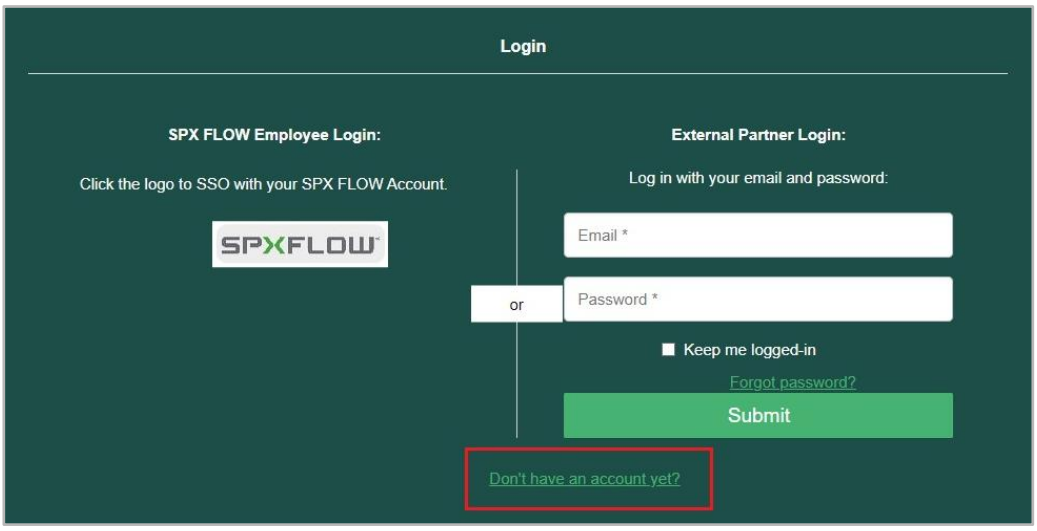


Figure 2.3: Create new Login ID

When the button above is hit, the screen below loads and asks the user to complete the External account registration form with all the mandatory fields. Please make sure that you have selected "**Hydraulic Investigator 3 and CAPS 2**" under Application Access category. Please review and accept the terms of use. After submitting the form, a second screen with the message "Account registration complete" appears for confirmation.

Figure 2.4: Creating login ID and password

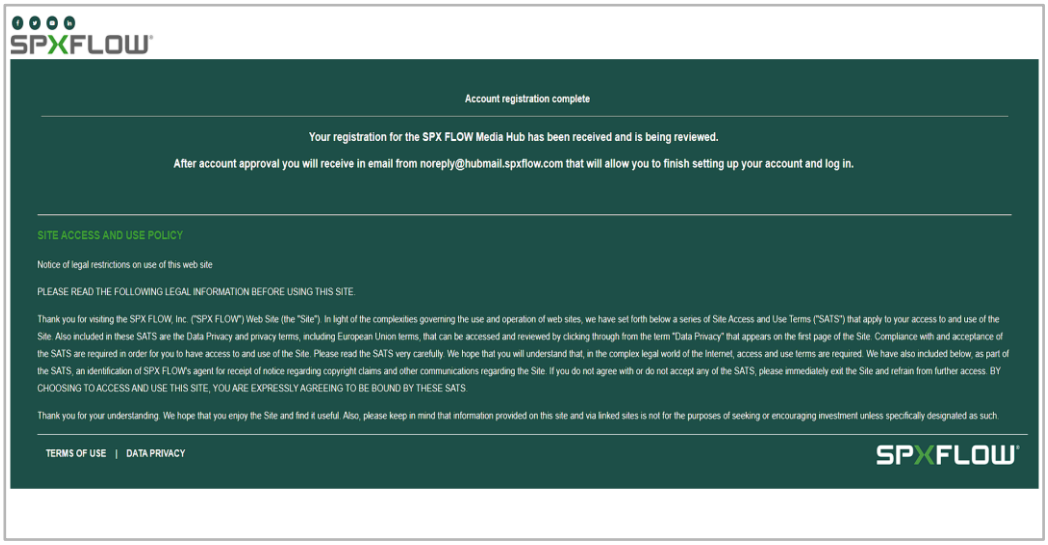


Figure 2.5: Confirmation Screen

Reloading the screen takes you to the entry screen. When you click the login button after creating a Login ID, you are immediately logged in and taken to the main screen.

In the unlikely event that the user forgets their password, they can reset it to a different one by clicking the "forgot password?", as seen below.

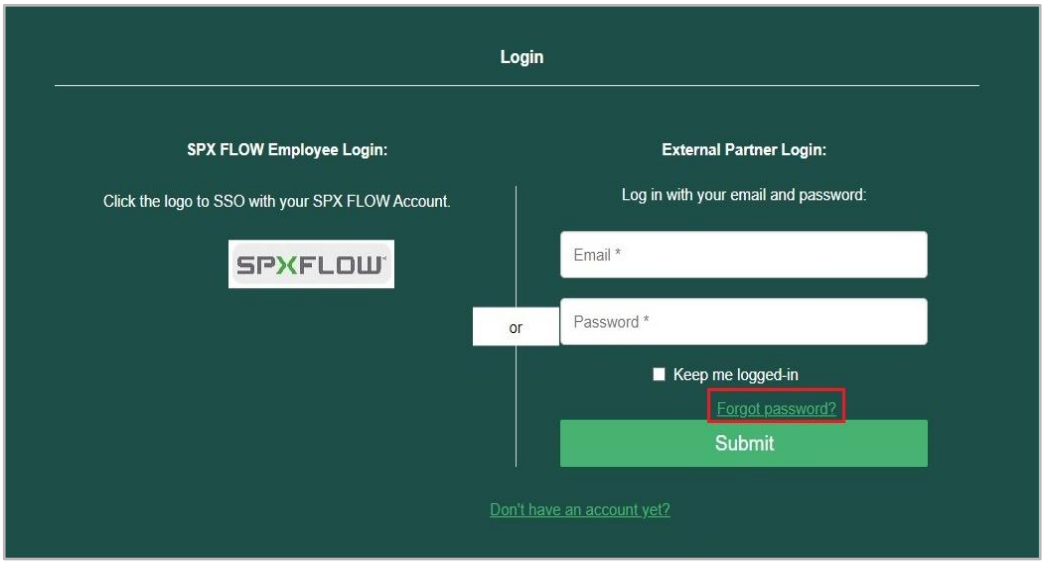


Figure 2.6: Forgot Password

On clicking "forgot password?", the user is directed to a page requesting the email address they used to create their Login ID. This is shown in the illustration below.

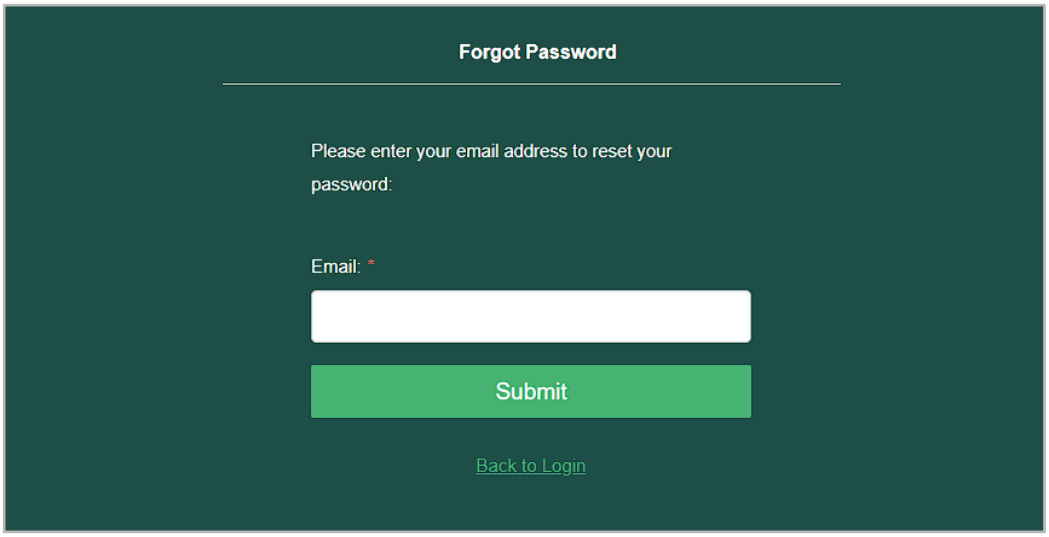


Figure 2.7: Provide email

An email regarding the password change is sent when the submit button is pressed.

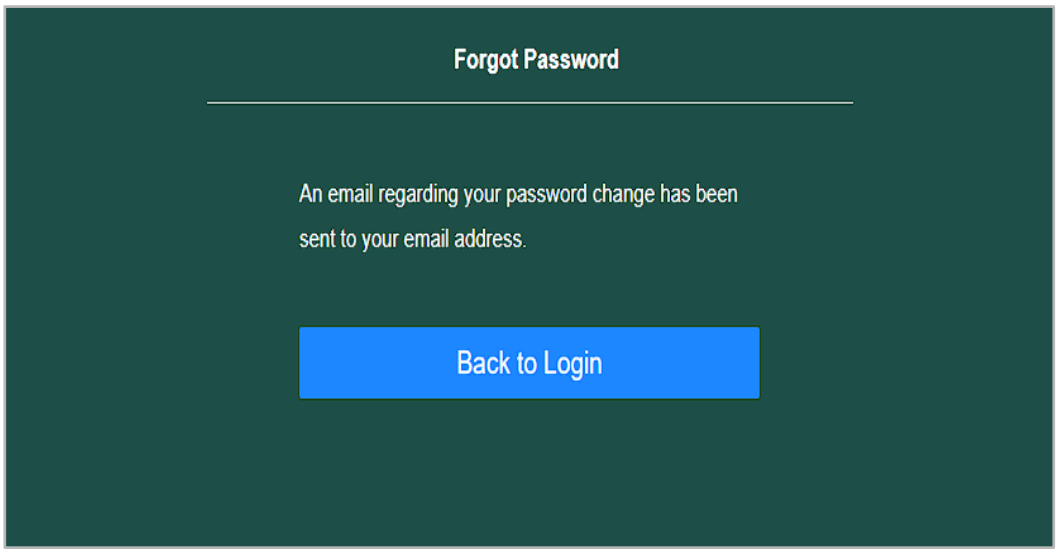


Figure 2.8: Back to login page

You can access the login page by selecting "Back to Login" after updating your password. The user can now log in and utilise the application there.

Note: The user's login will be valid for 8 hours from the time of Login, Once the timeout occurs and the user seems active, the refresh token with a validity of 7 days will be generated automatically, and the session will be maintained. After this timeout the user will be taken to Login Screen.

2.2. Main Screen

Once the Login is valid the Main screen will open with the Q-H selection tab as default. The Options available in Main Screen are explained below.

- **Q-H Selection** - Q-H Selection tab is used to select pumps from the database by entering a Q-H value (and supplementary criteria) the whole database is automatically searched for suitable pumps. Pumps that fall under the selections made will be filtered and listed.
- **Pump Selection** - Pump Selection tab, can be used to choose pump type directly by selecting the desired Pump Family and Pump SubType. Based on the selected Family and Pump type, the pump graphs with the pump data can be viewed in the graph screen.
- **Fullscreen** - To toggle between Fullscreen mode and normal mode.
- **Units selection –** Use radio button to select the required set of units (US or Metric).
- **Logout** - To logout from the HI-3 application.
- **User profile** - To view the user details, changes in the user's "application and geolocation" details lead to different pump results. The application options available are Industrial and Horticulture. The Geolocation options are EMEA, APAC and AMERICAS.
- **Help –** The Help screen provides access to the User Manual, Release Notes, FAQs, and details about the Software and Database Versions. For any feedback or queries, users can reach out to us via email at ***hi3support@spxflow.com*.**

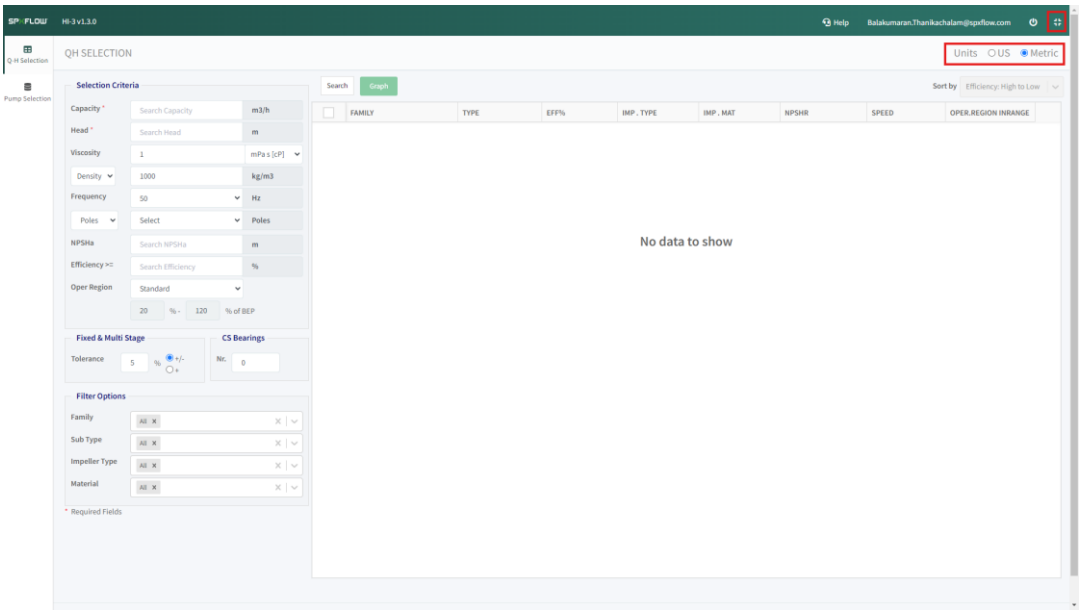


Figure 2.9: Main Screen- Fullscreen Toggle Button and Units selection

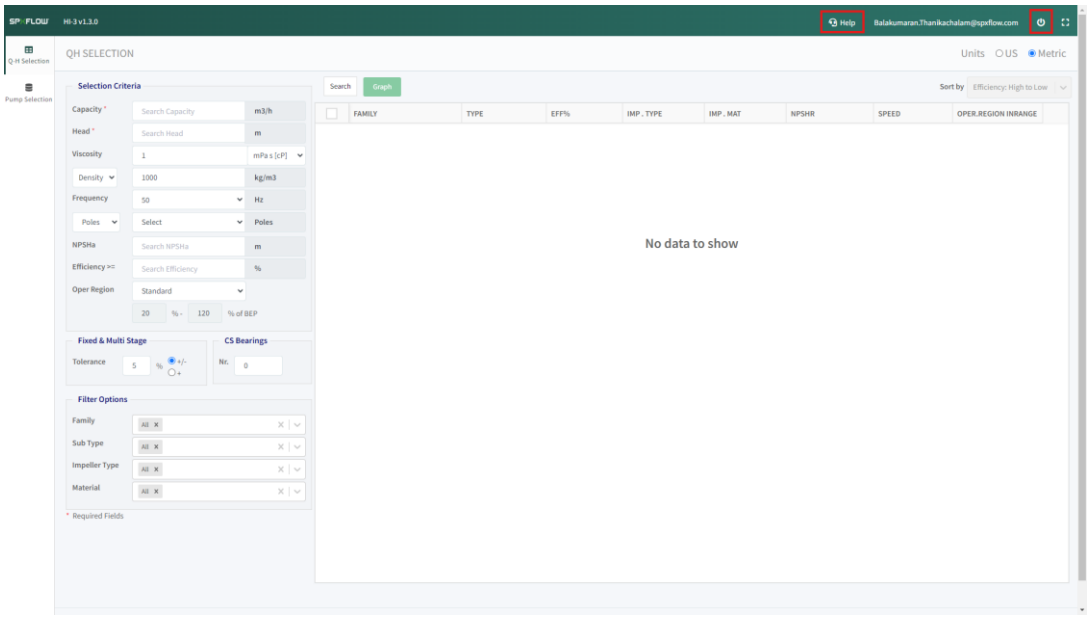


Figure 2.10: Main Screen- Logout and Help

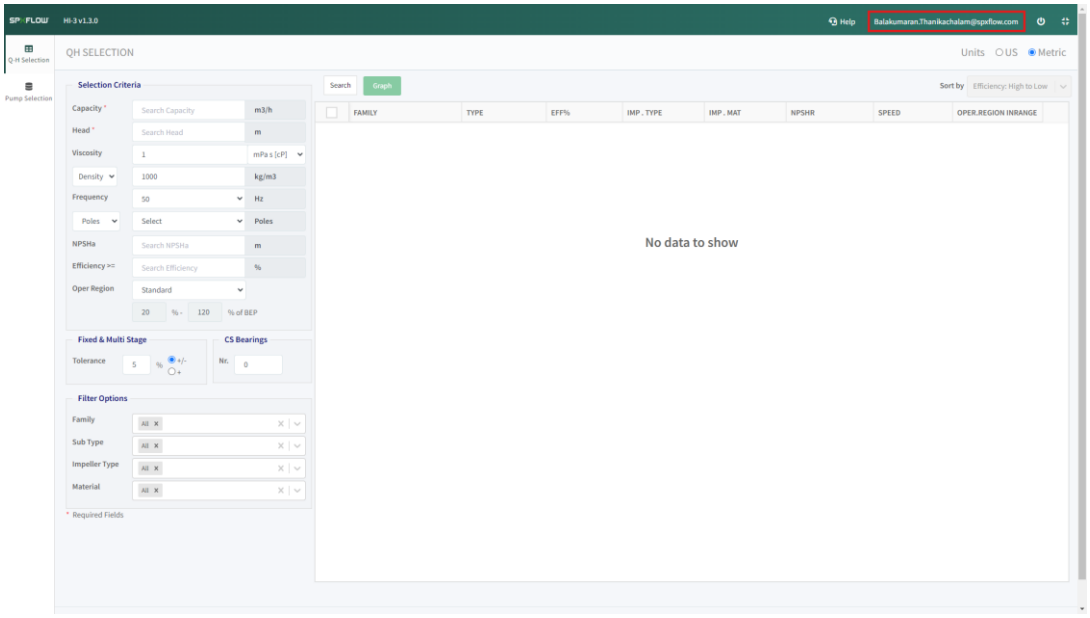


Figure 2.11: User Profile

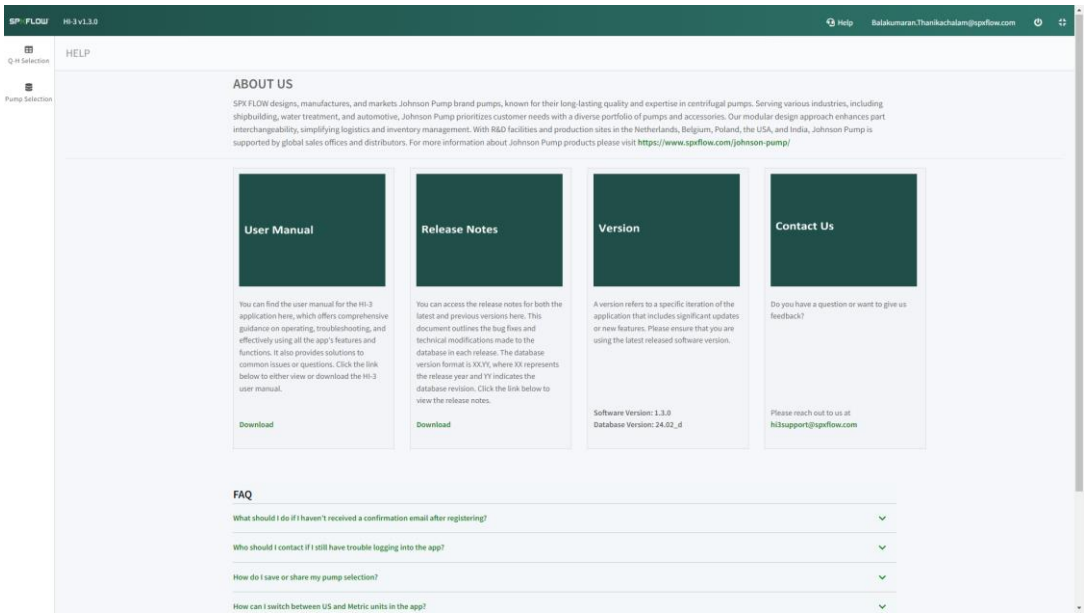


Figure 2.12: Help screen

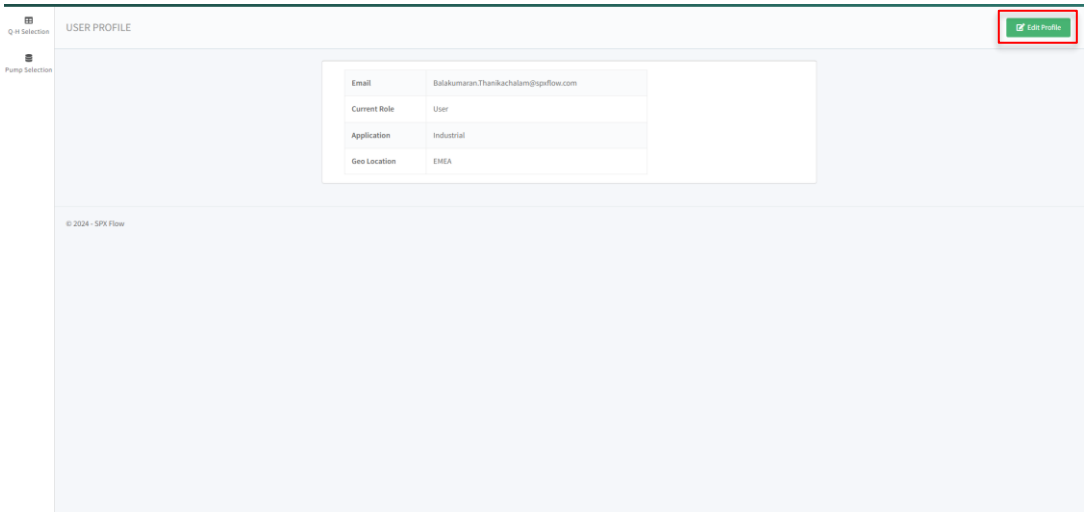


Figure 2.13: User profile details

Using the Edit Profile button, one can edit their application and geolocation options. The application options are Industrial and Horticulture. Geo location options available for the user to select are EMEA, AMERICAS and APAC (Asia Pacific). Please be noted that based on the selected location and application, pump family and pump types availability may vary. For example, Horticulture application will only have pump families that are sold under that category.

2.3. Q-H Selection Tab

The Q-H selection tab used to choose pumps from the database by selecting and sorting manually with the required Q-H value and some other criteria.

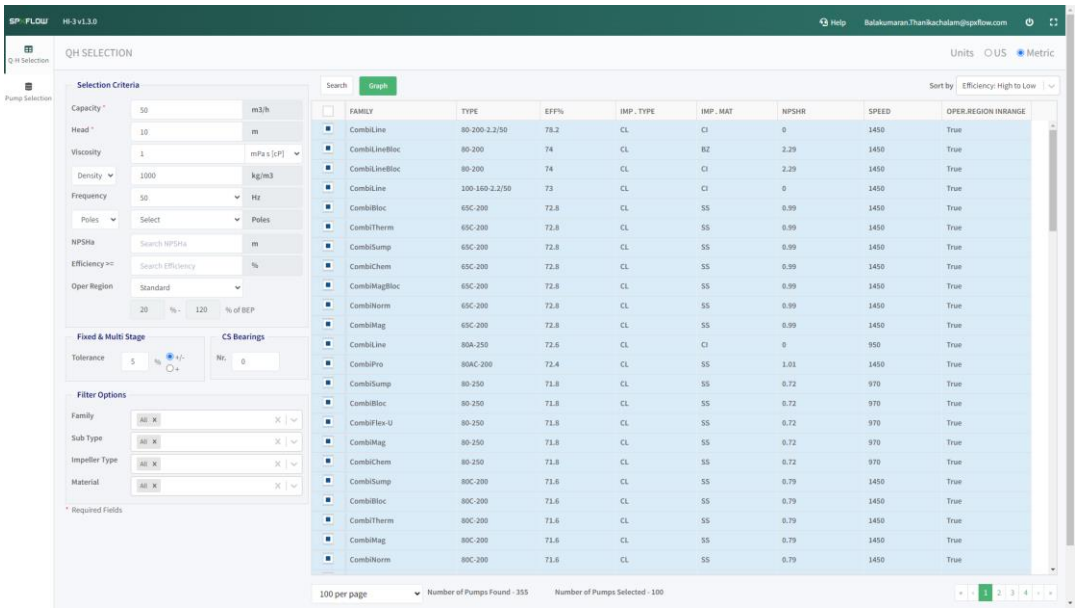


Figure 2.14: Q-H Selection Tab

Based on the selection made in the **Q-H Selection Tab**, the Pump records will be filtered.

2.4. Procedure to select a Pump

2.4.1. Selection Criteria

- There are choices for unit selection. If Metric is chosen, then all capacities are entered in m^3/h and head in metres. If 'US' is chosen, the capacity must be entered in USGPM and head in feet.

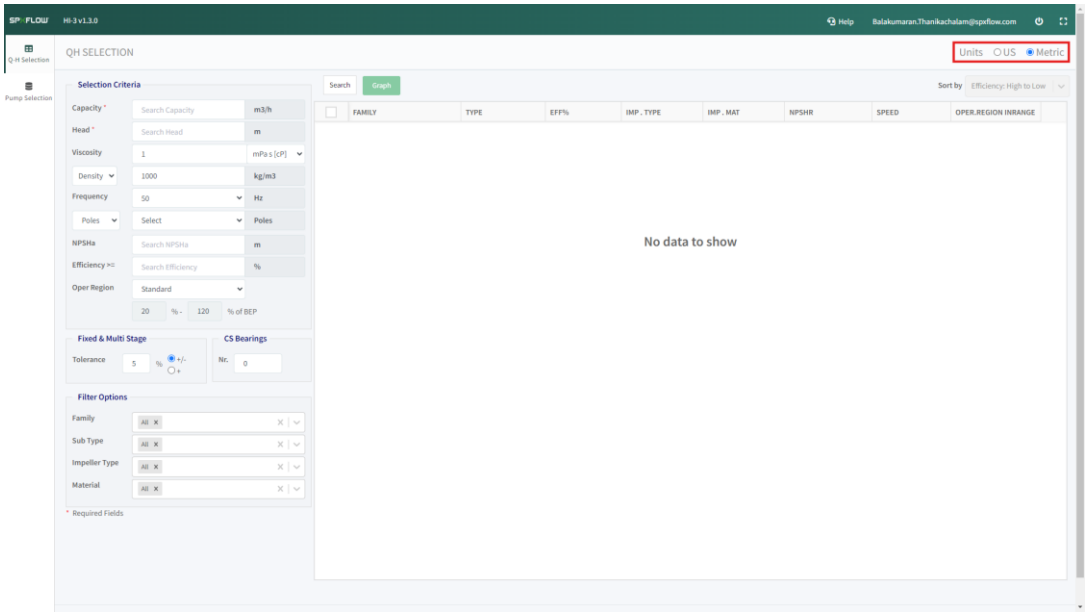


Figure 2.15: Q-H Selection Tab: Unit Selection

- The minimum information required is the **Q-value (Capacity) and H-value (Head),** which are specified with an asterisk (*). If these are not entered, a warning message appears.

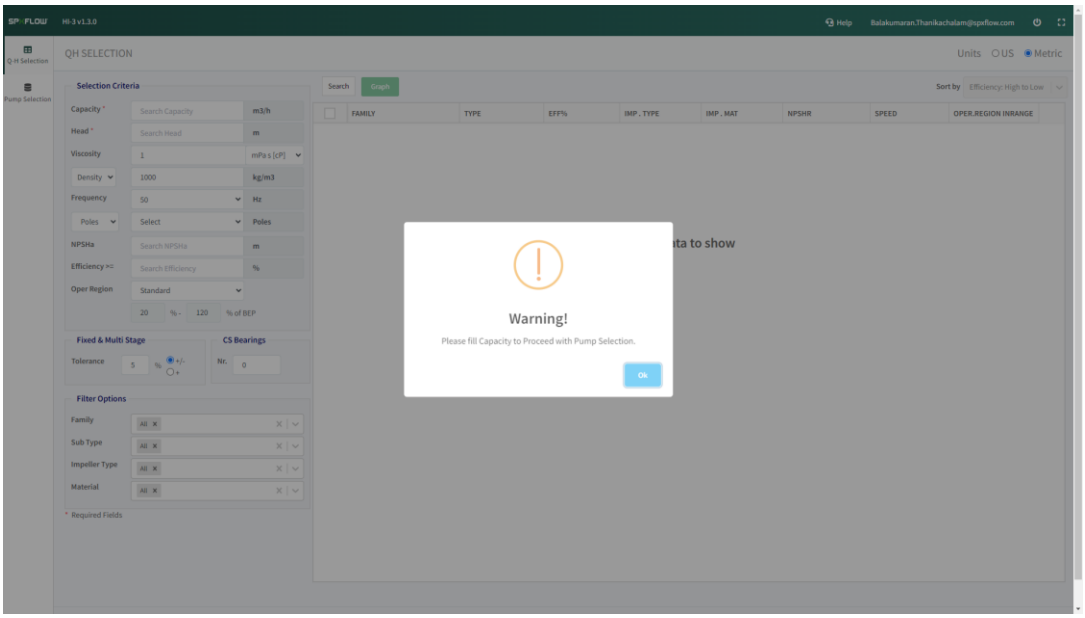


Figure 2.16: Q-H Selection Tab: Missing Required Fields

- Information about the medium to be pumped can be filled under **Viscosity** and **Spec. gravity**/**Density**. The viscosity can be entered in mm^2/sec (=cSt) or in mPa s (=cP). The density affects viscosity and power. Default value is 1000 kg/m^3. It must be a positive value.

- Under the **Frequency** section, you can enter the net frequency as either 50Hz or 60Hz. When selected, the corresponding correct speeds are applied automatically. In the **Poles**/**Speed** field, you can choose the number of poles in the motor or manually enter a specific speed if needed.

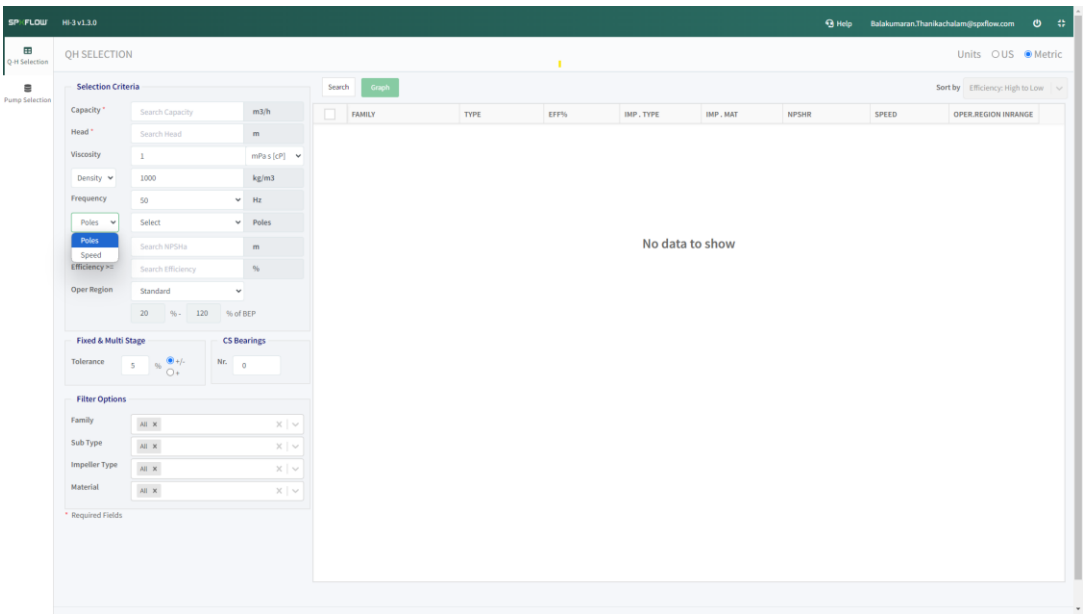


Figure 2.17: Q-H Selection Tab: Poles/Speed option

- If the available **NPSHa** is known, this value can also be included in the selection. Here, a safety margin of 0.5 meters must be kept (for trimmed impellers or at the end of the curve: 1m).
- Under **Efficiency**, the required minimum efficiency can be entered if known. This concerns the pump efficiency associated with the graph.
- In the **Oper Region** section, you can choose from Standard, API 610, and User options. The Standard operating region ranges from 20% to 120% of the Best Efficiency Point (BEP). Pumps that fall outside this region will be highlighted in **red**, and a separate column labeled "**OPER. REGION INRANGE**" will indicate **False**. You can also switch to the API 610 region, which corresponds to 80% to 110% of BEP, or define a custom User region.

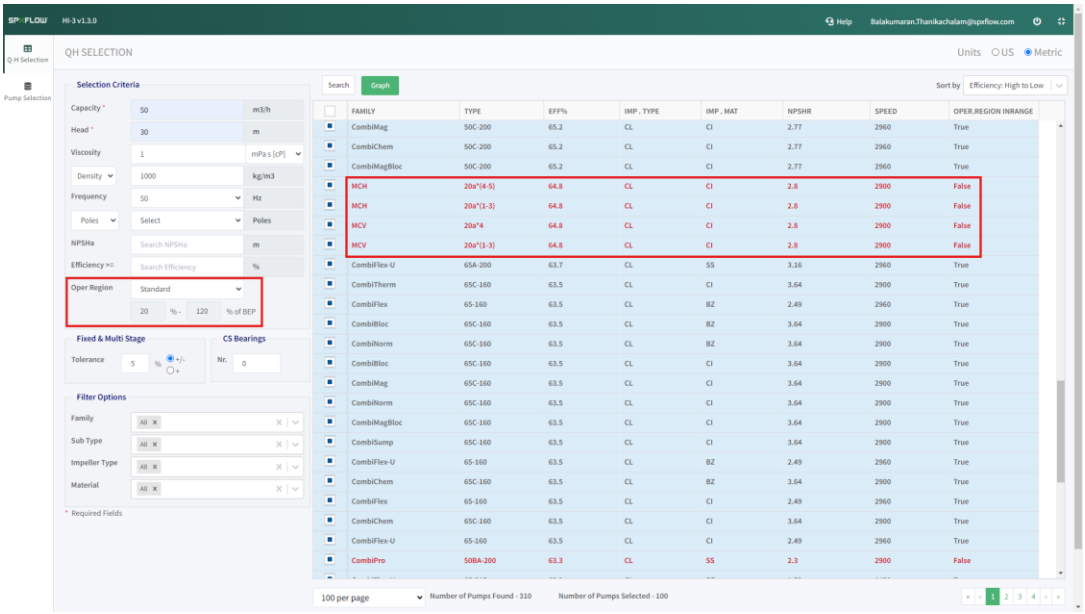


Figure 2.18: Q-H Selection Tab: Operating Region option

2.4.2. Impeller diameter

For pumps having variable impeller diameter, the impeller diameter is calculated in such a way that the curve goes straight through the entered duty point. Pumps with fixed impeller diameter always have a curve with a deviation from the entered duty point.

With multistage pumps the maximum speed depends on the number of stages. To prevent selection of pumps beyond maximum speed, the multistage pumps have been divided into several sub-groups, like in the TSM on page "operational range".

Curves of pumps with fixed impeller diameter mostly never go straight through the duty pint. The maximum permitted deviation is entered under **Max. tolerance**. This is set at +/- 5% by default. It is also possible to set +5%.

2.4.3. Adjustment of absorbed power

CombiSump pumps have an increased absorbed power consumption because of the use of intermediate bearings. The number of bearings can be entered in the field **CS Bearings**. The power will be adjusted according to the number of bearings.

Also, the self-priming part of the CombiPrime H and CombiPrime V and MCHZ pumps cause an increase of absorbed power. This will be calculated automatically.

2.4.4. Pre-selection options

- A pre-selection of pump family, impeller type and impeller material type can be made to get precise results. This can be done under Filter options with the help of down arrows available in Family, Sub type, Impeller type and Material.

Figure 2.19: Q-H Selection Tab: Filter Options

2.4.5. Activating and proceeding with the selection

- After all the desired selection criteria and other additional have been made, then the pump selection is activated using the **Search** button in the Q-H selection screen.

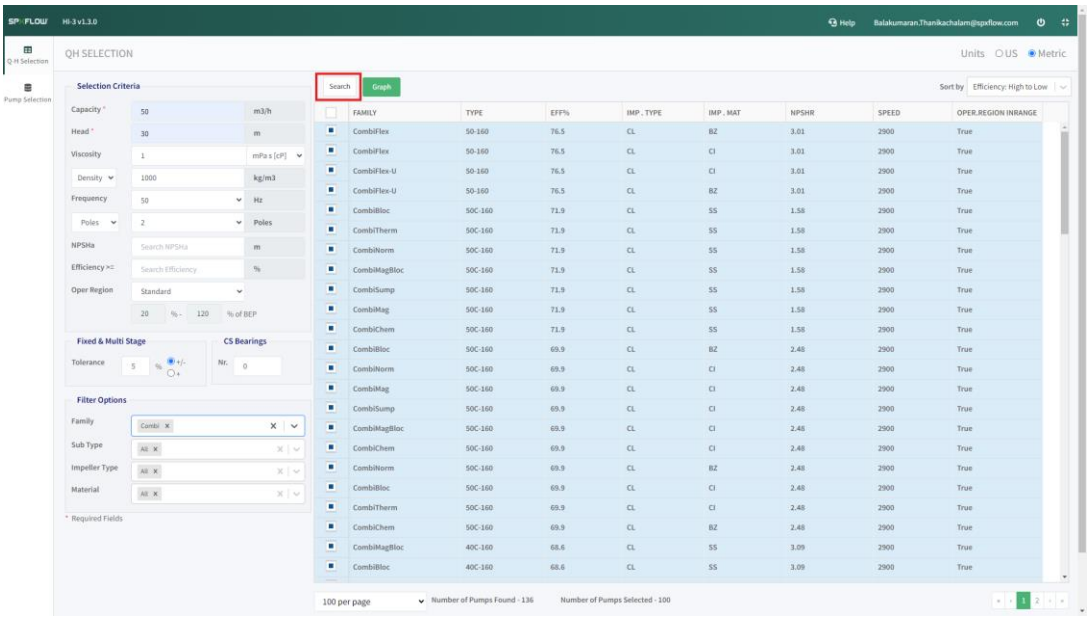


Figure 2.20: Q-H Selection Tab: Search Button and selection results

- A list is shown of all graphs that meet the specified requirements. Pumps outside the chosen operating region are shown in red. These results are sorted according to their efficiency in descending order. However, using the Sort by menu, other sorting options such as NPSHA and Speed are also possible. By default, all search results are selected but if desired pumps can be removed from the selection list by single-clicking the check box (dark blue colour disappears) on the relevant pump.

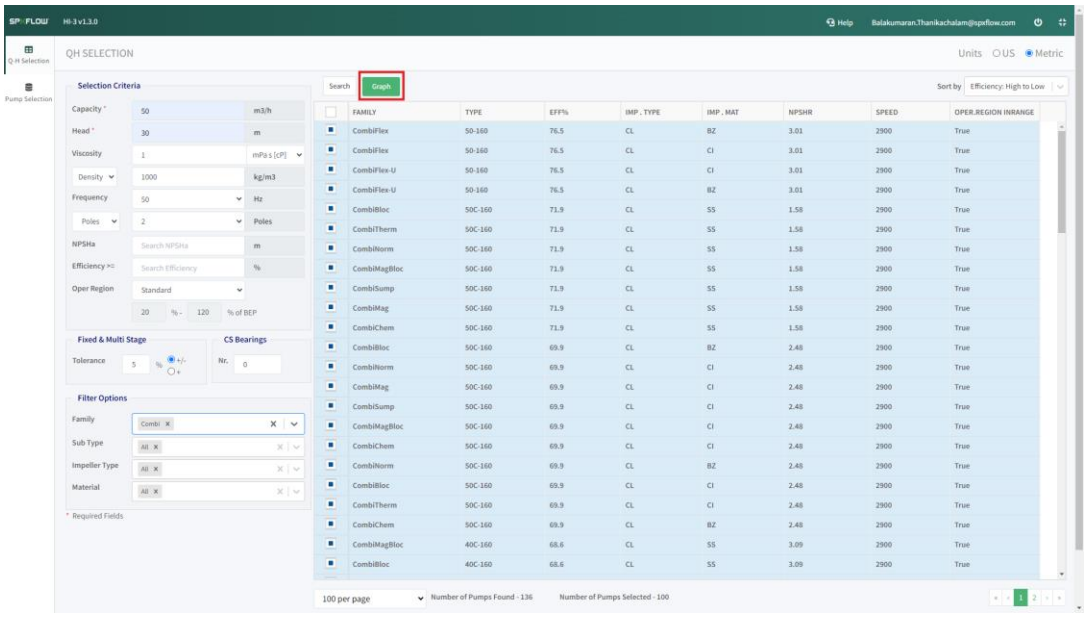


Figure 2.21: Q-H Selection Tab: Graph Button

- The graph button will be enabled only if at least one pump is selected. Clicking the graph button takes to the graph screen with pump curves of first pump in the list. It is also possible to select one pump from the list by double-clicking on it.

2.5. Interpretation of the selection results

The following points must be considered when looking at the selected curves:

- The curves represented a selection of hydraulics and **not** pumps.
- The selected graph must always be checked for its availability in the product supply range.
- The speed / impeller diameter combination, speed / number of stages combinations and the maximum speed must be checked in the TSM.

2.6. Pump Selection Tab

- The second way of selecting a graph is via the option **Pump Selection**. Using this, a list is displayed of all pump families which are available in HI3.

- After selecting a pump family and, if available, a pump subtype, a pump type can be chosen using the **search** bar. The checkboxes allow for the selection of multiple pump types simultaneously. To deselect all selected pump types, you can use the **Clear** button.

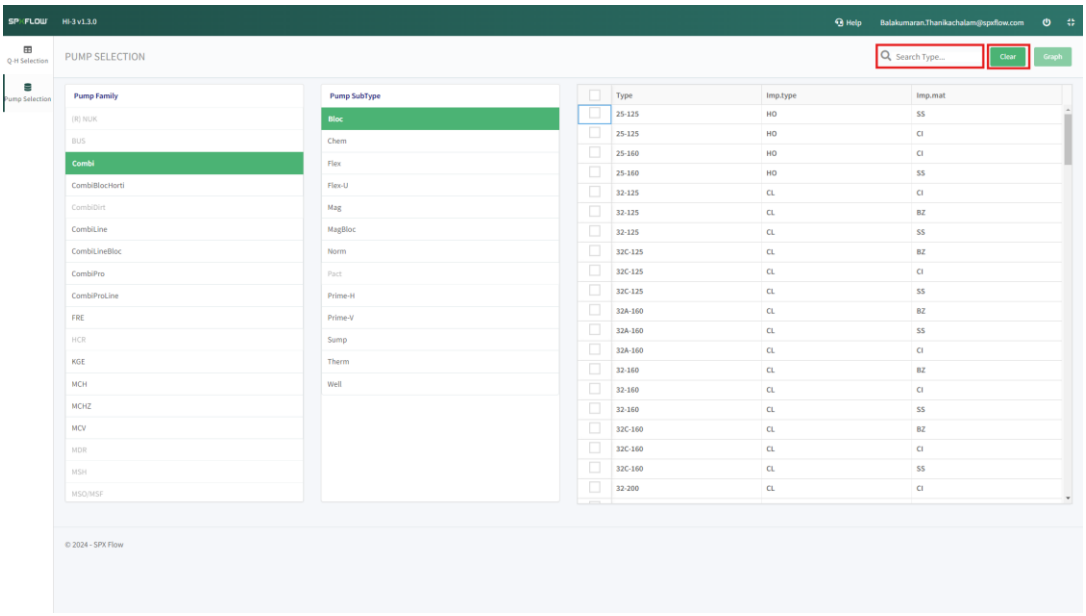


Figure 2.22: Pump Selection Tab with search option and clear button

- The graph is displayed by selecting the relevant type and then clicking the Graph button.

2.6.1. Sub-classification of pump families

Pump family	Embedded Pump families
(R) NUK	
BUS	
Combi	CombiBloc CombiChem CombiFlex CombiFlex-U CombiMag CombiMagBloc CombiNorm CombiPact CombiPrime H CombiPrime V CombiSump CombiTherm CombiWell
CombiLine	
CombiLineBloc	
CombiBlocHorti	
CombiDirt	
CombiPro	
CombiProLine	
CombiThermPlus	
FRE	FRE FRES FREF FREM
HCR	
KGE	
MCH	
MCHZ	
MCV	
MDR	
MSH	
MSO/MSF	
NURT	
VRD	

2.7. Graph Tab

2.7.1. Graph section

The graph section is divided into 3 charts.

- First chart on the top shows the **capacity - power curve**.
- Second chart on the middle shows the following information:
  - ❖ The selected **capacity – head curve**.
  - ❖ The **efficiency curve** (2nd Y-axis on right side of the graph).
  - ❖ The **capacity – system resistance curve** (system curve) based on the specified duty point.
  - ❖ The specified **Duty point.**
- Third chart on the bottom shows the **capacity - NPSH curve**.

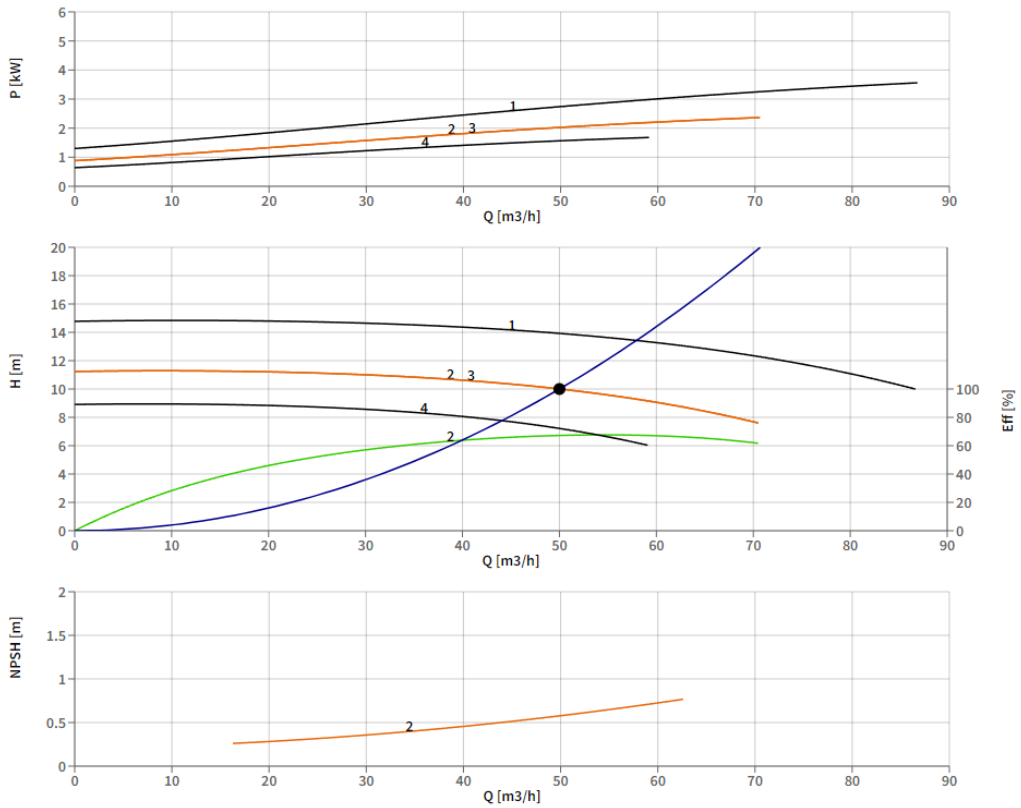


Figure 2.23: Graph section

- The NPSH req.Curve drop down list can be used to select the desired curve(s) for **NPSH curve** in the bottom chart.
- The Efficiency Curve drop down list can be used to select the desired curve(s) for **Efficiency Graph** in the middle chart.
- **Static Head** input box can be used to set the required static head.

- **Parallel Pump** drop down list can be used to set a graph for 2, 3 or 4 pumps arranged in parallel.
- The **Characteristic curve** checkbox is used for the visibility of the capacity – system resistance curve based on the specified working point**.**
- The **Duty Point** checkbox is used for the visibility of the specified working point**.**

Figure 2.24: Graph section selection options

2.7.2. Data section

The data section in the graph screen reveals the performance of the pumps at 4 columns describing different situations. Each column can be switched on and off by ticking the box at the top of the relevant column. The non-editable fields are grouped and highlighted under red, and rest of the fields are editable. The values edited in this section will show its impact in the graph screen.

The number of fields in this section will vary across the nature of pumps, For Example: In case of multistage pumps the field name “No of Stages” will be added into this section.

When a CombiMag or CombiMagBloc has been selected, an extra field appears in the data section as **Mag.Corr.** The value of the magnet correction can be entered from the CombiMag calculation program, and it indicates the power absorption of the magnet coupling.

Special Handlings:
The spin button-based value change is handled for the No. of Stages field as it can have custom value change.

Note: *The KeyBoard Arrows (↑↓) can be used to increase and decrease the values in the editable fields*

Check Boxes:
The check boxes at the top of this data table will decide the visibility of curves and data in the Graph Section and as well as in the Print Sheet.
The check boxes at the bottom - Orifice, will decide the visibility of Pressure Drop and Diameter.

- The impeller diameter can be varied between the minimum and maximum value for the relevant pump type.
- If known, the viscosity of the medium to be pumped can be entered in the Viscosity field.
- The relative density of the medium can be entered in Density field.
- The motor speed can be varied up to the maximum speed for the type of pump. Which can be entered in the Speed field.

- The effect of an orifice can be seen by ticking the checkbox at the top of the relevant column. The Pressure drop at the working point or the diameter (of the hole in the orifice) can then be entered.

Duty Points	☑1	☑2	☑3	☑4	
Impeller Dia	174	148	148	125	mm
Q	60.4	50.3	50.3	41.4	m3/h
H	36.5	25.2	25.2	17.1	m
P	8.23	4.63	4.63	2.55	kW
NPSH req	2	1.6	1.6	1.5	m
Efficiency	72.9	74.6	74.6	75.5	%
Efficiency BEP	76.7	77.2	77.2	77.2	%
Q/Qbep	75.2	79.7	79.7	84.4	%
S Value	10052	10052	10052	10052	
MEI Value	> 0.40	> 0.40	> 0.40	> 0.40	
Spec.Speed ns	31.19	31.19	31.19	31.19	
Dia.BackVanes	145	145	145	125	mm
Kin.Viscosity	1	1	1	1	mm2/s[cSt]
Dyn.Viscosity	1	1	1	1	mPa s [cP]
Density	1000	1000	1000	1000	kg/m3
Motor					
Speed	2900	2900	2900	2900	1/min
Max.Power	10.36	5.64	5.64	3.01	kW
Orifice	☐1	☐2	☐3	☐4	
Pressure Drop					m
Diameter					mm

Figure 2.25: Data section

A graph can be opened from both the Q-H selection tab and the Pump selection tab. In both cases the tab displayed below becomes visible. This tab is split into a left and right section. The left section shows the graph, the right section shows the associated data.

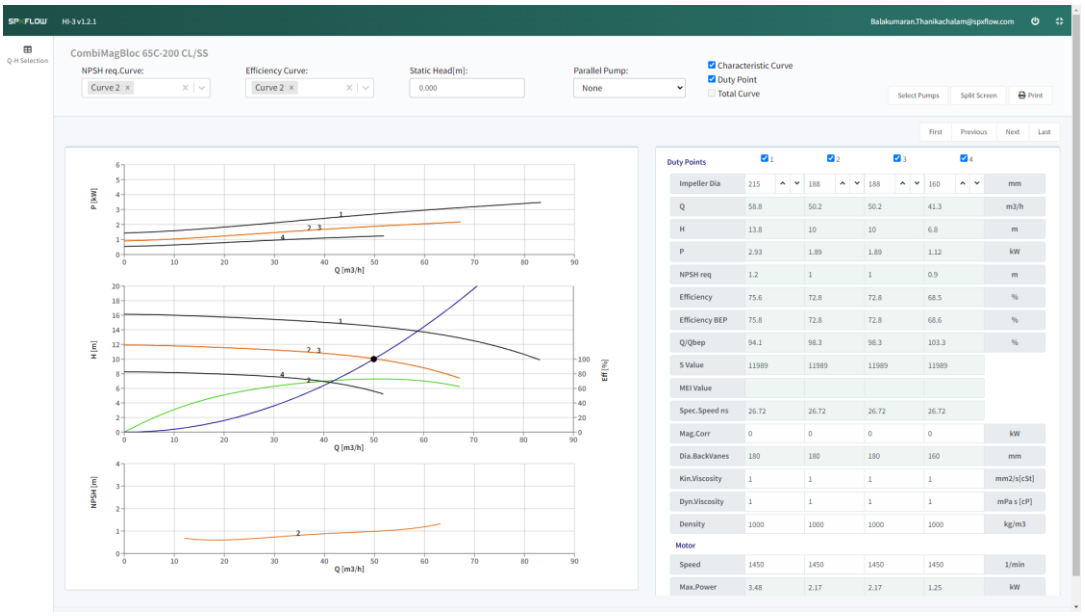
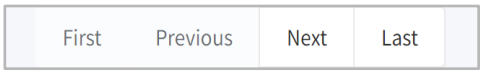


Figure 2.26: Graph Tab

- To view another graph from the selection, **Navigation keys** at the top right of the data section can be used.



- It is also possible to compare two curves with each other. To do this, the **Split Screen** Button at the top of the Data section can be used. Using the navigation keys or the selection menu, all the curves in the selection can now be looked at one by one.

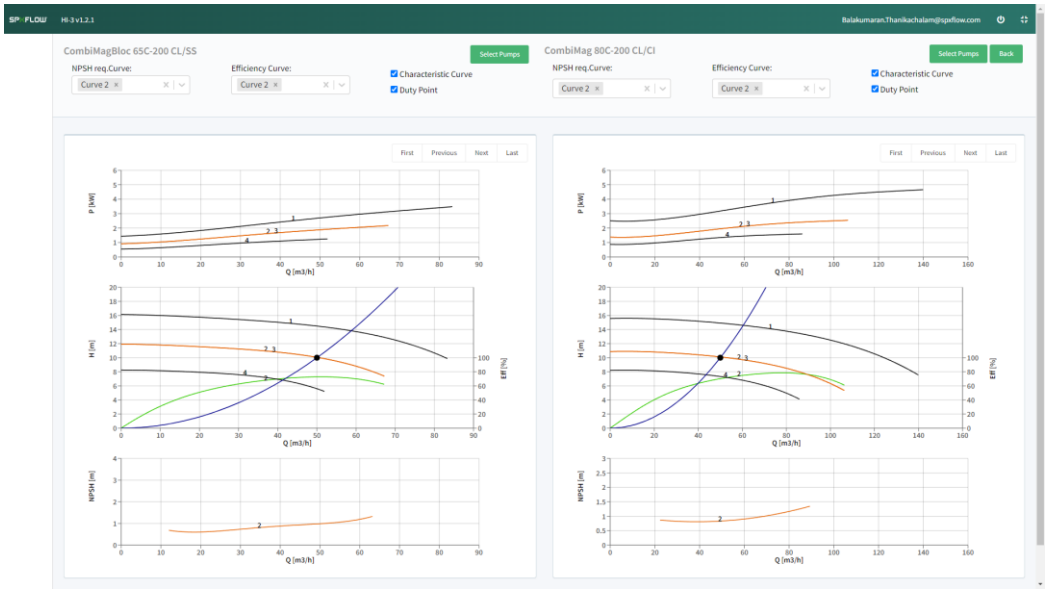


Figure 2.27: Split Screen

- It is also possible to print the data. Print Button at the top of the Data section can be used. The pop-up will appear on clicking the Print Button. By Filling the Required Field one can print the data. Also, it is possible to save the Pump curves with data as PDF with the use of a PDF printer driver like Microsoft Print to PDF.

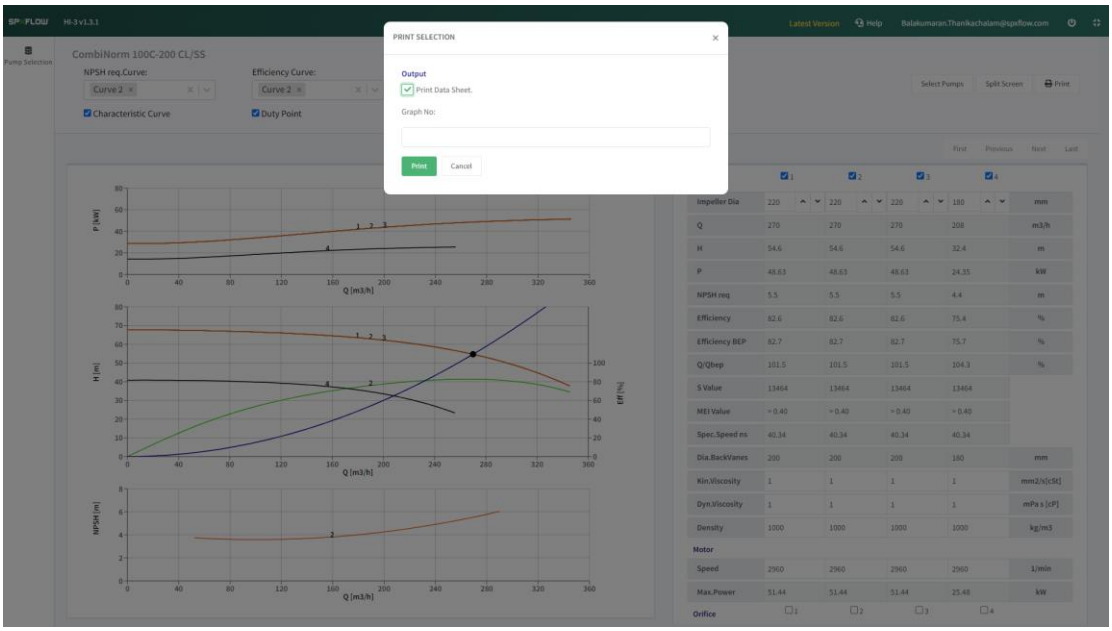


Figure 2.28: Pop-up after pressing Print Button

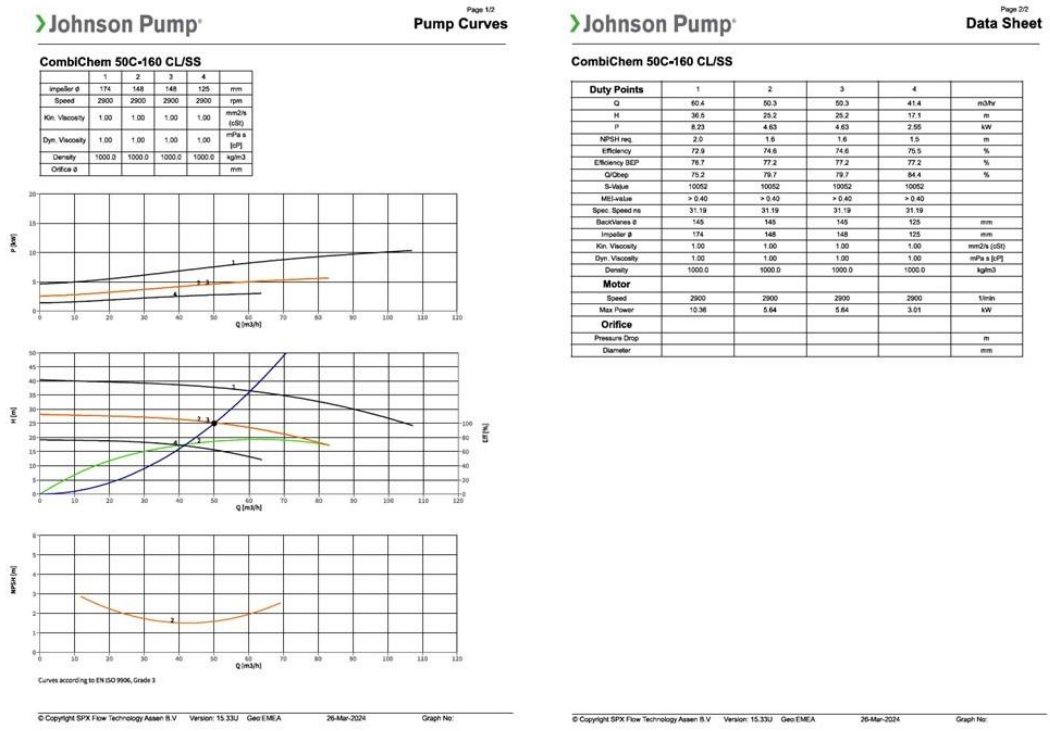


Figure 2.29: Printed Graph example

2.7.3. Temporary Data Storage & Allocations

- Since this is a web-based application, the data will be temporarily stored with the respective login ID. Until another search is performed, the user data remains unchanged.
- The data are unique and unaffected while another user uses this application at the same time with another user ID.
- There can be any number of user IDs, and each has its own data stored separately according to the user ID.

