Solution Specification Document (Project)

Development of FMDQ Clear Initial Margin Calculator ("Q-Calc")

iQx Consult Limited

November 2023

Document Revision History

Document Version	Modification Details	Modified By	Modification Date
Version 1.0	Initial requirement specification and documentation	Oluwatoni Amusan	October 2023
Version 2.0	Review and updated the following sections	Adedamola Folarin	November 2023

Contents

Part 1 – Functional Requirement Specification

1 Document Information/Approvals for Business Stakeholders

Document Name	Solution Specification Document for Automation of HRD Interview Forms
Prepared By *Adedamola Folarin*	 --- **Business Interface Group** **November 2023**
Concurred By *James Daves*	 --- **Divisional Head, Clearing Risk Management** **November 2023**
Approved By *Ayodele Onawunmi*	 --- **Managing Director, FMDQ Clear Limited** **November 2023**

2 INTRODUCTION

FMDQ Clear Limited ("**FMDQ Clear**" or the "**CCP**") is Nigeria's foremost Central Counterparty, providing post-trade services to enhance the integrity of and eliminate the inherent counterparty risks in financial market transactions, whilst facilitating settlement finality, towards delivering capital and cost efficiencies, and de-risking the Nigerian financial markets. As part of its value propositions as a Financial Market Infrastructure ("**FMI**"), FMDQ Clear seeks to provide CCP clearing services for the recently launched Exchange Traded Derivative ("**ETD**") market.

This innovation is the deployment of the Initial Margin ("**IM**") calculator, also called "**Q-Calc**," which stands as a cornerstone in accurate IM obligation estimation for open or potential positions on cleared products held by market participants as well as enable Users simulate the collateral amount that will be sufficient to fulfil IM obligations on these exposures.

This innovative tool facilitates the seamless capture of market participant's contracts, provides a consolidated portfolio obligations report, and a comprehensive insight into collateral allocation. By seamlessly integrating these features into one system, FMDQ Clear seeks to empower engagement with clients and stakeholders, ushering in a new era of precision and efficiency in the realm of the financial market infrastructure.

2.1 Purpose

To develop a sophisticated, robust, flexible and transparent system within the Central Counterparty Clearing Services domain for the recently launched Exchange Traded Derivatives ("**ETD**") market, with the goal of limiting market risks, diversifying investment portfolios, creating realistic investment opportunities, and providing an accurate and efficient computation of Initial Margin requirements held by market participants, thus, ushering in a new era of accurate risk assessment and collateral optimisation in the financial sector.

2.2 Scope

The system under consideration is for the development and deployment of an Initial Margin calculator ("**Q-Calc**"), with the goal of revolutionising risk assessment, optimising collateral management, having a seamless and accurate estimation of IM obligations, and increasing user engagement, thereby, establishing FMDQ Clear as a ground-breaking force in the realm of the financial market infrastructure.

2.3 Background

FMDQ Clear recognised the need to adjust its operations and services to suit the rising complexities and needs of market participants in the face of an ever-changing global financial landscape. As the financial market continues to develop and expand, the significance of strong risk management systems and efficient counterparty clearing services has become obvious. The recent launch of the ETD market offered FMDQ Clear with a great chance to expand its capabilities and better serve its clients. In response to this volatile environment, FMDQ Clear has devised an innovative strategy to revolutionise its central counterparty clearing services. This project aims to address numerous aspects of the financial ecosystem, from risk management to portfolio diversification.

Recognising the need for an innovation that could reliably estimate **IM** requirements, FMDQ Clear saw the need for a cutting-edge tool that could eliminate market risks and ensure transparent, efficient clearing operations. The plan is to create an **Q-Calc** that would not only act as a risk assessment mechanism but would also be used for the estimation of the IM obligations on open/potential positions on cleared products, allow users to simulate collateral allocation schemes, giving them the tools needed to optimise their trading strategies while adhering to regulatory requirements.

This approach to financial risk management and portfolio optimisation aligned with FMDQ Clear's commitment to quality and innovation. The Q-Calc project, by combining technology, financial expertise, and a deep

understanding of market dynamics, is poised to not only transform the way market participants engage with CCP clearing services, but also position FMDQ Clear as a pioneer in modern financial market infrastructure. In a world of rapid change and sophisticated financial networks, this initiative demonstrated FMDQ Clear's commitment to strengthening financial stability, stimulating innovation, and fostering long-term growth.

2.4 References

This document references the approved BRD for the FMDQ Clear Initial Margin Calculator.

2.5 Assumptions and Constraints

Assumptions

- The different currencies and exchange rates used for accurate and timely calculations of IM requirement on transactions will be regularly updated by FMDQ Clear
- Market participants will input contract details accurately in the 'Portfolio Builder' module
- Exchange rates for currencies remain relatively stable during the calculation process
- Non-cash collateral types and securities listed in the system are assumed to be eligible and compliant with regulatory requirements

Constraints

- Unforeseen downtime with the system, including servers, networks, and bandwidth, may impose constraints on the system's performance and scalability
- Compliance with data retention policies and privacy regulations may introduce constraints on data storage, archival, and deletion

2.6 Document Overview

This Solution Specification Document ("**SSD**") provides detailed description of the requirements, features, and functionalities of the Initial Margin Calculator ("**Q-Calc**"). It serves as a blueprint or a guide for the implementation team to understand what needs to be built and how it should function.

3 METHODOLOGY

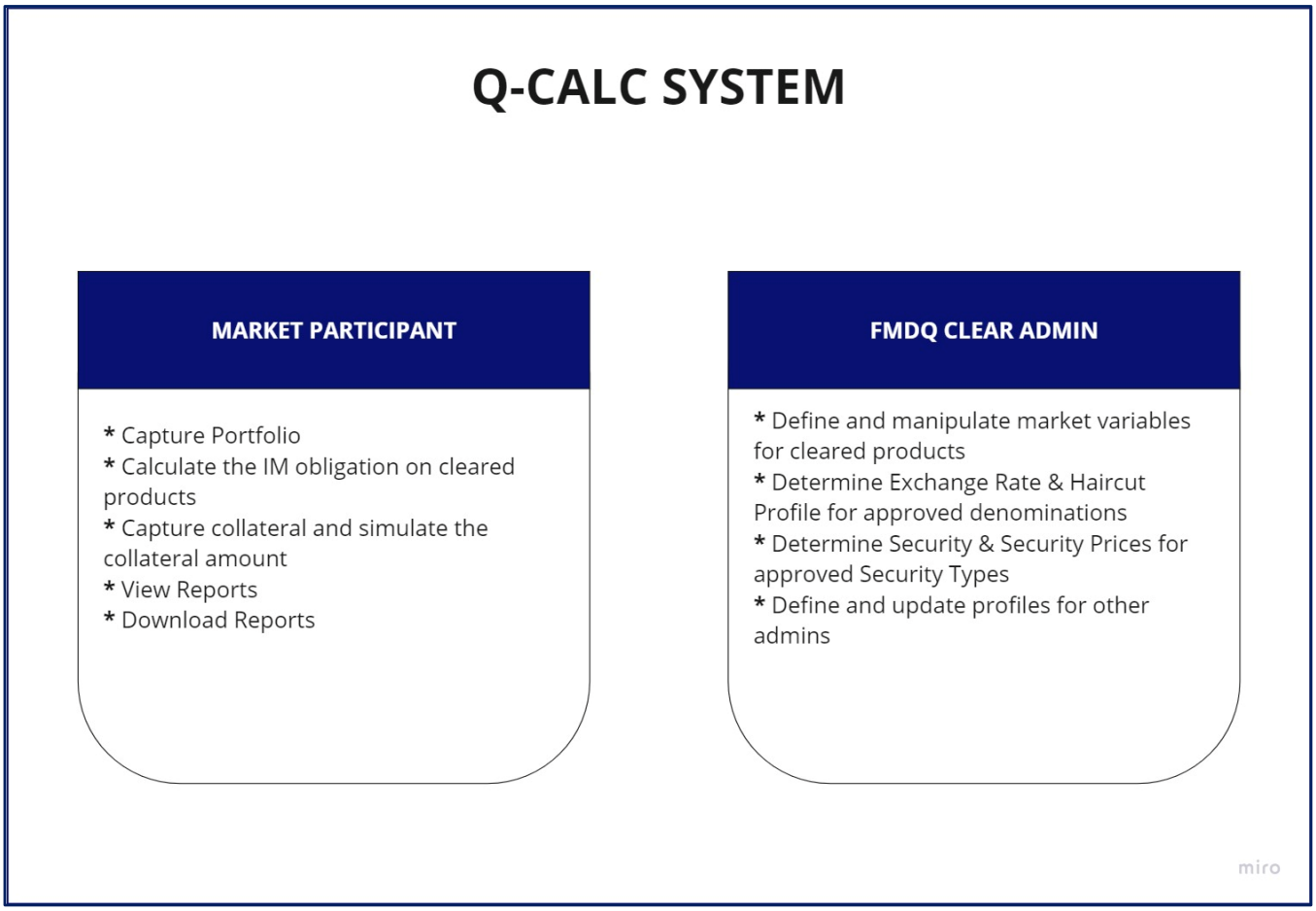
The major goal is to provide a system that can provide an automated and accurate mechanism for calculating IM obligations, enable market participants to easily manage their portfolios and simulate collateral amounts to fulfil IM obligations. The system will be used mainly by:

- Market participants
- FMDQ Clear Administrators

The system will have modules to cater for portfolio capturing, IM requirement report and a collateral administration. The overall goal of the Q-Calc system is to enhance the efficiency, accuracy, and transparency of IM calculations and collateral management for FMDQ Clear and market participants.

4 FUNCTIONAL REQUIREMENTS

4.1 Context Diagram



4.2 Generic Context Table

The proposed system to consists of the following major actors and their activities:

S/N	ACTORS	ACTIVITIES
1.	Market participants	▪ Capture Portfolio ▪ Calculate the IM obligation on open/potential positions on cleared products ▪ Capture collateral and simulate the collateral amount that will be sufficient to fulfil IM obligations on exposures ▪ View Reports ▪ Download Reports

2.	FMDQ Clear Admin	▪ Define and update the following:
		  ▪ Market
		  ▪ Product category
		  ▪ Contract
		  ▪ Nominal Amount
		  ▪ IM Rate

		▪ Denomination ▪ Exchange Rate ▪ Haircut Profile ▪ Security Type ▪ Security ▪ Security Prices

4.3 User Requirements

The following are high level requirements of the proposed system, considering all major classes/categories of user:

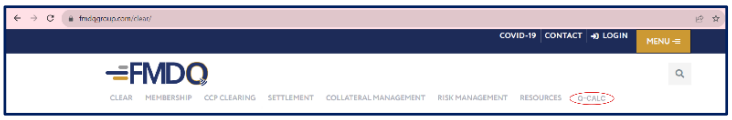
- The system should feature an intuitive and user-friendly interface that allows users, regardless of their technical expertise, to easily navigate and interact with the system
- The system should be able to perform accurate IM calculations based on captured contract details, considering market variables and risk factors
- The system should enable users to build, manage, and analyse their portfolios, capturing contract information, price, net positions, and IM obligations for various contracts
- The system should enable users to efficiently input contract details, including market, product category, contract type, and net positions. The system should accommodate multiple entries for different contracts
- The system should adhere to data privacy regulations and industry best practices
- The system should be accessible across and compatible with various devices and operating systems to facilitate access for users across different platforms
- The system should include clear and transparent explanations of the IM calculation methodology, ensuring that users understand the basis for IM obligations
- The system should offer a consistent experience across devices, enabling users to access their portfolios and IM information on desktops, laptops, tablets, and mobile phones
- The system should enable users to add multiple entries for contracts in their portfolio
- Users should be able to download and/or email IM reports
- The system should be able to calculate the market value of collateral based on specified formulas
- The system should provide quick responses and minimal latency, ensuring efficient interactions, especially during times of market volatility
- The system should be scalable to handle an increasing number of users. It should be able to handle growing data volumes while maintaining performance

These high-level user requirements lay the groundwork for creating a powerful and user-centric Initial Margin Calculator. It will allow for the creation of a system that contributes to a more transparent, secure, efficient, and accessible financial market infrastructure.

4.4 System Utilisation

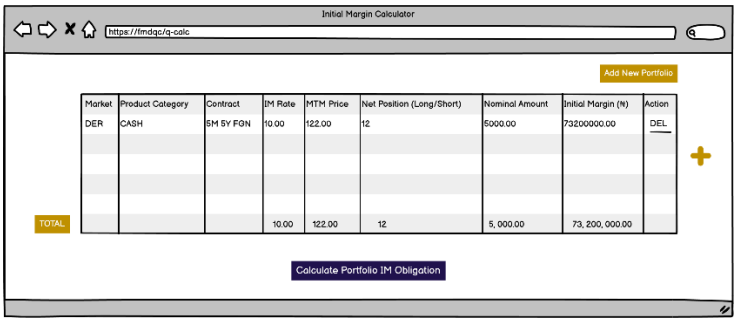
The system under consideration must be capable of handling massive volumes of data, and provide a strong, adaptable, and scalable platform. The system must be built to manage a large volume of concurrent users, data upload and transmission. The system will be utilised by the FMDQ Clear team and market participants who require CCP services.

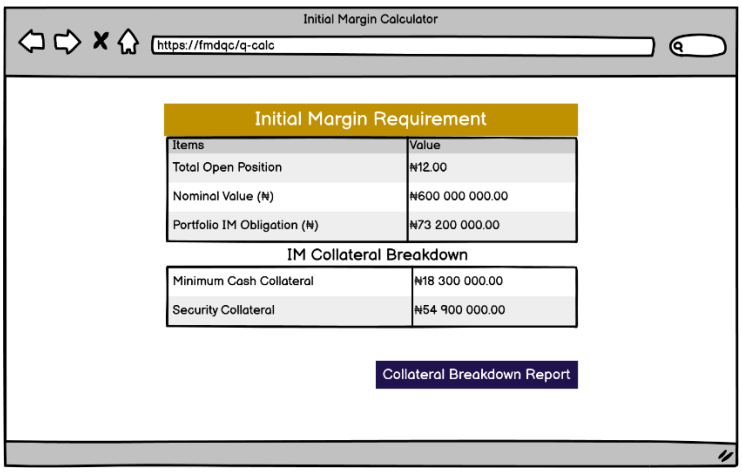
4.5 Functional Requirements

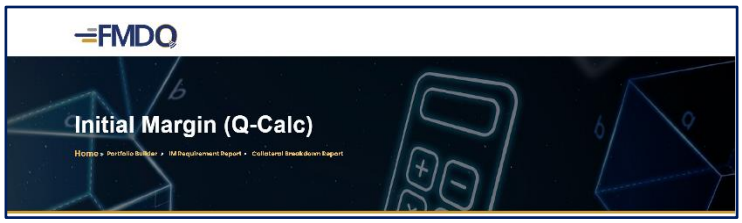
S/N	Screen	Sub-Module	Requirement Definition
1.	**System Accessibility**	FMDQ Clear Website	▪ A new navbar item labeled **''Q-CALC**" shall be integrated within the navigation bar of the FMDQ Clear webpage to help market participants or users navigate to the Initial Margin Calculator/Q-Calc landing page ▪ **Kindly refer to the screenshot below** 
2.	**Q-Calc Home Page**	Navigation Menu	▪ The system shall include a navigation menu that guides users to each of the submodules/screens of the IM calculator **Kindly refer to the screenshot** 

S/N	Screen	Sub-Module	Requirement Definition
		FMDQ Clear's IM Policy	▪ The landing/home page of the system shall provide market participants with the conceptual definition of Initial Margin ▪ The system shall capture key principles or statements about FMDQ Clear's IM Policy and Methodology ▪ The landing page of the system shall include a button that navigates users to a page where they can calculate their Initial Margin **Kindly refer to the screenshot below** 
3.	**Portfolio Builder**	Navigation Menu	▪ The system shall include a navigation menu that guides users to each of the submodules/screens of the IM calculator as listed below: ▪ Home ▪ Portfolio Builder **Kindly refer to the screenshot** 

		Input Fields	▪ Given that a market participant clicks on the 'Calculate Initial Margin Portfolio' button when on the Q-Calc Home Page, the system shall respond by displaying an inbuilt form or template. This form/template must enable the user to efficiently capture details of contracts or potential contracts relevant to their portfolio ▪ The form shall contain the following fields: ▪ **Market**: contains a dropdown of all cleared markets ▪ **Product Category**: dropdown of product categories affiliated with the selected market in the 'Market' field ▪ **Contract**: dropdown of contracts/securities traded in the selected product category within the 'Product Category' field ▪ **Nominal Amount**: should auto populate with the nominal amount of the selected contract ▪ **IM Rate**: should auto populate with the IM rate of the selected contract ▪ **Net Position (Long/Short)**: allow market participants to input the current or prospective net open position on the selected contract ▪ **MTM Price**: input field that allows the market participant to capture the Market-to-Market price of the contract. The system shall display a default figure as the MTM price of the selected contract from the previous day ▪ **Initial Margin (~~₦~~)**: the system shall calculate this field based on the contract details captured. It will be calculated as: *Net Position * Nominal Amount * MTM Price * Initial Margin ("IM") Rate* **Note that all fields on the portfolio builder page are required i.e., they must be filled by the user** **Kindly refer to the image below:** 

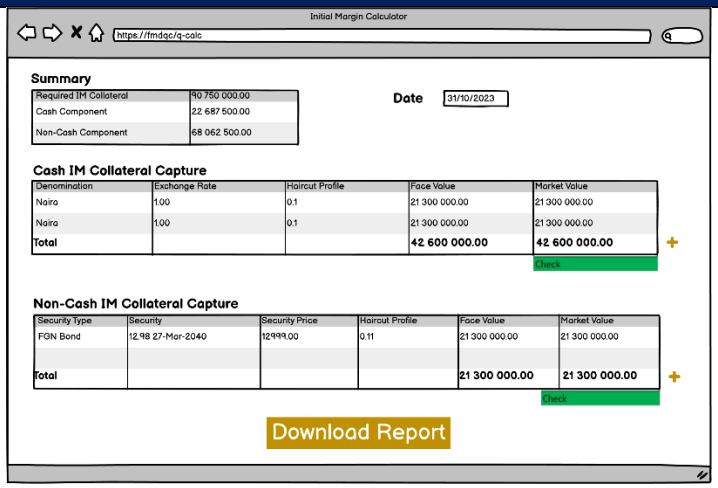
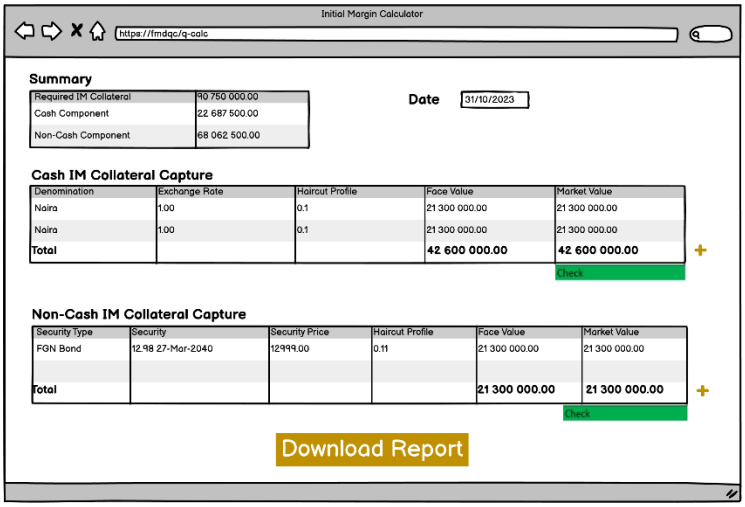
S/N	Screen	Sub-Module	Requirement Definition
		Contract Manipulation	▪ Upon clicking the 'CALCULATE' button, the system shall display a page that summarises all information that has been previously captured ▪ The system shall permit users to create new records or add multiple entries for contracts within their portfolio. This functionality should be accessible by clicking the '+' icon or selecting the 'Add New Portfolio' option, as seen in the image below ▪ The system shall enable users to delete a contract entry/record that is no longer required using the 'Del' icon as seen below **Kindly refer to the image below**:  ▪ Upon clicking the 'Calculate Portfolio IM Obligation' button, the system shall navigate the user to the IM Requirement Report page
4.	**IM Requirement Report**	Navigation Menu	▪ The system shall include a navigation menu that guides users to each of the submodules/screens of the IM calculator as listed below: ▪ Home ▪ Portfolio Builder ▪ IM Requirement Report **Kindly refer to the screenshot** 

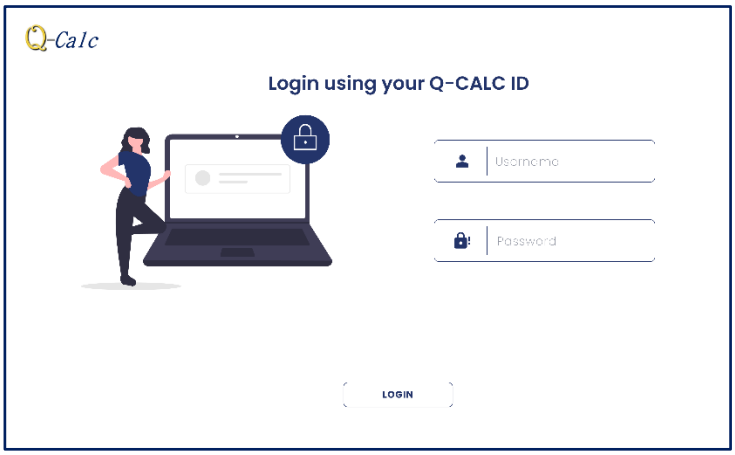
S/N	Screen	Sub-Module	Requirement Definition
		Consolidated View	▪ This page shall display a consolidated view of user's portfolio based on the details captured in the 'Portfolio Builder' submodule. This consolidated view shall contain the following: ▪ **Total Open Position**: display the absolute sum of all 'Net Positions' captured in the Portfolio Builder page ▪ **Nominal Value**: display the sum of all 'Nominal Values' updated in the Portfolio Builder page ▪ **Portfolio IM Obligation**: calculate and display the sum of all 'Initial Margin (₦)' fields of all contract entries captured in the Portfolio Builder page ▪ **IM Collateral Administration**: this section shall contain two fields: ▪ **Minimum Cash Collateral**: display the portion of the 'Portfolio IM Obligation (₦)' that must be provided as cash. The system shall apply the following formula to this field and calculate as follows: Portfolio IM Obligation * 25% ▪ **Security Collateral**: display the portion of the 'Portfolio IM Obligation (₦)' that should be provided as security. The system shall apply the following formula to this field and calculate as follows: Portfolio IM Obligation - Minimum Cash Collateral **Note that the 'IM Requirement Report' page only displays a consolidated view of the 'Portfolio Builder' page, hence, it cannot be manipulated/edited by the user except changes are made to the 'Portfolio Builder' page**  ▪ Upon clicking the 'Collateral Administration Report' button, the system shall navigate the user to the 'Collateral Administration Report' submodule

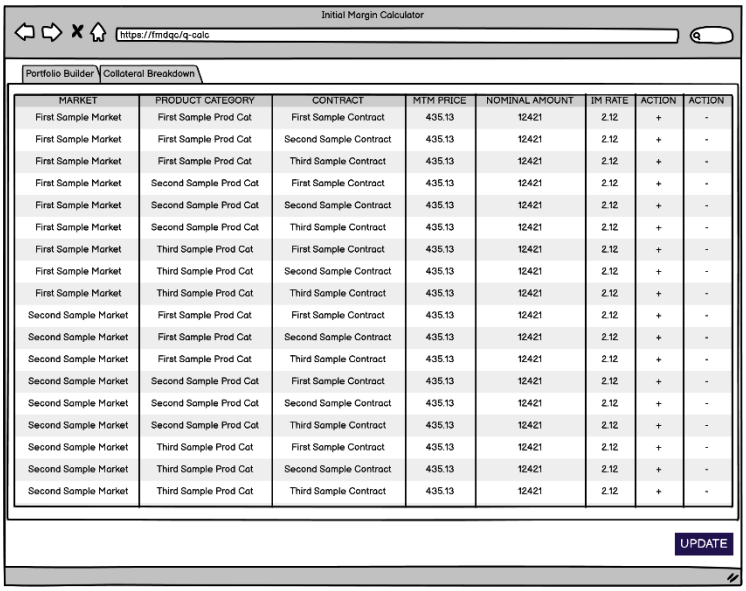
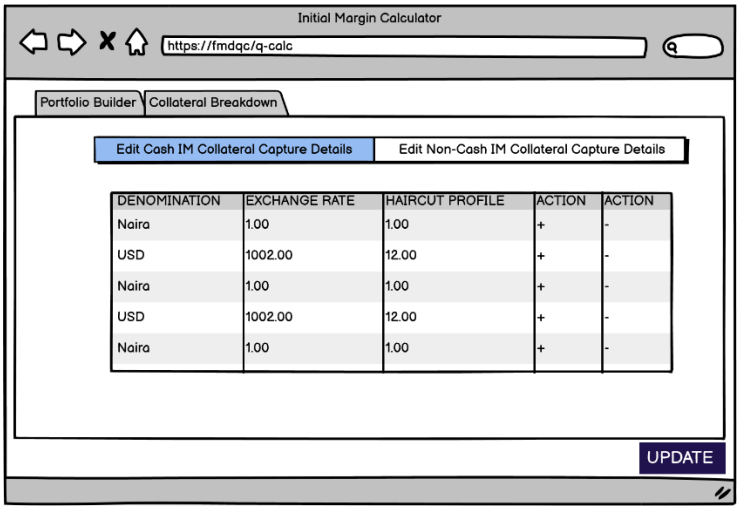
S/N	Screen	Sub-Module	Requirement Definition
5.	**Collateral Administration Report**	Navigation Menu	▪ The system shall include a navigation menu that guides users to each of the submodules/screens of the IM calculator as listed below: ▪ Home ▪ Portfolio Builder ▪ IM Requirement Report ▪ Collateral Administration Report Kindly refer to the screenshot  ▪ The 'Collateral Administration Report' submodule shall show the summary of a user's total initial margin requirement and the cash to non-cash collateral breakdown as calculated in the 'IM Requirement Report' submodule ▪ This submodule should have the following subsections: ▪ Cash IM Collateral Capture ▪ Non-Cash IM Collateral Capture

S/N	Screen	Sub-Module	Requirement Definition
		Cash IM Collateral Capture	▪ The Cash IM Collateral Capture section shall display an inbuilt template with the following fields that will enable users to input details of their cash collateral: ▪ **Denomination**: this field shall include a dropdown which displays the list of all eligible currency as advised by FMDQ Clear ▪ **Exchange Rate**: this field shall be auto populated with the exchange rate applicable to the selected currency ▪ **Haircut Profile**: this field shall be auto populated with the haircut profile applicable to the selected currency ▪ **Face Value**: this field should enable the user to capture nominal value of cash collateral to be pledged ▪ **Market Value**: this field calculates the current market value of cash IM collateral captured by a user and is dependent on the denomination of currency being pledged. It is calculated as: ▪ **For Naira denominated Cash IM Collateral** *Market Value = Face Value* ▪ **For USD denominated (and other currencies) Cash IM Collateral** *Market Value = Face Value * Exchange Rate * (1 – Haircut Profile)* ▪ **Total:** this field computes the total value of cash collateral (face and market value) captured by a user ▪ **Check:** The system shall include a validation mechanism to confirm that the total value of cash collateral, as calculated above, is greater than or equal to the value of the cash IM collateral component computed in the 'IM Requirement Report' submodule. In case the total value is less than the cash IM collateral component, the system shall highlight the 'Check' field with red. Conversely, if the total value is greater than or equal, the system shall highlight the 'Check' field with green

		Non-Cash IM Collateral Capture	▪ The Non-Cash IM Collateral Capture section shall display an inbuilt template with the following fields that will enable users to input details of their non-cash collateral: ▪ **Security Type:** this field shall include a dropdown which displays the types of all eligible non-cash collateral ▪ **Security:** this field shall display a dropdown of all applicable securities applicable to the selected security type ▪ **Security Price:** this field shall auto populate with the security price applicable to the selected security ▪ **Face Value**: this field should enable the user to capture nominal value of non-cash collateral to be pledged ▪ **Market Value**: this field calculates the current market value of non-cash IM collateral captured by a user and is also dependent on the denomination of currency being pledged. It is calculated as: ▪ **For Naira denominated Non-Cash IM Collateral** *Market Value = Face Value * (Security Price / 100) * (1 – Haircut Profile)* ▪ **For USD denominated (and other currencies) Non-Cash IM Collateral** *Market Value = Face Value * (Security Price / 100) * Applicable Exchange Rate * (1 – Haircut Profile)* ▪ **Total:** this field computes the total value of non-cash collateral (face and market value) captured by a user ▪ **Check:** The system shall include a validation mechanism to confirm that the total value of non-cash collateral, as calculated above, is greater than or equal to the value of the non-cash IM collateral component computed in the 'IM Requirement Report' submodule. In case the total value is less than the non-cash IM collateral component, the system shall highlight the 'Check' field with red. Conversely, if the total value is greater than or equal, the system shall highlight the 'Check' field with green ▪ The system shall permit a user to create multiple entries of both a cash collateral and non-cash collateral with the '**+**' icon **Kindly refer to the image below**

S/N	Screen	Sub-Module	Requirement Definition
			
		Data Export / Download	▪ The system shall include a 'Download Report' button (as seen in the image below) that provide users with the functionality to download contract report as PDF ▪ The report shall fully export details from the Portfolio Builder page, the IM Requirement Report page, and the Collateral Administration Report page 

S/N	Screen	Sub-Module	Requirement Definition
6.	**FMDQ Clear Admin**	User Authentication	▪ The system shall include a dedicated module to the FMDQ Clear admin and implement a secure user authentication system for the FMDQ Clear Admin to control access to the system  ▪ Upon successful login to the Q-Calc FMDQ Clear admin module, the system shall display two tabs labelled 'Portfolio Builder' and 'Collateral Administration' that shall enable the system administrator to perform necessary data manipulation

		Data Manipulation	▪ The system shall feature a 'Portfolio Builder' tab that includes a comprehensive list of all cleared markets. For each market, the tab shall display the associated product category, and within each product category, a list of contracts shall be presented. Each contract entry in the list should include the corresponding nominal amount and Initial Margin (IM) rate for accurate and detailed portfolio management  ▪ The 'Collateral Administration' tab shall contain two sections as seen below: 'Edit Cash IM Collateral Capture Details' and 'Edit Cash IM Collateral Capture Details' ▪ The 'Edit Cash IM Collateral Capture Details' shall contain a list of all eligible currencies as advised by FMDQ Clear as long with their applicable exchange rate and haircut profile  ▪ The 'Edit Non-Cash IM Collateral Capture Details' shall contain a list of all security types and applicable securities and security prices ▪ The system shall include a feature that permits the admin to update this module by uploading an Excel file containing the following fields and data types

MARKET	PRODUCT CATEGORY	CONTRACT	MTM PRICE	NOMINAL AMOUNT	IM RATE	ACTION	ACTION
First Sample Market	First Sample Prod Cat	First Sample Contract	435.13	12421	2.12	+	-
First Sample Market	First Sample Prod Cat	Second Sample Contract	435.13	12421	2.12	+	-
First Sample Market	First Sample Prod Cat	Third Sample Contract	435.13	12421	2.12	+	-
First Sample Market	Second Sample Prod Cat	First Sample Contract	435.13	12421	2.12	+	-
First Sample Market	Second Sample Prod Cat	Second Sample Contract	435.13	12421	2.12	+	-
First Sample Market	Second Sample Prod Cat	Third Sample Contract	435.13	12421	2.12	+	-
First Sample Market	Third Sample Prod Cat	First Sample Contract	435.13	12421	2.12	+	-
First Sample Market	Third Sample Prod Cat	Second Sample Contract	435.13	12421	2.12	+	-
First Sample Market	Third Sample Prod Cat	Third Sample Contract	435.13	12421	2.12	+	-
Second Sample Market	First Sample Prod Cat	First Sample Contract	435.13	12421	2.12	+	-
Second Sample Market	First Sample Prod Cat	Second Sample Contract	435.13	12421	2.12	+	-
Second Sample Market	First Sample Prod Cat	Third Sample Contract	435.13	12421	2.12	+	-
Second Sample Market	Second Sample Prod Cat	First Sample Contract	435.13	12421	2.12	+	-
Second Sample Market	Second Sample Prod Cat	Second Sample Contract	435.13	12421	2.12	+	-
Second Sample Market	Second Sample Prod Cat	Third Sample Contract	435.13	12421	2.12	+	-
Second Sample Market	Third Sample Prod Cat	First Sample Contract	435.13	12421	2.12	+	-
Second Sample Market	Third Sample Prod Cat	Second Sample Contract	435.13	12421	2.12	+	-
Second Sample Market	Third Sample Prod Cat	Third Sample Contract	435.13	12421	2.12	+	-

DENOMINATION	EXCHANGE RATE	HAIRCUT PROFILE	ACTION	ACTION
Naira	1.00	1.00	+	-
USD	1002.00	12.00	+	-
Naira	1.00	1.00	+	-
USD	1002.00	12.00	+	-
Naira	1.00	1.00	+	-

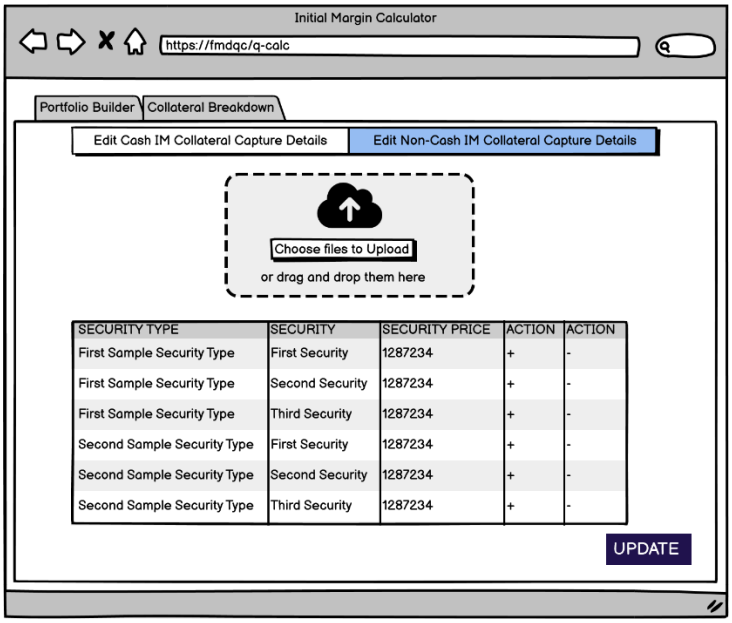
S/N	Screen	Sub-Module	Requirement Definition

S/N	Field	Data Type
1.	Security Type	String
2.	Security	String
3.	Security Price	Float

Kindly refer to the screenshot below for the template to be uploaded

SECURITY TYPE	SECURITY	SECURITY PRICE
First Sample Security Type	First Security	1287234
First Sample Security Type	Second Security	1287234
First Sample Security Type	Third Security	1287234
Second Sample Security Type	First Security	1287234
Second Sample Security Type	Second Security	1287234
Second Sample Security Type	Third Security	1287234

- Upon upload of the MS Excel file, the system shall display the following



- The system shall display two action on all pages within the FMDQ Clear admin module labeled '**+**' and '**-**'. These two actions shall be used to either add a new record or delete a pre-existing record

5 Document Information/Approvals for iQx Consult Limited

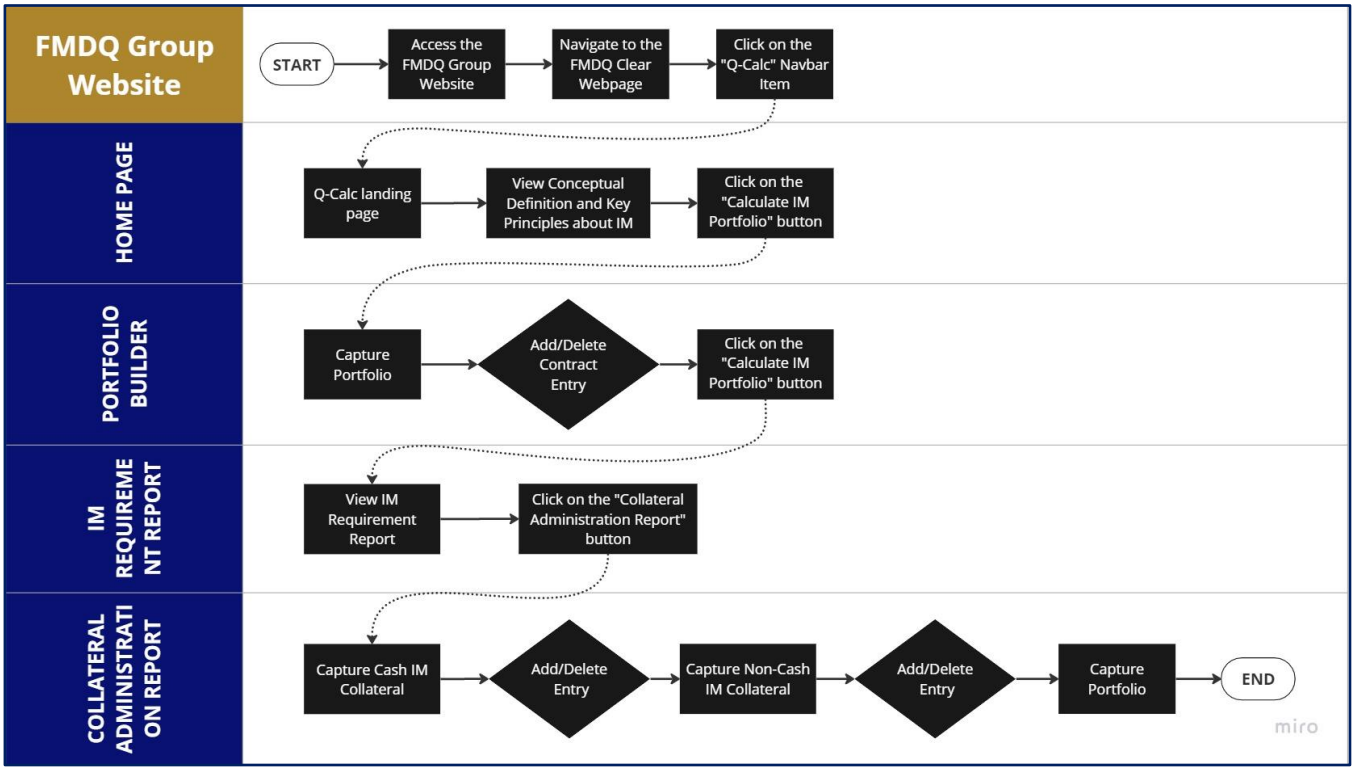
Document Name	Solution Specification Document
Approved By *Emmanuel Alao*	Emmanuel Alao (Nov 17, 2023 13:20 GMT+1) ---------- ***Executive Supervisor, iQx Consult*** **October 2023**

6 TECHNICAL REQUIREMENTS

- **Database Management**: The system must have a reliable and scalable database management system ("**DBMS**") to store and manage contract details, portfolio data, user information, and historical records securely. The system should also consider factors like data backup and recovery, data replication, and performance optimisation
- **Security Measures**: The system must implement robust security measures to protect candidate data, system integrity and prevent unauthorised access or malicious attacks. This includes data encryption, secure access controls, user authentication and authorisation, role-based permissions, firewall configurations, and regular security audits
- **Performance**: The system should be designed to handle a large volume of data without any significant slowdowns or crashes
- **Scalability**: The system should be scalable, allowing it to handle an increasing number of users and data over time without requiring significant hardware upgrades
- **Availability**: The system should be highly available, with a minimum downtime or interruptions throughout recruitment processes
- **Usability**: The system should be user-friendly and easy to use, with a simple and intuitive user interface
- **Maintainability**: The system should be designed for easy maintenance and updates, allowing for easy bug fixes and software updates
- **Portability**: The system should be portable, meaning it can run on different hardware and software platforms without significant modification
- **Compatibility**: The system should be compatible with a wide range of devices and operating systems. This requires a responsive design that adapts to different screen sizes and resolutions, as well as support for different web browsers and mobile devices
- **Testing**: The system should undergo rigorous testing at different stages of development, including unit testing, integration testing and system testing
- **Calculation Engine**: Implement a robust calculation engine for computing Initial Margin based on the provided formula. Ensure that the system regularly updates the IM rates and nominal values appropriately
- **Error Handling and Exception Management**: the system should be designed to have robust error handling mechanisms to handle exceptions, edge cases, and error scenarios effectively. The system should also implement proper error logging, error messages, and exception handling to provide a smooth user experience

The above requirements are essential for the system's overall performance, scalability, security, and maintainability, ensuring that the system can operate efficiently and reliably over time.

6.1 Process Flow Diagram



6.2 Logical Data Model/Data Dictionary

The below data requirements describe the business data needed by the application system.

Entities:

- User Information: This entity represents users within and outside the organisation i.e., FMDQ Clear user or market participant that will utilise the system. It will include the users ID, username, email, role, and password for admin roles
- Market Information: This entity represents the market information such as the market ID and market name
- Product Category Information
- Contract Information: This entity represents the various types of contracts and includes the contract ID, contract name, nominal amount, IM Rate
- Portfolio Information: Including the portfolio ID, user ID, contract ID, net position, market price
- IM Requirement Report
- Cash Collateral Information: The cash collateral information includes the ID, user ID, denomination, exchange rate, haircut profile, face value and market value
- Non-Cash Collateral Information: This entity represents the non-cash collateral information such as non-cash ID, user ID, security type, security, face value, market value

Relationships:

- Each User can have multiple Portfolios (One-to-Many)
- Each Portfolio is associated with a Market, Product Category, and Contract (Many-to-One)
- Each Contract belongs to a Product Category, which is associated with a Market (Many-to-One)
- Each IM Requirement Report is associated with a User and may have multiple Cash and Non-Cash Collateral entries (One-to-Many)
- Each Cash Collateral entry is associated with a User (Many-to-One)
- Each Non-Cash Collateral entry is associated with a User (Many-to-One)

This logical data model provides a foundation for structuring the data in the Q-Calc system, capturing the relationships between users, portfolios, contracts, collateral information, and more. The actual implementation details, including data types, constraints, and indexing, will depend on the chosen database management system.

6.3 Interface Requirements

Hardware Interfaces

The system should be able to perform with the following hardware interface requirements:

- Processor speed of 0.5ghz or more for mobile gadgets
- Processor speed of 1.5ghz or more for desktop and computer gadgets
- Ram of 500mb and above for all devices
- Free storage memory capacity of more than 100mb

Software Interfaces

The system should have a smooth performance on the following operating systems and internet browsers:

- Windows/ android/ Linux/ mac/ chrome or any other operating system
- Mozilla Firefox / Google chrome / opera mini / UC browser or internet explorer and any other browsers

Communications Interfaces

- Internet connectivity will be required for communication to occur on the system

6.4 Data Conversion Requirements

- **Data Format Compatibility**: Ensure that data from existing systems and sources are compatible with the format required by the IM calculator. This might involve transforming data from different formats, such as spreadsheets or databases, into a standardised format that the calculator can process
- **Data Integrity**: Data integrity is paramount. Ensure that data is accurately transferred from the source systems to Q-Calc without any loss or corruption. Implement data validation checks during the conversion process to identify and rectify any inconsistencies
- **Data Mapping**: Create a mapping between data fields in the existing source data and the corresponding fields within Q-Calc. This ensures that the right data is mapped to the appropriate fields during the conversion process

- **Data Cleansing**: Prior to conversion, perform data cleansing activities to identify and rectify any errors, redundancies, or inconsistencies in the data. Clean data is essential for accurate calculations and reporting in the new system
- **Data Transformation**: In cases where data needs to be transformed or calculated before being loaded into Q-Calc, ensure that the transformation rules are clearly defined and accurately applied
- **Data Security**: Implement appropriate data security measures during the conversion process to protect sensitive information from unauthorised access or breaches
- **Data Testing**: Rigorously test the data conversion process using sample data before migrating live data. This helps identify any issues or discrepancies that might arise during the conversion
- **Data Migration Plan**: Develop a comprehensive data migration plan that outlines the sequence of steps, responsibilities, and timelines for data conversion. This plan should also include contingency measures in case of unforeseen issues
- **Data Backup**: Ensure that proper backup mechanisms are in place for both the original data and the converted data. This is essential in case there is a need to roll back to the original data in case of unforeseen issues

6.5 Hardware/Software Requirements

All specifications applied in the interface requirements will be applied here also

6.6 Operational Requirements

The following requirements should be considered for system efficiency:

- **System Availability and Reliability**: The IM calculator should be always available and reliable, with a high uptime percentage. Downtime for maintenance and updates should be scheduled during off-peak hours and communicated in advance
- **User Management**: The system should provide functionality for user management, including the ability to create, and deactivate user accounts by the System Administrators
- **Data Security and Privacy**: The system should ensure data security and privacy and other sensitive information. It should implement appropriate security measures, access controls, data encryption, and comply with relevant data protection regulations
- **Scalability and Performance**: The system should be designed to handle a growing number of users. It should be scalable and perform efficiently even with increased system usage
- **Backup and Recovery**: Regularly back up the system's data and configurations. Establish a comprehensive disaster recovery plan to swiftly restore the system in case of data loss or system failure
- **Monitoring and logging**: The system should be designed to provide real-time monitoring and logging of system activities to enable system administrators to identify and address issues promptly
- **Compliance and Regulatory Requirements**: Ensure that the IM calculator adheres to relevant financial regulations and compliance standards. Implement necessary controls to meet regulatory obligations

- **Backup and recovery**: The system should be designed to perform regular backups and implement recovery mechanisms to ensure that data is not lost in case of system failures

6.7 Security and Privacy

The following security and privacy requirements are critical to ensure the confidentiality, integrity, and availability of the system. The system must comply with all applicable data privacy regulations, such as Nigeria Data Protection Regulation ("**NDPR**"), and other relevant data protection laws. The system must also be compliant with industry best practices such as the OWASP Application Security Verification Standard version 4 and associated vendor recommendations (e.g., Microsoft Security Guidance, Oracle Hardening Guides, etc.). At the minimum, the system must meet the security requirements as seen below:

- **Data Encryption:**
    - Ensure that all Personally Identifiable Information ("**PII**") data, both in transit and at rest use strong and secure encryption algorithms, such as Advanced Encryption Standard ("**AES**") or Twofish, to encrypt sensitive data. Avoid using weak encryption algorithms that can be easily cracked
    - **Encrypt Data in Transit**: Use Transport Layer Security ("**TLS**") or Secure Sockets Layer ("**SSL**") to encrypt data in transit between the web application and the client browser. This helps protect against eavesdropping and man-in-the-middle attacks
    - **Encrypt Data at Rest**: Store sensitive data in an encrypted format in the database or on disk. This helps protect against data breaches and unauthorised access to the data
    - **Use Key Management Best Practices**: Implement key management best practices, such as key rotation, to ensure that encryption keys are kept secure and are not compromised. Do not hardcode encryption keys in the application code or configuration files
- **Access Control:** Implement strict access controls to limit data access to authorised personnel only. Role-based access control ("**RBAC**") should be employed, granting different levels of access based on job responsibilities and the principle of least privilege including the use of complex passwords and multi-factor authentication
- **Consent and Transparency:** Obtain explicit consent from individuals to collect and process their personal data. Clearly communicate the purpose of data collection, how it will be used, and any third parties with whom it may be shared. Maintain a record of consent for auditing purposes
- **Data Minimisation:** Collect and retain only the necessary PII required for HR processes. Avoid storing unnecessary or sensitive information that is not directly relevant to the HR system's functionality
- **Anonymisation and Pseudonymisation:** Anonymise or pseudonymise personal data whenever possible, especially if it is not directly needed for HR processes. This reduces the risk of re-identification and protects individuals' privacy
- **Data Retention and Deletion:** Define clear policies for data retention and deletion. Regularly review and delete personal data that is no longer required for HR purposes, adhering to applicable laws and regulations
- **Employee Training and Awareness:** Provide regular training to HR staff and other relevant personnel on data privacy best practices, security protocols, and their responsibilities in handling PII. Promote a culture of data privacy awareness throughout the organisation
- **Vendor Management:** If there is a need to engage third-party vendors or service providers for the system, ensure they have adequate data privacy and security measures in place. Conduct due diligence when selecting vendors and establish data protection agreements that outline their obligations

- **Input and Output Handling:**
    - **Use parameterised SQL queries**: SQL queries should be crafted with user content passed into a bind variable. SQL queries should not be created dynamically using string concatenation. Similarly, the SQL query string used in a bound or parameterised query should never be dynamically built from user input. Queries written this way are safe against SQL injection attacks

- **Session Management:**
    - **Session Timeout**: Implement session timeout to ensure that inactive sessions are terminated after a specified time. This helps prevent session hijacking attacks by closing the session after a certain period of inactivity.
    - **Secure Session ID Generation**: Generate random and unpredictable session IDs to prevent session fixation attacks. Session IDs should be unique for each user and should not be guessable or predictable.
    - **Session Encryption**: Encrypt session data and the session ID to prevent eavesdropping and session hijacking attacks. Use SSL/TLS to encrypt session data in transit and store session data in an encrypted format in the server.
    - **Cookie Security**: Use secure cookies to transmit session data between the client and server. Secure cookies should have the 'secure' flag set to prevent interception by attackers, and the 'httpOnly' flag set to prevent client-side scripting attacks.
    - **Session Revocation**: Implement session revocation mechanisms to terminate sessions that are suspected to be compromised or hijacked. This helps prevent further exploitation of the session by attackers.
- **Software versions and updates**: At a minimum, the software used in and around the application must be up-to-date, and there must be no known vulnerabilities
- **Secure Coding:** The application must be developed using secure coding practices to prevent common security vulnerabilities, such as SQL injection, cross-site scripting (XSS), and buffer overflow attacks
- **Vulnerability Assessment and Penetration Testing (VAPT):** VAPT must be done against the OWASP Top 10 Web Application Vulnerabilities (Version 2021), and all identified vulnerabilities must be remediated

6.7.1 Audit Trail

The application must maintain a complete audit trail of all user activity to enable the identification of unauthorised access or data breaches.

6.7.2 Reliability

The system should be able to function correctly and consistently, without any unexpected failures or errors. Regular system maintenance and testing should be conducted to identify and address any potential issues before Go-Live.

6.7.3 Data Backup and Recoverability

The application must have a robust backup and recovery system in place to ensure that data can be restored in the event of a system failure or data breach

- If the system is unavailable to users (experiencing downtime) because of a system failure, the failure must be detected, and function will be restored within thirty (30) minutes to one (1) hour

- In the event the database is corrupted, the database must be capable of being restored to its condition of no more than one (1) hour before the corruption occurred

6.7.4 System Availability

The system must be always available to users daily, including weekends and public holidays.

6.7.5 General Performance

- **Response time for queries and updates**: The system should be able to respond to user queries and updates within a few seconds to ensure a seamless user experience. However, certain queries or updates may require more processing time, such as bulk updates. In such cases, the system should provide feedback to the user, indicating that the query or update is being processed and the estimated time for completion
- **Expected rate of user activity**: The system will experience activity anytime, daily including weekends and public holidays. User activity will be monitored and analysed by the System Administrators

6.7.6 Capacity

The system will be utilised by the FMDQ Clear team and a wide range of market participants who require CCP services. The system should be built to handle a large volume of users.

6.7.7 Data Retention

The data retention policy for the HR interview automation system outlines the guidelines for the retention and disposal of data collected, processed, and stored within the system. The system shall retain Personal Identifiable Information ("**PII**") for a period of seven (7) years from the date of data creation. Data archive and destruction will be conducted in a secure manner, ensuring permanent deletion or anonymisation. The policy will comply with applicable laws and regulations, provide mechanisms for employee consent and rights, maintain records of retention activities, and undergo periodic review to align with changing requirements and best practices.

6.7.8 Error Handling and Logging

Error messages should not reveal details about the internal state of the application. For example, file system path and stack information should not be exposed to the user through error messages. Implement proper error handling mechanisms to prevent information leakage and avoid exposing sensitive information to attackers. Use custom error messages and avoid displaying detailed error messages to users. Some development frameworks or platform may generate default error messages. These should be suppressed or replaced with customised error messages as framework generated messages may reveal sensitive information to the user

6.7.9 Validation Rules

All specified mandatory fields and business rules will be taken into considerations at the implementation phase

6.7.10 Conventions/Standards

- The system should comply with data protection and privacy laws and regulations, such as the Nigerian Data Protection Regulation (**"NDPR"**) and the Global Data Protection Regulation (**"GDPR"**)
- The system should adhere to industry-standard security protocols and frameworks

SSD - Development of an Initial Margin Calculator (Q-Calc)

Final Audit Report 2023-11-17

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