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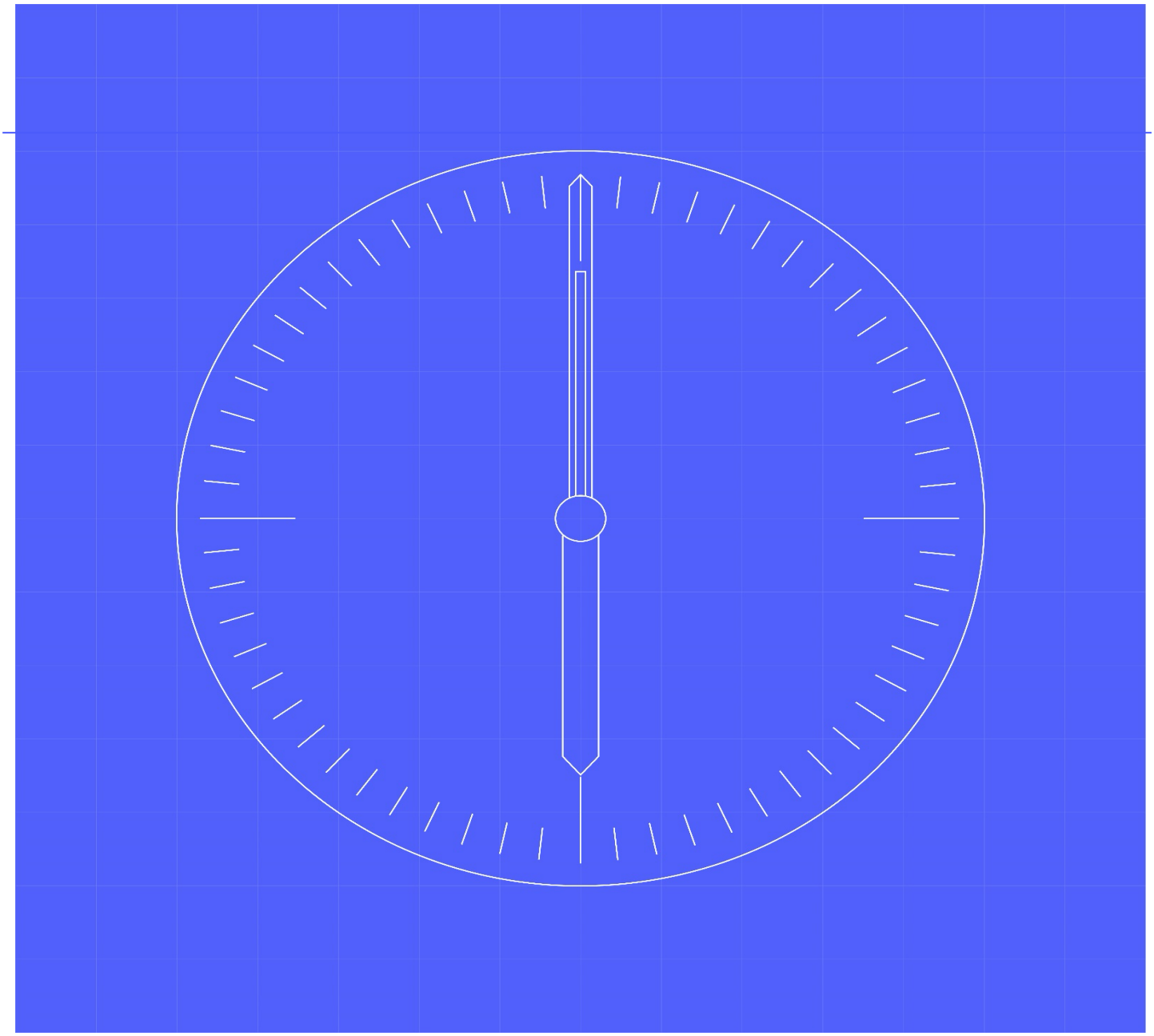
MHHS Non-Functional Testing Policy



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Tables

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1.1 Change Record

Date	Author(s)	Version	Change Detail
06/03/2024	MHHS NFT	0.1	Initial Draft
13/03.2024	MHHS NFT	0.2	Updates following LDP, SRO & Code Bodies review
18/03/2024	MHHS NFT	0.3	Approved version for Industry Review

1.2 Reviewers

Reviewer	Role
Lee Cox	SI Test Manager
Kevin Davis	SI Test Architect
Julia Ledden	SI Operational Test Manager
Paul Petit	Design
Cesar Lopes	SI Data Architect
John Wiggins	SI Migration Lead
Adrian Ackroyd	SRO Function Programme Test Manager
Smitha Pichrikat	SRO Function Client Delivery Manager
Phil Heiton	SRO SIT NFT/Operational Test Manager
Nicola Farley	SRO Qualification Test Manager
Code Bodies (BSC and REC)	Various

1.3 References

Ref No.	Document/Link	Publisher	Published	Additional Information
REF-01	MHHS-DEL315 - E2E Testing & Integration Strategy	SI Testing	29th April 2022	
REF-02	MHHS-E2E002 Requirements v3.1.xlsx	Design	13th July 2023	
REF-03	MHHS-DEL852 - Pre-Integration Test Guidance	SI Testing	18th March 2024	
REF-04	MHHS-DEL618 - Environment Approach & Plan	SI Testing	13th October 2023	
REF-05	MHHS-DEL813 - Overarching Test Data Approach and Plan	SI Testing	5th May 2023	
REF-06	MHHS-DEL1332 - Test Management Tool User Guide	SI Testing	16th June 2023	
REF-07	MHHS-DEL1064 - Placing Reliance Policy	SI Testing	27th April 2023	
REF-08	MHHS-DEL466 - Defect Management Plan	SI Testing	23rd May 2023	
REF-09	MHHS-DEL1089 - Release and Configuration Management Approach & Plan	SI Testing	17th May 2023	
REF-10	MHHS-DEL1139 - MHHS Outline Plan	SI Testing	See MHHS Website	
REF-11	MHHS-DEL466 - Defect Management Plan	SI Testing	23rd May 2023	

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REF-12	MHHS-DEL030 - Programme Governance Framework	PMO	08th Mar 2023	
REF-13	MHHS-DEL1140 - Milestone Register	PMO	11th Oct 2023	
REF-14	MHHS-DEL2128 NFR Categorisation	SI Testing	In Development	
REF-15	MHHS E2E003 - End-to-End Solution Architecture - Transaction Volumes	MHHS DAG	25th Sept 2023	
REF-16	MHHS-DEL2324 Initial BAU Volume Model	MHHS DAG	13th Feb 2024	
REF-17	MHHS-DEL1259 SIT Functional Test Approach & Plan	SI Testing	16th Aug 2023	
REF-18	MHHS-DEL1118 Qualification Approach and Plan	BSC & REC Code Bodies	31st Jan 2024	
REF-19	MHHS-DEL396 MHHS-DIP002 Functional & Non-Functional Requirements v2.2	MHHS DAG	18th Jul 2022	
REF-20	MHHSP_OPC001_Operational_Choreography	MHHS DAG	21st Sept 2023	
REF-21	Requirements traceability SIT F OOS v2.xlsx	MHHS DAG	15th Nov 2023	
REF-22	MHHS-DEL2127 SIT Non-Functional Test Approach & Plan	SI Testing	18th March 2024	
REF-23	NFT_Testing_Agreed_Scope_On_A_Page	SRO	8th Mar 2023	

1.4 Terminology

Term	Description
Various	For terminology, see Programme glossary on the MHHS portal: Programme Glossary (sharepoint.com)

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2 Executive Summary

The Market-wide Half Hourly Settlement programme (MHHS), when completed, will contribute to a more cost-effective electricity system, encouraging more flexible use of energy and helping consumers to lower their bills.

This document describes the overall Non-Functional approach to testing and the manner in which all parties involved in the MHHS programme will conduct testing. It spans initial testing of individual systems through to complete E2E tests, the major phases of testing being:

- **Pre-Integration Testing (PIT)**
- **Systems Integration Testing (SIT)**
- **Qualification Testing (QT)**

Non-Functional Testing (NFT) will form a stage of testing within each of these major phases. This document intends to set out the approach taken to how NFT will be conducted across these phases, ensuring that testing is delivered in a consistent manner, with no duplication of effort, to prove that the systems and solutions being delivered as part of this programme conform to the MHHS Design, meet Non-Functional requirements, and are fit for purpose.

The Programme has a defined set of documentation which will be produced to support the preparation and conduct of each phase/stage of delivery. This policy, or strategy, document specifically relates to NFT stages across each phase of delivery, describing the associated objectives, scope, approach, and schedule of these stages of testing.

This will provide a high-level view of NFT delivery, where additional detail is required, i.e. detailed stage scheduling, management, governance and assurance of each test stage, these details will be contained within the following documents:

- For PIT - [REF-03] MHHS-DEL852 - Pre-Integration Testing Guidance
- For SIT – [REF-22] MHHS-DEL2127 SIT Non-Functional Test Approach & Plan
- For QT – [REF-18] MHHS-DEL1118 Qualification Approach and Plan

Therefore, it is recommended that, for context, the documents listed above are read in conjunction with this document.

As an overview of this document, the MHHS Programme intends to carry out the bulk of Non-functional testing, at expected volumes, as early within the delivery cycle as possible. This approach allows systems to be exercised under production like scenarios, as early as possible, i.e. PIT NFT stages of test execution. This allows for a more targeted approach to NFT to be carried out on the integrated systems during the SIT NFT test stage. Concentrating on solutions that are new for this programme, namely DIP and Helix, followed by a full suite of integrated NFT, targeting areas of infrastructure not previously covered during earlier stages of testing, namely the interfaces and their behaviours under various simulated conditions (buffering, successful release of messages when an interface returns to action etc) under scaled volumes of traffic (scaled volumes as each Central Party and Programme Participant solution’s capacities would have been previously validated during PIT delivery.

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3 Introduction

3.1 Document Purpose

This document, the Non-Functional Test Policy is intended to provide a high-level overview of NFT delivery as part of the MHHS Programme. As summarised in section 2, the main purpose of this document will be to provide a summary of the overall scope and approach to delivery of Non-Functional Testing across multiple phases of delivery.

The MHHS Non-Functional Test Policy (this document) sits within a two tier MHHS Test documentation hierarchy. Please note this document references tier 1 parent documents throughout and doesn't seek to repeat content contained within them, readers will be sign posted to these documents for further detail where relevant. This document also refers to tier 2 child documents that will be produced later.

This Non-Functional Test Policy will cover:

- Test Objectives
- Scope
- Architecture and Coverage
- Approach, and the rationale behind this approach to:
    - PIT NFT
    - SIT & QT NFT Phase
    - Migration
    - Operational Choreography
- MHHS Programme Schedule

This document is intended to be read by the following groups:

- SRO Function (SRO)
- Lead Delivery Partner (LDP)
- Migration Working Group (MWG)
- SIT Working Group (SITWG)
- Systems Integration Testing Advisory Group (SITAG)
- Qualification Advisory Group (QAG)
- Non-Functional Testing Working Group (NFTWG)
- All Programme party teams and resources involved in NFT execution or support.
- BSC and REC Code Body Qualification teams
- Independent Programme Assurance (IPA).

3.2 Reviews and Approvals

The SIT Non-Functional Test Approach and Plan will go through initial LDP review by the following team members:

- Lee Cox, SI Test Manager
- John Wiggins, SI Transition Lead
- Cesar Lopes, SI Data Architect
- Simon Berry, SI Environments and Release Manager

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- Paul Pettitt, Design Lead
- Nicola Farley, SRO Qualification Test Manager
- Julia Ledden, SI Operational Test Manager

Upon completion of LDP review, any comments and feedback would be incorporated before going to the SRO and Code Body Teams teams for formal review by:

- Adrian Ackroyd, SRO Client Programme Test Manager,
- Smitha Pichrikat, SRO Function Client Delivery Manager,
- Kiran Raj, SRO SIT Functional Test Lead,
- Phil Heiton, SRO SIT NFT/Operational Test Manager,
- Code Bodies (BSC and REC)

Upon completion of the SRO and Code Body review it will then be distributed to the NFTWG for consultation, where comments will be incorporated leading to a recommendation for SITAG and QAG approval.

Approval will then be requested from:

- Systems Integration Testing Advisory Group (SITAG).
- Qualification Advisory Group (QAG).

The document will be made available for information via the programme portal.

3.3 Change Forecast

The SI team will own this document and keep it up to date, with review and approval by MHHS programme governance as appropriate. Each new version supersedes the previous version in its entirety.

This document, alongside updates to [REF-03] MHHS-DEL852 - Pre-Integration T**e**st Guidance **and [REF-22]** MHHS-DEL2127 SIT Non-Functional Test Approach & Plan are to be issued and reviewed in conjunction with each other, in order to highlight the total scope and approach to NFT testing for the MHHS Programme, once a greater degree of maturity has been reached on these artefacts, they will be socialised and developed in consultation with the NFTWG and the agreed output, if required, will be formalised in a new full version of this document that will be targeted for approval in the May-24 SITAG.

All updates to this document will follow the review and approval process outlined in section 3.2.

3.4 Summary of Changes

N/A for initial draft

3.5 Assumptions and Dependencies

3.5.1 Assumptions

- Production or scaled PIT environments are stood up for PIT NFT Phases of execution.
- ‘E2E’ NFT testing within Central Parties and PP’s PIT environment is physically possible, i.e. the DIP Adapter interface to/from DIP is the end point to the solution under test.
- Participants can interface with SIT-B and load clean data, including existing data from their systems.
- SIT Participants will have conducted E2E connectivity tests to SIT-B and ensured correct PKI certificates are validated prior to commencement of testing.
- Suitable test data creation tools exist and are utilised within the solutions under test, e.g. ‘aged’ data storage.

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- Overlap with Operational Testing phase, there will be some overlap with OT in terms of observability and general industry best practice, i.e. interface failure, monitoring, and dashboards in use. To minimise duplication of test effort, SI NFT and SIT Operations teams will work closely to ensure that where there is overlap, there will be no replication of testing between NFT and Ops stages of delivery.
- MHHS SI test teams will support participants with their data requirements, scheduling of NFT, including, but not limited to the scheduling of specific failures on dependent systems like DIP, Helix etc.
- Test acceptance activities will be undertaken by Core Systems Providers in PIT/SIT phases before deployment into UIT.
- Preceding test phases, Functional phases of PIT and SIT, have met their aims and scope.

Dependencies

- Suitable Test data creation tools are utilised to create realistic ballast storage levels in both PIT and SIT environments.
- Use of MHHS DIP simulator, this has not been built for performance testing loads, a suitable solution should exist within PP PIT environments to simulate inbound/outbound traffic from DIP at volume.
- Re-use of Participant's PIT message injection tools, test stubs/harnesses for NFT SIT and NFT QT phases of testing (see section 6.2). A series of bi-lateral meetings to discuss the use of these existing tool sets will be setup between the SI and relevant participants once there is a greater understanding of the NFT data plan and NFT Scenarios.

-

4 Objectives

4.1 Objectives

The objective of carrying out NFT over multiple phases is to successfully demonstrate that all Non-Functional Requirements, as specified within [REF-02] E2E MHHS E2E Functional & Non-Functional Requirements, have been met. Allowing for an informed decision to be made against the stability, suitability and capability of the solutions being delivered as part of the MHHS programme.

This NFT policy document sets out the testing framework, objectives, and approach taken to Non-Functional Testing across the programme. The purpose of the document is to:

- Deliver an approach to Non-Functional testing to ensure that all NFRs are met, tested within the appropriate test phase in a practicable and achievable manner.
- Define the testing scope and approach that is necessary to demonstrate that services can operate under the new MHHS arrangements.
- Identify and inform Central Parties and Programme Participants of the activities and responsibilities to be able to successfully complete Non-Functional testing.
- Ensure that the NFR Categories comply with all code and delivery bodies expectations and fit in with industry standard best practice.

This overarching NFT policy/approach will define the required route to:

- Implement a robust approach to NFT over multiple phases of testing that will reduce the likelihood of service outages, with execution scope to cover application, server, hardware resilience and data loss.
- Ensure that performance and capacity are measured and tested according to predicted volumes and growth.

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5 Scope

5.1 In Scope

As briefly covered within section 3.5.1, given the split between NFT and Operational Testing, there will be some overlap in terms of NFRs and assurance, where this occurs, it will be called out within this document, with further details on the specific scope for each phase of testing to be detailed within [REF-03] MHHS-DEL852 - Pre-Integration Test Guidance, MHHS-DEL2127 SIT Non-Functional Test Approach & Plan and respective Operational Testing Approach documents.

With NFT expected to be carried out over both PIT and SIT phases of delivery, we can further define the scope by:

- PIT NFT:
    - Operational SLAs/ Performance efficiency – Performance testing of each programme participants solution at expected loads, as defined within the NFR and Message Modelling documents referenced within section 1.3. Effectively an individual participant's SIT. Scale and scope of environments that are recommended to be utilised in this phase for NFT can be found within section 6.2, the full scope of expected performance testing can be found within section 7.1
    - Component Resilience (event/message buffering when failing to communicate with MHHSP central system). During PIT, the definition of a component can be related to all layers of infrastructure, from web/application/DB servers through to containers, interfaces, and DIP adapters if these are an area where message buffering is expected to take place.
    - Recoverability (Data Loss) – While an Ops related NFR, if data synchronisation between environments can be validated whilst a system is under load, this would go a long way to providing assurance that the NFR of zero data loss can be meet at an early stage of delivery.
    - Migration and Operational Choreography (at expected volumes) – These areas of planned processing have defined NFRs and windows of processing. Exercising individual participants solutions in siloed PIT environments will go a long way to providing assurance that the production environments planned to be implemented are fit for purpose, at an earlier stage of delivery.
    - Observability – taking industry best practices where NFRs do not exist and, taking into account the overlap between NFT and Operational testing, this is a contested area of assurance. The NFT team are making an assumption that toolsets utilised for the validation of NFT results will form some part of participants delivery within this area and so also assuming that where NFRs exist around this area, will come under the SI's NFT team for assurance at an earlier stage of delivery than Operational Testing.
- SIT NFT:
    - Operational SLAs/ Performance efficiency – Taking each Central Party and Programme Participants systems as individual components within MHHS infrastructure, scaled volume, integrated, testing to be carried out as a means of ensuring areas not under test during PIT, namely E2E interfaces and the transfer of data between them, are not detrimentally affected. Scale and scope of environments that are recommended to be utilised in this phase for NFT can be found within section 6
    - Reliability/Recoverability (event/message buffering when failing to communicate with MHHSP central system) – With the SIT phase of testing treating each interface as a component rather than the internals of the participants solution themselves, this will be a means of exercising areas of the end-to-end infrastructure interfaces in a targeted manner not achievable during PIT. As all solutions will have been tested under volume during PIT stages of NFT, the behaviour of interfaces between systems and subsequent release of messages on these being re-instated will be exercised during this phase of activity. It should be noted that as each participants solution has already been validated at volume during PIT stages.
    - Security – NFR's around PKI and levels 1 through to 4 validations will take place during SIT NFT delivery, this is the first point in time that these systems will be physically connected to the DIP allowing this validation to take place. In terms of a full set of security tests, the requirements and approach to testing of these will be clarified within the Operational Test Phase documentation.
    - Compatibility (message or schema validation) – as above

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    - IF-021 Integrated testing (SIT Only) – This is a completely new route, and responsible for roughly 90% of the network traffic across this programme, as part of the NFT 'targeted' interface testing, E2E testing of this message processing will form an initial phase of SIT NFT, new systems, new interfaces means that this fits into the overall approach taken to NFT across delivery phases,
    - Migration/Operational Choreography – As detailed above, given the numbers of participants involved within the SIT environment, and physical end points available within the SIT-B environment, settlement and migration processing will be carried out at scaled volumes in order to determine the overall effect of this within an end to end environment, however, we need to note that some areas will not be available, therefore full testing at volume will not be available. To mitigate these factors, the MHHS NFT team believes that carrying out the scheduled processing as defined within both the migration and operational choreography documents referenced within section 1.3 can be utilised during the PIT phase of delivery to determine infrastructure behaviour under load, with the SIT phase targeting how the systems will manage data loss during infrastructure failures not covered during the Operational Phase of test execution.
    - Observability – As with PIT, a level of crossover with Operational Testing will occur. In terms of compatibility based NFRs, messages must be traceable via participant/DIP created reference and transaction IDs should any issue occur during E2E processing.
- Qualification NFT:
    - Operational SLAs/ Performance efficiency – Suitably scaled volume, integrated to DIP, testing to be carried out as a means of ensuring areas not under test during PIT, DIP interfaces and the transfer of data between them, are not detrimentally affected. Scale and scope of environments that are recommended to be utilised in this phase for NFT can be found within section 6
    - Reliability/Recoverability (event/message buffering when failing to communicate with the DIP systems this phase of testing will treat each interface as a component rather than the internals of the participants solution themselves, this will be a means of exercising areas of the end-to-end infrastructure interfaces in a targeted manner not achievable during PIT, namely DIP connectivity. The behaviour of interfaces between systems and subsequent release of messages on these being re-instated will be exercised during this phase of activity. It should be noted that as each participants solution has already been validated at volume during PIT stages.
    - Security – NFR's around PKI and levels 1 through to 4 validations will take place during QT NFT delivery, this is the first point in time that these systems will be physically connected to the DIP allowing this validation to take place.
    - Compatibility (message or schema validation) – as above
    - Migration/Operational Choreography – Given the numbers of participants involved within the QT environment, detailed within [REF-18], simulated settlement and migration processing will be carried out at scaled volumes in order to determine the overall effect of this within the targeted QT environment, however, we need to note that some areas will not be available, therefore full testing at volume will not be available. To mitigate these factors, the MHHS NFT team believes that carrying out the scheduled processing as defined within both the migration and operational choreography documents referenced within section 1.3 can be utilised during the PIT phase of delivery to determine infrastructure behaviour under load, with the QT phase targeting how the systems will manage data loss during infrastructure failures not covered during the Operational Phase of test execution.
    - Observability – As with PIT, a level of crossover with Operational Testing will occur. In terms of compatibility based NFRs, messages must be traceable via participant/DIP created reference and transaction IDs should any issue occur during E2E processing.

For more details on scope of Non-Functional testing types, evidence requirements and environment scope please refer to [R**EF-**14] MHHS-DEL2128 NFR Categorisation (please note that this is still as document in progress and so subject to change). However, for NFT delivery over all phases and stages of testing, the following roles will be involved:

- Data Integration Platform (DIP)
- BSC Central Services
- Registration Service (REGS)
- Smart Data Service (SDS)
- Advanced Data Service (ADS)
- Metering Service Smart (MSS)
- Metering Service Advanced (MSA)
- Electricity Suppliers

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- Network Operations
- Electricity Enquiry Service (EES)
- Unmetered Supplies Operator (UMSO)
- Unmetered Supplies Data Service (UMSDS)
- DCC (DSP) – Not within scope of SIT NFT (SEC Mod MP162), however, MHHS will have a stake in the results from the testing carried out by the DCC and would therefore require the DCC to provide a level of assurance to their systems capacity and performance testing results.
- DCC (CSS) – Only a single instance of CSS is to be made available to the integrated SIT environments, this will be provisioned to SIT-A, as such there will be a limitation on business processes involving CSS during SIT NFT, this will be taken into account as the NFT Scenarios are being completed.
- Electralink (DTN) – no test environment for DTN exists, this area will be stubbed if/where required.
- MPRS – Within SIT NFT, we are limited to 2 volunteer LDSO's, the scope for this area of infrastructure under NFT will be further defined once there is a greater understanding of the test data design and volume, alongside NFT Scenarios.

5.2 Out of Scope

- Any form of functional testing within the MHHS Programme, during PIT, SIT or QT phases.
- All other PIT and SIT Stages of testing – these will be the subject of separate Test Approach and Plan documents:
    - Component Integration Test
    - Functional Test
    - Operational Test
    - Migration Test (Functional Test)
- UIT Test Stages:
    - Qualification Test (Functional Test)
    - E2E Sandbox.
- Data cleansing activities and processes prior to Go Live

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6 MHHS Architecture and Coverage

6.1 Architecture and Scope

With the overarching approach to NFT being to test at volume, as early within the delivery cycle as possible, this section will provide a high-level overview of the environmental requirements that we believe necessary in the successful delivery of the MHHS programme, in addition to the following limiting conditions against both the SIT-B and UIT test environments:

- Not all programme participants testing within the same tranche,
- Participants placing reliance on 3rd parties,
- The need for some form of correlation between testing carried out during SIT and QT NFT,
- Environment scale, following on from [REF-01], no repetition of tests over stages (if systems have been tested at volume during PIT, assurance has already been provided for these requirements) – Suitably scaled volume tests targeted to untested interfaces to determine characteristics under error etc,
- A large proportion of systems being implemented into this programme already exist, while additional processing may be main drive behind NFT testing, existing performance profiles in conjunction with results gather during PIT will provide the level of assurance required for successful delivery.

The following sections will outline the environment scope and coverage that is expected throughout delivery to this programme.

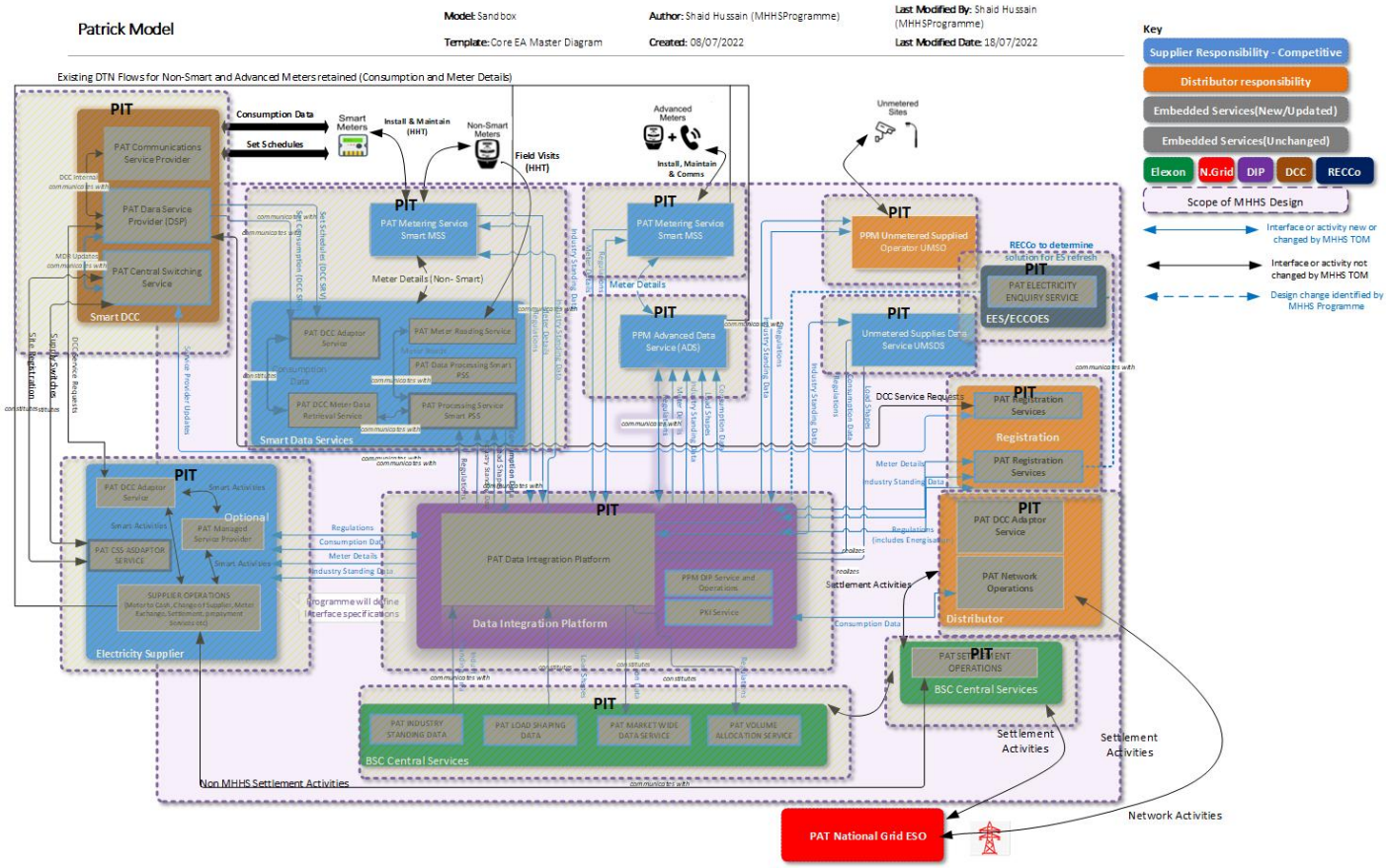

Figure 1 – TOM - PIT Coverage

Figure 1 – TOM - PIT is a loosely based diagram to highlight the scope of coverage for the recommended PIT NFR stages of testing, please note that expected end points for each PIT environment would be the points of ingress and egress, within each participants solution, to the DIP. As a means of ensuring that capacity and time behaviour NFRs can be met, it is recommended that where DIP Adapters are utilised, that these also fall within the eco system under test, this would ensure that any latency introduced by these layers of infrastructure are also taken into consideration when execution is taking place under anticipated volumes of message processing.

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Additionally, including these layers of infrastructure would, where adapters are responsible for error handling and/or buffering of messages, ensure that test execution against data loss NFRs can also be validated.

Where the inclusion of DIP adapters is not a feasible option for PIT NFT, a level of assurance against NFT carried out by the vendor providing the adapters must also be carried out, with evidence provided to the MHHS programme as part of their PIT deliverables.

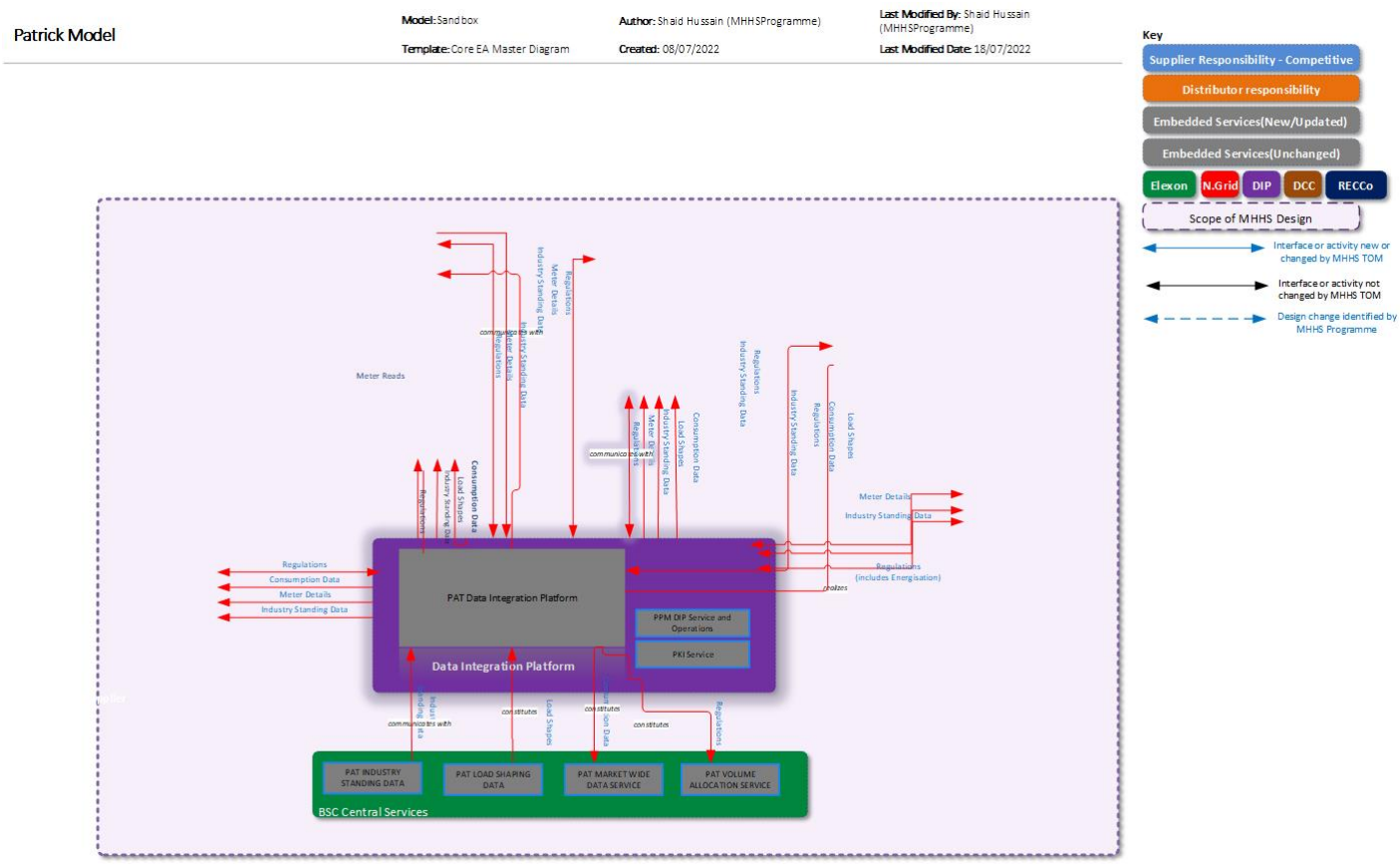

Figure 2 – TOM – SIT Phase 1

Given that the majority of systems being delivered as part of this programme are already in production, with the new interfaces to MHHS systems forming additional NFRs on top of an already known daily processing profile. SIT has been split into two main phases of delivery, with phase 1 targeting new systems, and new interfaces.

As stated in section 5.1, IF-021 is responsible for roughly 90% of the messaging volume across this TOM. With this being the case, a decision has been made to include a level of integrated testing to validate the processing of this business process, including relevant participants and interfaces within the TOM. There are some options available in terms of the environments to use for this phase of NFT SIT:

- Increase the stacks for DIP and Helix to production like environments.
- Stand-up NFT PIT/Pre-Production environments and interfaces between DIP and BSC Central Systems (Helix) in order to exercise this NFT.

A decision on these available options will be driven out of bi-lateral meetings between all involved parties.

While the physical scale of these test environments is still to be determined, the planned volume of messages will be scaled to a suitable level to exercise both the participant systems and interfaces, utilizing DIP load injection methods from DIP PIT testing, and test stubs or harnesses already used during DIP PIT test execution phases. In theory, this would allow for the re-use of, albeit tailored to match test data across the selected systems, of previously used data sets from PIT testing.

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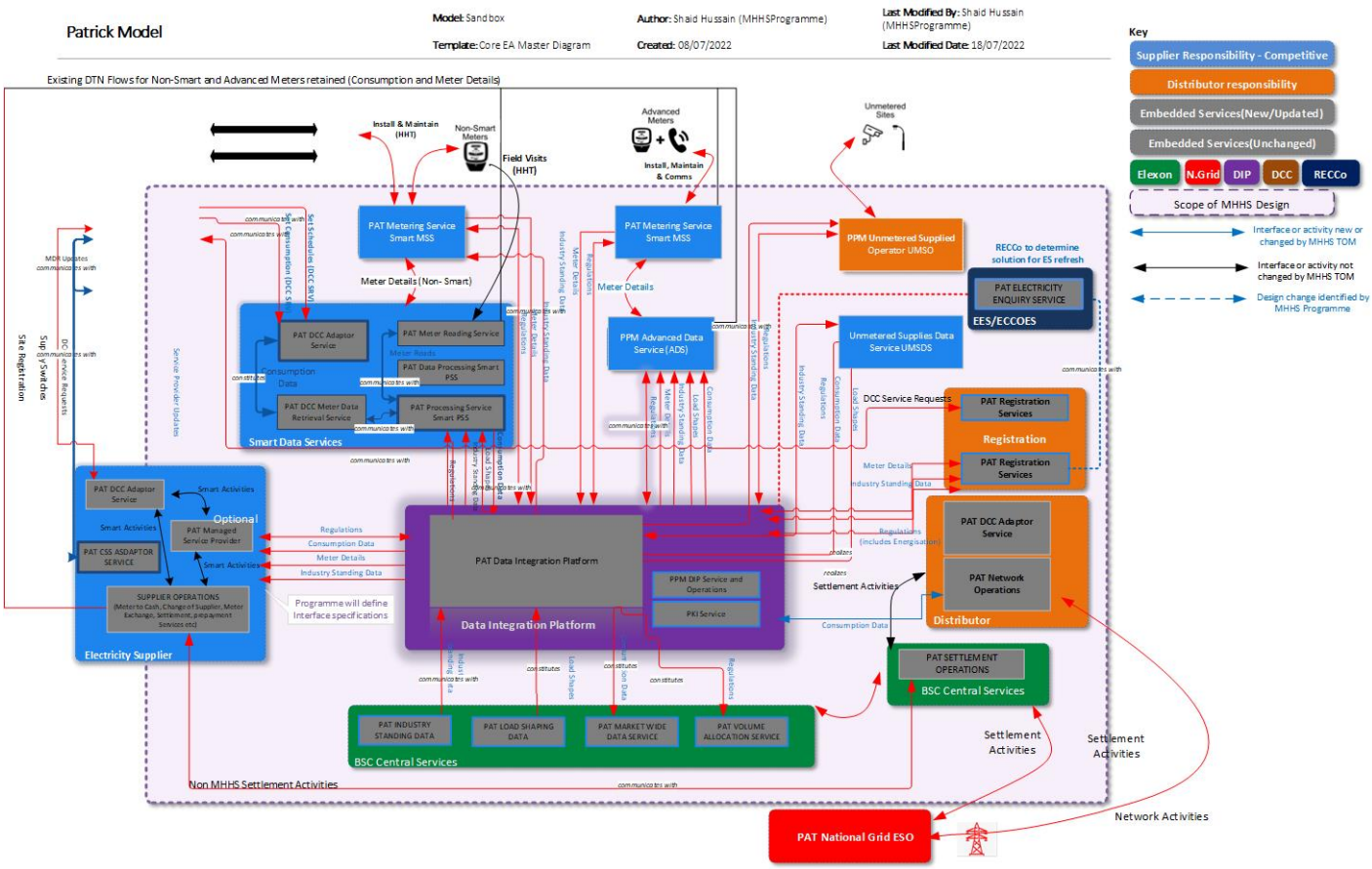

Figure 3 - TOM - SIT Phase 2

As with previous phases of NFT, with the overarching approach being not to repeat testing across phases, the bulk of execution for this phase will be targeted at the interfaces between systems themselves, i.e. the only remaining new layers of untested infrastructure. With the proviso that volume/capacity testing has been successfully completed up to the end points of a Participants infrastructure, validation during phase 2 of SIT NFT will concentrate on scaled volumes of E2E processing, and interface error

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handling (highlighted red in

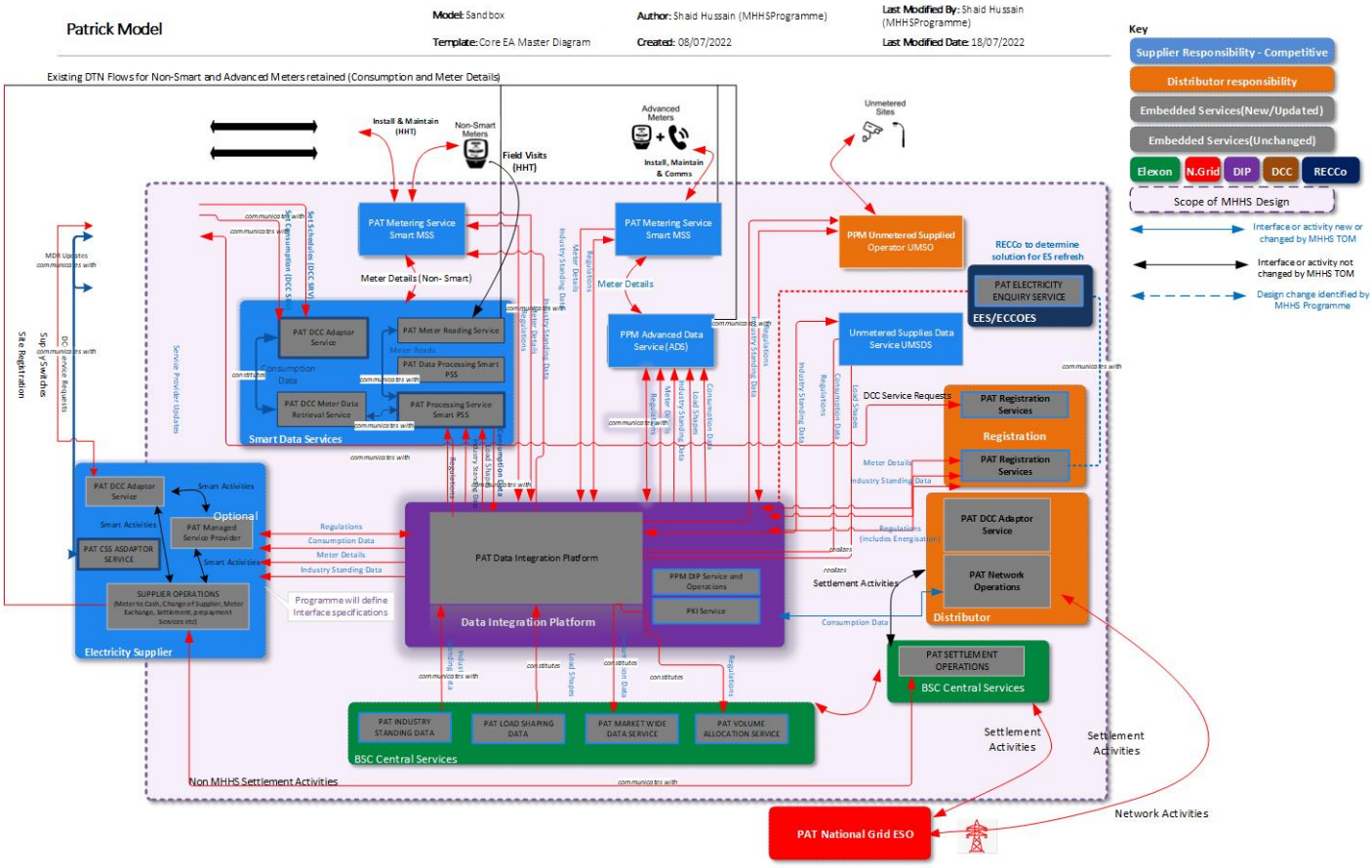

Figure 3 - TOM - SIT Phase 2). Using this level of testing will ensure that NFRs around data loss and buffering (and the successful release and onward processing of buffered messages) are validated in an end-to-end environment.

6.2 Environment Requirements

6.2.1 PIT Environment

The main, overarching recommendations from the MHHS Programme around PIT environments being stood up for NFT testing are:

- Aligned in design and scale to the participants expected production environment as closely as possible. If this is not a feasible option for participants, for example the design is 'swim-lane' based, then evidence of horizontal scaling will also need to be provided as part of capacity NFR assurance process.
- Points of ingress and egress to DIP, if DIP Adapters are utilised, it is recommended that these form the end points for NFT within the PIT environment. Assurance of NFRs around data loss, time behaviour, and reliability would be difficult if this layer of infrastructure does not form part of the PIT scope when running at expected messaging rates/volumes,
- Data Storage, Operational Choreography has a 'To-Be' Timescale up to the Final Reconciliation Run of 84 working days, as part of OC and migration testing being conducted within PIT, this should be a minimum requirement for data storage for realistic processing times to be collated during NFT. Where possible, obfuscated copies of existing production data should be utilised as ballast during test execution.
- DIP Simulation, the DIP simulators provided by the programme have not been built with Non-Functional Capacity Testing in mind. It is recommended that Participants utilise their own test stubs/harnesses to simulate this area when testing at Capacity, these may already exist where DIP Adapter vendors have carried out their own internal performance testing.

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- Where participants approach to PIT NFT differs from the above, this will be resolved via Bi-Lateral meetings to drive through to a suitable solution.

6.2.2 SIT NFT Environment

As PIT NFT will form the bulk of testing at NFR stated volumes and capacity, a more focused approach to both phases of SIT NFT will be carried out, utilising scaled load profiles.

The MHHS programme has proposed running a semi integrated IF-021 cycle of tests for the initial phase of SIT NFT. This is planned to be run at BAU levels of message throughput, scaled to a suitable level to match the environments stood up by both DIP and Helix participants.

Based against volumes of traffic defined within [REF-16] MHHS-DEL2324 BAU Message Model, a scaled 'peak' load of traffic based of both Smart and Traditional Meters will be simulated for processing within the DIP and Helix systems for consumption data processing. Registration Services, Suppliers, LDSO and EES systems will be stubbed for this phase of testing as the main focus for processing are the new systems being implemented as part of the MHHS Programme.

Phase 2 will incorporate all other participant systems that have formed the scope listed within section 5.1. However, unlike the initial phase of SIT, these systems are, on the whole:

- Existing participant systems, being updated to fit into the TOM.
- Have already had capacity/volume testing as part of their PIT NFT stage of execution.

With the focus being based around interface behaviour, the load will be scaled to a suitable level. As a means of exercising error handling and processing profiles within this stage of execution, the support of all involved participants will be required. Scheduling and the type of issues that will be simulated during execution will be detailed within the SIT NFT Test Scenarios and Test Cases (these are still a WIP and will be issued for review once the NFT Approach document pack becomes more stable post SRO, Code Body and Industry reviews).

In terms of process start/injection points, these will be identified within the SIT NFT Test Scenarios and Test Case creation process. Participant support will be required in the replication of message injection/start point tests under scaled the levels of load (tbd). At the time of writing, the re-use of load injection toolsets from Participant PIT NFT test execution is the preferred option to carry out these suitably scaled volume simulations.

6.2.3 QT Environment

Aligned with SIT-B requirements for Phase 2, scaled volume processing, in terms of environments being delivered being capable of processing some form of scalable volume of messaging.

Given the scope of roles available within the QT test infrastructure, further analysis of achievable testing and to what volumes will be required. This will be determined as the SI NFT team complete their test scenario analysis. This will be further documented either within an appendix of this document, or within [REF-18] whichever is more suitable for review by all relevant parties.

A review of existing test harness/stub collateral is being carried out, it is envisaged that given the scope of Qualification functional testing, that a new method of simulating registration parties will be required to generate a scaled volume of traffic across the UIT infrastructure for LDSO NFT QT testing.

At the time of writing, the re-use of load injection toolsets from DIP PIT NFT test execution is the preferred option, making use of existing test stubs or harnesses for message acceptance and processing outside of the scope of QT delivery. As the SI NFT team are defining the NFT Scenarios, a series of bi-lateral meetings between all relevant participants will take place to drive further through toolsets available, suitable, and transferable to the Qualification Test infrastructure.

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7 Test Approach

As intimated up to this point within this policy/strategy document, NFT will be delivered during multiple stages of testing within the programme. No delivery programme of this size is without risk, the aim of each stage of testing is to de-risk later stages and the eventual release to production of these systems, and not replicate test types, as we move from PIT through to integrated testing in SIT and Qualification.

The definition of the 'shift left' approach being taken to NFT, is to move testing to earlier stages within the development lifecycle taking into consideration the feasibility of carrying this type of testing on each proposed test infrastructure:

- Complexity of data/integrated systems.
- Complexity of defining and creating required levels of test data.
- Test environment maintenance.
- Tracking and co-ordination of NFT.
- Cost to implement.

Taking these bullets into consideration, the programme has developed the following approach to NFT and types of testing, NFR categories to be validated/assured for each phase of delivery.

[REF-14] MHH**S**-DEL2128 NFR Categorisation can be utilised in conjunction with this document, as a means to compare the programmes expectations of stages we believe NFRs can be assured at, and some additional details around evidence requirements for these.

7.1 Pre-Integration Testing

The PIT phase of testing is focussed on the participants own testing, proving that they have designed, developed, and tested their systems to align with the programme's NFRs. Effectively a participant's internal SIT phase should they be implementing a multi system solution as part of this programme. With environment requirements detailed within section 6, we would expect participants to carry out for following test types at the anticipated volumes of traffic, defined in [REF-16]

- Full Performance/Capacity/Load Test Suite:
    - Low volume initial testing
    - Peak volume - including migration and Operational Choreography throughput)
    - Full stack assurance – all areas of participant infrastructure
    - Extended soak - including migration, Operational Choreography, effectively a day(s) in the life of a Participants system, including scheduled jobs/batches etc.
    - Spike
- Resilience – Internal solution components including adapter layer within the test infrastructure.
- Reliability/Data loss – Error handling (simulation of DIP issues at volume/buffering NFRs)
- Operational Choreography – At expected volumes of traffic, processing within defined windows of activity as defined for this area of processing, additional testing of message handling when inbound/outbound traffic misses these set windows. With the inclusion of a viable set of ballast data for processing, see section PIT Environment to provide assurance against data growth in the system.
- Migration – As above, ensure that there is no degradation in service while the migration of MPANs is taking place.
- Throttling of processing rates by participants, where this configuration type is in place and breached.
- Observability – taking industry best practices where NFRs do not exist, assurance of reporting, alerts etc. This level of assurance can take the place of using participants monitoring processes as a means of validating performance results, i.e. expected numbers of messages injected V messages successfully processed etc.

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7.2 Systems Integration Test

Following section 7's overview of the decision process, SIT NFT will be split into two distinct phases of delivery:

- Phase 1 - Validation of new systems and interfaces in a near end to end, integrated environment
- Phase 2 – Targeted interface testing, effectively the ongoing assurance of interface behaviour under error and error resolution

As solution processing, under load, has already been validated during the PIT stage of delivery, the volumes of traffic expected to be generated will be scaled to suite the infrastructure size (Phase 1), and scaled further down for Phase 2 (assurance of PIT and the fact that these are already proven production systems adapted for the MHHS Programme).

7.2.1 Phase 1 NFT SIT

The main factor behind this phase of NFT is to identify and exercise new areas of infrastructure, these will have already been assured during PIT NFT, but as means of further reducing the risk for successful delivery, a cycle of NFT will be carried out against the processing of IF-021 messages (Meter Consumption Data Processing) where the various parties involved in this processing being integrated. This message processing was selected as it accounts for roughly 90% of the overall traffic expected within this programme.

To fully understand the processing involved, the proposal is to exercise this process at a scaled volume of traffic relative to the participants test environments. Re-use of DIP simulation of inbound traffic from SDS is the preferred method of kicking off the processing itself. Test data alignment will need to be matched by all involved parties (DIP and Helix). Given the end points for consumption data are the supplier, registration and LDSO roles, i.e. existing systems, we believe that these areas can effectively be stubbed, and so for this phase of SIT, may make the creation of the required amounts of MPANs for processing a little less complex than for complete E2E execution as in Phase 2.

We are not exercising the performance of the end points, focussing on the message journey for processing within the selected areas of the TOM for this specific test, namely DIP and Helix.

To gain enough data points for analysis of the results, we would expect to carry out at least 3 cycles of scaled load testing across this configuration. The load will be based around the injection of Smart and Traditional Meter data from the SDS to DIP for processing.

7.2.2 Phase 2 NFT SIT

Following on from Phase 1, the final areas remaining un-validated, are the interfaces between all involved programme parties. In terms of what has been achieved in terms of assurance up to this point, we have:

- Assured the performance of participant systems under volume/load (PIT)
- Assured against the relevant NFRs for message processing, error handling and buffering at volume (PIT)
- Windows of processing for Operational Choreography at volume (PIT)
- Resilience within a participants own infrastructure (PIT)
- E2E simulation of Meter Consumption Data Processing (SIT)

The planned approach to testing within this phase of SIT, will focus on:

- The end-to-end processing times of a suitably scaled volume of messages – a comparison can be made against the initial low volume message processing times captured during PIT NFT
- The behaviour of message handling within integrated environments should issues occur with interfaces. Unlike a DR activity, specific interfaces will be targeted. Unlike similar testing carried out during PIT, testing of this type will allow us to determine the behaviour of systems when interfaces are actually made unavailable, i.e. message buffering NFRs, additionally, the successful processing of messages by the subsequent systems down the line of the business process.

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- Additionally, where interface behaviour is being exercised, a level of Observability can be assured in terms of tracing buffered messages, through to successful processing at their expected end points.

There will be a level of reliance on the support of programme participants in terms of generating the required volumes of traffic from specific ingress points into the overall infrastructure.

7.3 Qualification Testing

Following on from QT PIT, the final areas remaining un-validated, are the interfaces between the involved programme parties. In terms of what has been achieved in terms of assurance up to this point, we have:

- Assured the performance of participant systems under volume/load (PIT)
- Assured against the relevant NFRs for message processing, error handling and buffering at volume (PIT)
- Windows of processing for Operational Choreography at volume (PIT)
- Resilience within a participants own infrastructure (PIT)

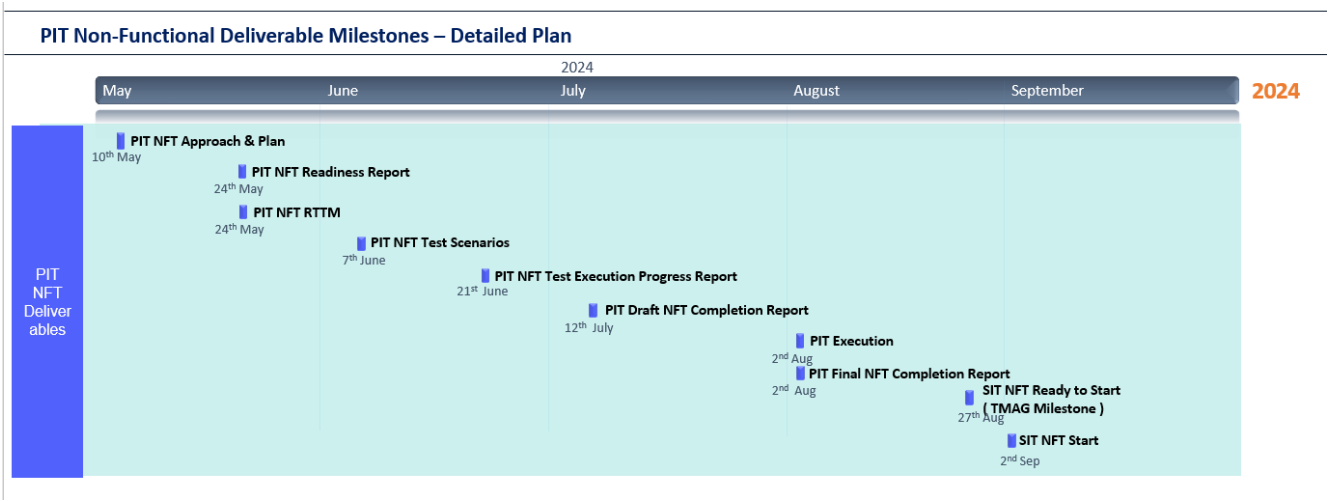
The planned approach to testing within this phase of QT, will focus on:

- The processing times of a suitably scaled volume of messages – a comparison can be made against the initial low volume message processing times captured during PIT NFT
- The behaviour of message handling within integrated environments should issues occur with interfaces. Unlike a DR activity, specific interfaces will be targeted. Unlike similar testing carried out during PIT, testing of this type will allow us to determine the behaviour of systems when interfaces are actually made unavailable, i.e. message buffering NFRs, additionally, the successful processing of messages by the subsequent systems down the line of the business process.

Additionally, where interface behaviour is being exercised, a level of Observability can be assured in terms of tracing buffered messages, through to successful processing at their expected end points.

8 NFT Delivery Timelines

8.1 PIT Delivery Schedule



8.2 Overall Programme/SIT/QT Schedule

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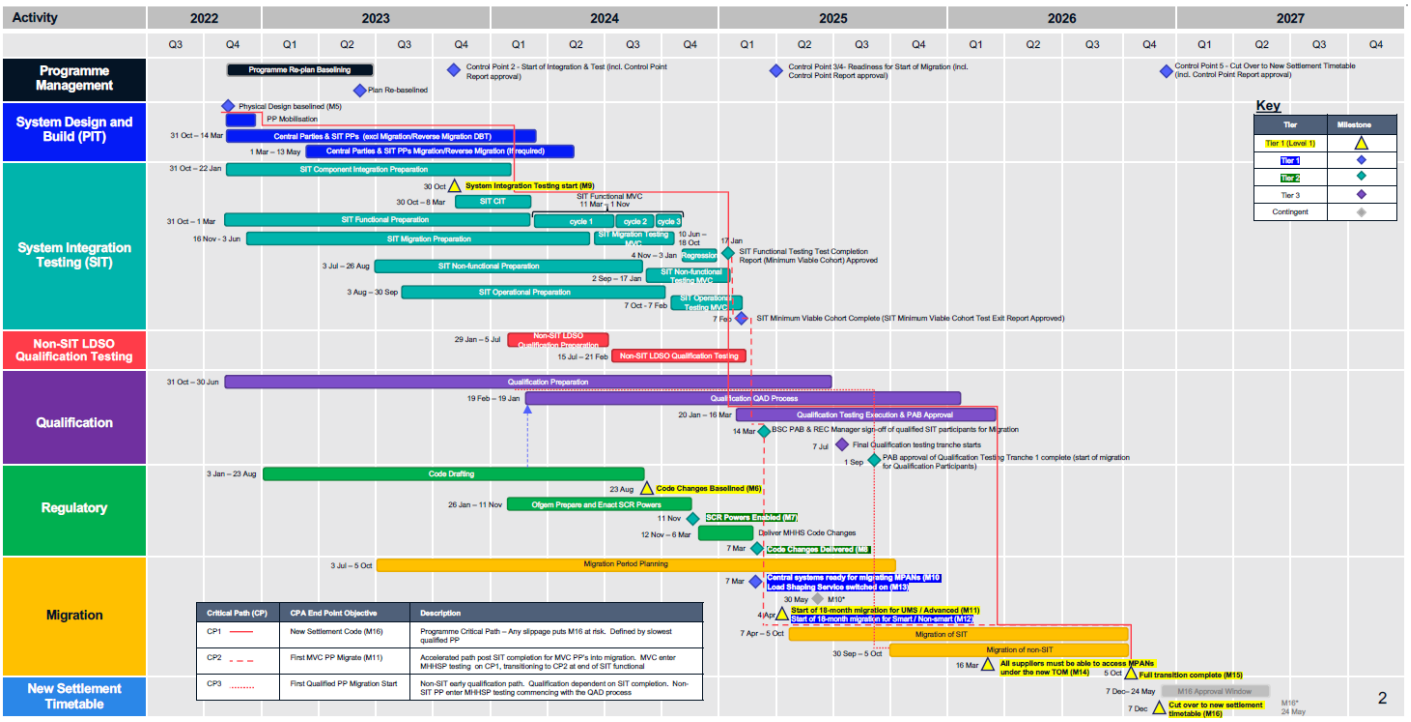
Baselined MHHS Implementation Timeline - POAP Showing Ofgem CR022 Approved Level 1 Milestones



8.3 Test Roles & Responsibilities

These will be defined within the respective stage guidance or approach documents.

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