

## SUMMARY POLICY ISSUE PAPER – FOR DESIGN AUTHORITY DISCUSSION

Title of Paper	<b>Switching Programme Testing Strategy</b>		
Issue Ref		Date:	31 August 2016
Issue Owners / Author	David Liversidge (Author), James Crump		
Discussed at User Group	30 August 2016	Discussion at EDAG Group	15 September 2016
Issued to DA	21 September 2016	Discussion at DA	28 September 2016

### Summary and recommendations

1. This paper describes the proposed testing strategy for the new switching arrangements which will enable gas and electricity consumers achieve faster, more reliable switching. The testing strategy aims to define the overall approach to planning and organising testing and allocating associated roles and responsibilities at a high level.
2. This Testing Strategy will be followed by a more detailed programme level Testing Management Plan which will be produced at the Detailed Level Specification (DLS) phase of the Switching Programme and will define the detailed approach to be taken, entry and exit criteria and individual roles and responsibilities for each test phase outlined in this strategy.
3. The main objectives for this testing strategy are:
  - Defining the purpose, aim, objectives, scope, requirements and risks relevant to testing within the Switching Programme;
  - Defining an overall approach to testing the new switching arrangements, taking into account best practice and any identifying any remaining areas of uncertainty due to ongoing definition of the programme; e.g. the solution architecture and the transition (release) strategy;
  - Identifying proposals for the testing phases for switching and any related options;
  - Identifying key roles and responsibilities for testing during Design, Build and Test (DBT) and any related options for how these could be fulfilled;
  - Defining key interrelationships between testing and other programme activities;
  - Highlighting the need for clear entry and exit criteria for each test phase and the need to consider and prioritise test coverage carefully in light of risk and importance; and

- Defying the key documentation and deliverables that would be expected as the programme progresses through its phases.
- There are many other interdependent areas with testing in the context of the programme, notably: solution architecture/design; transition; data cleanse & migration; governance & assurance. These interdependent areas are still evolving and maturing and so the Testing Strategy cannot be finalised until these interdependent areas have fully matured.

4. Our key recommendations are:

- Test phases are assessed and tailored in relation to specific needs of Switching. A number of formal/non-discretionary test phases are recommended:
  - Pre-Integration Testing
  - Systems Integration Testing
  - Service Integration Testing
  - End-to-End Testing
  - Operational/Service Management Testing
  - Non-functional Testing (for requirements not fully covered by the previous phases)
- A number of informal (discretionary) test phases are also recommended to manage and mitigate risk prior to the formal test phases above, similar to those used for SMIP. These should however be considered as part of a wider 'package' of design de-risking approaches (in line with Agile principles) which will be examined by the System Integration strategy (see paragraph 19 of the main document).
- Testing needs to be aligned with System Integration. We have commenced work on a complimentary System Integration Strategy for switching, which will be delivered as a separate product as part of this workstream.
- This Testing Strategy needs to be an enduring document for use within the programme by all parties. It should be updated again in DLS and periodically thereafter to ensure continued relevance.
- An additional Testing Management Plan should also be developed during DLS which will define the detailed testing approaches for each phase, entry/exit criteria, roles and responsibilities, and reporting.
- Management and execution of testing of solution components (pre-Integration Testing and System Integration Testing if applicable) should be undertaken by the parties responsible for their design and build.
- Cross-party testing (at system and service level interactions) needs to be managed and executed by a suitable, ideally independent, body on behalf of the authority; this should be the System Integrator if one is appointed or another specialist body appointed by the authority.

- Approval and acceptance criteria (for test inputs and outputs) and assurance (of testing process, deliverables) should align with overall governance and assurance proposals for the DBT phase.
  - Further work is needed to understand the potential scope of a market trial in addition to the recommended test phases, and the value that this would add, and whether this should be considered as part of testing or transition.
5. Our questions for consideration by the Design Authority are:
- Do you agree with our proposed approach to testing?
  - Are there any aspects of this approach that we have missed?

## Background and Analysis

6. Version 2 of the TOM established the need for progressive assurance for the Switching Programme through a series of defined test phases, similar to those for the Smart Metering Implementation Programme (SMIP).<sup>1</sup> For this reason, we have not considered a 'do nothing' approach to testing. However, if no or minimal changes to the current switching arrangements are recommended, then this will clearly have an impact on the amount of testing required.
7. The design of a testing regime for products and services forming a complex system is driven by the risk appetite of the system owner. To exhaustively test a system can add disproportionate time and cost if not carefully balanced against the risk impacts of not testing all parts of the system under all conditions. However, switching arrangements are crucial to the effective operation of the energy retail market, so for the purposes of this document we have assumed that the risk appetite is low to avoid any significant impact to consumers and suppliers and any consequential reputational impact for the industry.
8. To identify our preferred testing approach, we have conducted an analysis of applicable best practice and standards. In addition, a number of highly relevant recent projects were examined for Lessons Learned, including the on-going SMIP and Project Nexus.
9. As well as best practice and lessons learned applicable to switching, which have been embodied into the relevant parts of this testing strategy, there are some wider areas of best practice and lessons learned that have applicability to the whole delivery strategy within which testing sits. These are summarised below:
10. **System Integration.** Successful achievement of the outcomes of the Switching Programme are dependent on numerous parties delivering their part of the new arrangements together with the effective integration of these component parts to achieve the overall system and service level requirements to time, cost and quality. A separate System Integration strategy is being developed for the programme and aligned with this testing strategy.

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<sup>1</sup> [https://www.ofgem.gov.uk/sites/default/files/docs/2015/11/tom\\_v2\\_final\\_17112015\\_0.pdf](https://www.ofgem.gov.uk/sites/default/files/docs/2015/11/tom_v2_final_17112015_0.pdf), p52

11. **Agile Principles.** As recommended by the most recent Government report into public IT programmes, there are a number of underpinning Agile principles that can be applied to the Switching Programme. These are listed in Paragraph 20 of the main Testing Strategy.
12. How these processes and principles should be applied to the Switching Programme is covered in more detail in the main document and in the related system integration strategy currently being produced.

## Related Issues

13. In addition to the System Integration work package, as identified above, there are many other interdependent areas with the Testing Strategy in the context of the programme. The key areas are:
14. **Choice and design of solution architecture.** The extent of change involved in the building the switching solution and the final design will affect the complexity and risk and hence the extent and type of testing necessary to provide the required assurance. If a 'do nothing' or 'do minimum' solution is adopted, testing will be minimal.
15. **Transition strategy.** The chosen strategy for moving from the existing switching arrangements to the new solution will affect the duration and profile of testing, the manner in which it takes place and the way in which issues and defects are dealt with
16. **Governance and Assurance in the Design, Build and Test phase and immediate post-implementation period.** Governance of the testing stage will need to align with the overall governance arrangements and testing itself will need to be subject to appropriate assurance based on risk as for any other part of the programme delivery. The choice over System Integration roles and responsibilities will also affect testing roles and responsibilities. Effective governance and assurance will be required to ensure that testing by all parties is adequate and appropriate for the level of risk to the programme.
17. These interdependent areas are still being developed as part of the Delivery Strategy workstream and wider programme. When these areas are fully matured and stable, the testing strategy should be updated to reflect them.

## Discussion at EDAG

18. No objections were made to the proposed Testing Strategy at EDAG meeting 10 on 15 September. The group stressed that actions proposed within the Testing Strategy align with programme timelines, and agreed with the contention within the strategy that testing should not be 'squeezed'. The group discussed the possible role of a system integrator to ensure quality and independence of testing. This role will be covered by the forthcoming System Integration Strategy.

## POLICY ISSUES PAPER – CONTROL SHEET

Title of Paper	<b>Switching Programme Testing Strategy</b>		
DA Issue Ref	xxx	Date:	23 August 2016
Issue Owner (Accountable)	James Crump		
Author of Paper (Responsible)	David Liversidge		
Status of Paper	5 – Final Recommendation to DA		
Timing			
Dependencies	None – all dependencies are internal		

Circulation	User Group / EDAG /DA
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Issue	The proposed Testing Strategy for the new Switching arrangements including associated options		
Impacts Domestic?	Yes	Impacts Non-Dom?	Yes
Policy Objective (and reference to ToM v2)	Paragraphs 12.12 to 12.31 of the Target Operating Model v2		
Previous Positions on this/related Issues	See p50-56 of TOM v2		
Summary of Recommendations	<p>Progressive assurance should be provided through a defined set of 'core' or formal test phases similar to those used in SMIP. User Entry Process Testing and De-risking/Prototyping (informal) test phases should be considered in addition to the 'core' or formal test phases. The scope and value-add of a Market Trial should be further assessed when the Transition Strategy is finalised. Clear roles and responsibilities for testing are defined as well as deliverables and documentation required through the programme phases. Careful consideration needs to be given to who manages testing (and wider design, build and integration activities) at whole programme/whole solution level (i.e. cross-party) during DBT; it is recommended that a System Integration Strategy be looked at via a separate work package and then Testing aligned to this. Assurance of Testing and Approval/Acceptance of Testing outputs/results/entry and exit criteria should align with the recommended Governance and Assurance proposals for DBT being developed under the related work package as well as the System Integration strategy. The testing strategy is not finalised and will need further iteration in DLS to align with interdependent areas</p>		

	<i>that are still evolving; in particular the Solution Architecture, Transition Strategy and System Integration Strategy as well as Governance &amp; Assurance. In addition to updating this strategy during DLS, a detailed, programme level Testing Management Plan should be developed during DLS to define the detailed testing approach for each test phase, entry and exit criteria, detailed roles and responsibilities, reporting arrangements, etc.</i>
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<b>Internal and External Engagement</b>	
Business Process Design	<i>Jenny Boothe</i>
Regulatory Design	<i>Jon Dixon</i>
Delivery Strategy	<i>Ditto</i>
Commercial Strategy	<i>Ditto</i>
DIAT	<i>Ditto</i>
Legal	<i>Ditto</i>
Other Ofgem Teams	<i>Ditto</i>
<b>Meetings at which this paper has been discussed</b>	
Workstream Leaders	<i>6<sup>th</sup> April 2016</i>
User Group	<i>12<sup>th</sup> April 2016</i>
EDAG	<i>15 September 2016</i>
Other External	<i>N/A</i>
Ofgem Design Authority	<i>28 September 2016</i>

# POLICY ISSUES PAPER – CONTENT

## Issue

### Purpose of this Testing Strategy

1. This paper describes the proposed testing strategy for the new switching arrangements which will enable gas and electricity consumers achieve faster, more reliable switching. This product has been produced to comply with the Product Description issued by Ofgem (Appendix 1).
2. The purpose of the testing strategy is to define the overall approach to planning and organising testing and allocating associated roles and responsibilities. It is important that an appropriate testing strategy is established early in the programme to ensure that Ofgem and key stakeholders will be provided with assurance that the new switching arrangements will operate as specified.
3. The main objectives for this testing strategy are:
  - Defining the purpose, aim, objectives, scope, requirements and risks relevant to testing within the Switching Programme;
  - Defining an overall approach to testing the new switching arrangements, taking into account best practice and any identifying any remaining areas of uncertainty due to ongoing definition of the programme; e.g. the solution architecture and the transition (release) strategy;
  - Identifying proposals for the testing phases for switching and any related options;
  - Identifying key roles and responsibilities for testing during Design, Build and Test (DBT) and any related options for how these could be fulfilled;
  - Defining key interrelationships between testing and other programme activities;
  - Highlighting the need for clear entry and exit criteria for each test phase and the need to consider and prioritise test coverage carefully in light of risk and importance; and
  - Defining the key documentation and deliverables that would be expected as the programme progresses through its phases.
4. This testing strategy will be followed by a more detailed programme level Testing Management Plan which will be produced at the DLS phase of the Switching Programme and will define the detailed approach to be taken, entry and exit criteria and individual roles and responsibilities for each test phase outlined in this strategy.

### Approach

5. We have taken the following steps to develop this testing strategy:
  - a) Due Diligence investigation of applicable best practice and lessons learned;

- b) Tailoring of the best practice and lessons learned to the particular circumstances and predicted risks applicable to implementation of the new Switching arrangements;
- c) Iterative development and evaluation of the testing strategy in line with the programme TOM v2 ensuring coherence with related work packages as they develop (e.g. Solution Architecture, Governance & Assurance and Transition Strategy); and
- d) Consultation with stakeholders and subject matter experts, including formal review through the governance structure for the Blueprint Phase of the Switching Programme<sup>1</sup>.

#### Purpose, Aim and Objectives of Testing

6. The purpose of testing is to identify where a product or service does not conform to its defined specification. Successful testing will identify these non-conformances before a formal release. This will enable rectification and thereby reduce the number of incidents and problems arising in live operations where they are more costly and time-consuming to fix. This will also minimise disruption to the users of the products and services. Testing therefore: provides assurance that products and services will deliver the intended value; reduces incidents and improves stability; and reduces the need for customer contact and complaints.
7. The design of a testing regime for products and services forming a complex system is driven by the risk appetite of the system owner. To exhaustively test a system can add disproportionate time and cost if not carefully balanced against the risk impacts of not testing all parts of the system under all conditions. We consider that switching arrangements are crucial to the effective operation of the energy retail market. For the purposes of this document we have assumed that the risk appetite is low to avoid any significant impact to consumers and suppliers and any consequential reputational impact for the industry.
8. The aim of a well-designed and effectively implemented testing strategy is to provide confidence to stakeholders that the new switching arrangements will deliver the required outcomes, and help those stakeholders to understand and mitigate risks ahead of launch. This strategy should give consideration to the financial and time cost of testing and pressure to launch new arrangements (and to secure benefits for customers early). In particular, the strategy should anticipate and seek to avoid the unplanned squeezing of testing to meet time and cost constraints at the end of a project. Project governance and assurance should ensure that the testing strategy is enacted throughout the life of the project.
9. The objectives of testing within the Switching Programme will be to provide assurance that:

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<sup>1</sup> Design Team, User Group, EDAG and Design Authority



- the end-to-end switching solution delivered through the Switching Programme satisfies the requirements defined in the Blueprint, Detailed Level Specification (DLS) and Enactment Phases and is fit for purpose;
- the system and individual service components satisfy the appropriate requirements and are fit for purpose; and
- incumbent market participants and new entrants can participate in the new switching arrangements without compromising the overall integrity of their service or the switching service as a whole.

### Scope of Testing

10. The scope of testing will in turn depend on the scope of the solution to be developed for the new switching arrangements. The scope of this solution will be determined by the output of the Blueprint and DLS Phases which will specify:
- Systems in scope (CRS, industry parties' systems and third party system);
  - Scope of end-to-end business process model and the chosen solution architecture, including any external interfaces with relevant affected industry parties and other aspects of the retail market (e.g. balancing and settlement, network charging, etc.);<sup>2</sup>
  - Functional requirements (e.g. messaging formats, protocols);
  - Non-functional requirements (e.g. Availability, Reliability);
  - Service management (operational) requirements (e.g. Incident Management, Help Desks);
  - Market arrangements affected;
  - Transition, back-out and business continuity plans; and
  - Processes/mechanisms developed to cleanse and convert legacy data.
11. Currently outside of scope:
- Testing/Assurance requirements for migrated data sets needs to be agreed within context of wider Governance & Assurance arrangements (once Data Cleanse and Migration options are understood).

## **Essential Background**

12. This testing strategy forms part of the Delivery Strategy workstream within the Blueprint Phase of the Switching Programme. It builds on the work of the TOM V2 paragraphs 12.12 to 12.31. This product will be subject to a Request for Information (RfI), as part of Design Baseline 1 (DB1).
13. Following the RfI the programme will develop detailed design specifications for the chosen solution architecture and its operational requirements, and further develop commercial, regulatory and delivery proposals as part of the DLS phase. Following the DLS phase, regulatory changes will be enacted and the Data Communications

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<sup>2</sup> This will be determined by the output from the Business Process Design workstream which has identified a range of solution architectures to deliver the new switching arrangements and is going through a process of evaluating and down-selecting these

Company (DCC) will procure a provider of a Central Registration System (CRS) for the developed solution.

14. The programme contains other workstreams and activities which have strong interdependencies with the design of a robust testing strategy. These interdependencies are summarised in Table 1 below. Without proper understanding and management, these interdependencies represent a risk to the effectiveness and validity of the proposed testing strategy and should continue to be monitored until a stable situation is reached.

15. Given that many of these interdependent areas have not been finalised at the time of writing this initial testing strategy, this strategy will require further iteration to both reflect and inform these interdependent areas as the programme progresses towards delivery (see discussion of Next Steps below). Inbound dependencies will have a direct effect on the design of a testing strategy, and in turn the output arising from the testing strategy will affect a number of other programme areas.

<b>Work stream/ package</b>	<b>Type</b>	<b>What is affected</b>	<b>Impact and how it will be addressed</b>
Business Process (BP) Design – solution architecture	In	Complexity, risk and number of interfaces between parties' systems and CRS will affect extent of Integration and Interface Testing	It is likely that for either a middleware based solution or a central database solution the interfaces between parties will be critical in achieving a successful solution and the testing regime should both seek to de-risk the testing of these interfaces and ensure they are comprehensively tested. This is addressed by progressive testing in defined phases and the use of de-risking methods such as pre-Interface Testing and pre-Systems Integration Testing.
BP Design – solution architecture and business process model	In	Degree of change from current switching service (systems and processes) will affect amount of 'new' or changed functionality to be tested	A 'minimum' change solution (intelligent middleware) may require little change to Industry parties' current systems with the CRS middleware the main 'new' system. A more extensive change solution (registration and MIS data centralised) may need extensive testing of CRS and Industry systems and business processes. The testing strategy allows for this but until the final solution is determined it is not possible to estimate testing durations and resource profiles.
Delivery/ Transition	In	User Entry Process Testing (UEPT) profile (during DBT and post go-live) hence time & resources	A 'big bang' would mean 'all' users would need to undergo UEPT before go live. Transition based on sub-groups (e.g. fuel type) would mean that not all users would need to undergo UEPT during DBT.
Delivery/ Data Cleanse and	In/ Out	The need for and extent of testing of	Depending on the approach for data cleanse and migration, testing of data cleanse and

Migration		data cleanse and migration 'mechanisms' plus the actual data sets to be cleansed & migrated	migration mechanisms developed may be required to provide assurance prior to go live. It is also assumed that the solution specifications will include requirements to trap and report corrupt or suspect data and these will need to be tested.
Delivery/ Transition	In	The number of service 'releases' that need to be tested	If transition has multiple functional releases, each of these would need to go through the full test cycle with regression back to previous release. This does not affect the design of the testing regime but will affect the cost profile and duration of testing.
BP Design/ Operational Requirements & Service Model	In	Testing of Service Management/ Operational Requirements (& non-functional requirements)	A Single E2E service management model may require central testing as a 'whole model' whereas a federated model may just require each party and CRS to test their own service model. In any event, the defined operational and non-functional requirements defined for the new arrangements will need to be tested appropriately.
Delivery/ Data Cleanse & Migration	In/ Out	Availability of 'real' data sets for testing purposes	Testing will mainly use test-generated representative data but may also use 'sanitised' copies of actual live data. Data cleanse and migration may need to provide both 'clean' and 'dirty' real data sets for testing purposes.
Delivery/ Governance & Assurance	In/ Out	Testing will reveal issues and defects and these need to be addressed promptly via a clear Issue and Defect resolution supported by effective Change and Configuration Management	The Issue, Defect, Change and Configuration Management processes and governance need to be able to deal with the volume of change expected and the multi-party environment. 'Best for the programme' decisions need to be made by an empowered single body ideally informed by a specialist DA and Systems Integrator. Management of configurations across design baselines, test environments and specifications, etc. needs to be well controlled.
Delivery/ Governance & Assurance	In/ Out	Testing Roles and Responsibilities (in)/ Results and assurance findings (out)	Testing outputs contribute to programme assurance and will support key decisions during DBT within the defined governance regime. Roles and responsibilities for testing will also need to align with the overall Governance framework for DBT.
Delivery/ Governance & Assurance	In	The arrangements for providing programme assurance during DBT affect Testing	Testing, as for any aspect of the programme, will need to be subject to the agreed programme Assurance regime, which may involve a mix of self-assurance and independent assurance methods.
Regulatory Design	Out	Code modifications and licence changes arising from the Switching	Regulatory architecture accompanying the Switching Programme must provide appropriate incentives to ensure that parties carry out adequate testing on a timely basis.

		Programme	
Commercial	Out	Procurement of the CRS and related services	Procurement and cost decisions relating to the CRS and other related services will need to consider the requirement for testing and that these are appropriately resourced.
Delivery/Post-Implementation	Out	Requirement for post-implementation support	Risk of errors and defects being present in the released solution will be determined by the extent and quality of testing, and therefore resources which must be deployed in post-implementation support.

Table 1 - Testing Dependencies within the Switching Programme

## Analysis

### Applicable Best Practice, Standards and Lessons Learned

16. In line with the approach defined above, due diligence of applicable best practice, standards and lessons learned was undertaken. This is summarised at Appendix 2 and has been used to develop this strategy. The areas of best practice, standards and guidance examined are summarised in Table 2 below.

		Domain/Discipline				
		Systems Engineering	Software Engineering	IT Service Management	Project Management	Programme Management
Best Practice	Lead professional bodies	INCOSE	BCS (Chartered Institute for IT) Axelos (formerly OGC)		APM & PMI, Axelos, DSDM (for Agile)	
	Best Practice Guidance / Frameworks	INCOSE Body of Knowledge	ITIL (+ SIAM)		Prince 2 & APM BoK	MSP APM Body of Knowledge
	Aspects applicable to Testing		Agile		Solution and Scope Mgmt (APM) Quality (Prince 2)	Assurance Quality
Standards	Higher level standards that mandate	ISO15288, ISO9000 and ISO9001. IEEE730		ISO20000	None?	Management of Portfolios
	Life Cycle Delivery Models	ISO12207 (System & Software Lifecycle Processes) – ‘V model’		Service Life Cycle	Waterfall, Agile, V model, Prince 2 Processes	Transformational Flow
	Testing Specific Standards	IEEE1012 & ISO15026 (pt2 – Assurance Case)	ISO29119, IEEE829, IEEE1008, IEEE1028	None	None	None

Table 2 – Sources of Best Practice, Standards and Guidance Relevant to Testing

17. In addition to examination of best practice, standards and guidance, which is itself drawn from multiple lessons learned across many programmes, a number of highly

relevant recent projects were examined for Lessons Learned, including the on-going Smart Metering Implementation Programme (SMIP) and project Nexus.

18. As well as best practice and lessons learned applicable to switching, which have been embodied into the relevant parts of this testing strategy, there are some wider areas of best practice and lessons learned that have applicability to the whole delivery strategy within which testing sits. These are summarised below together with the recommended way forward:

19. **System Integration.** Successful achievement of the outcomes of the Switching Programme are dependent on numerous parties delivering their part of the new arrangements together with the effective integration of these component parts to achieve the overall system and service level requirements to time, cost and quality. Implementation of the new arrangements will be a challenging system realisation problem and there will be a number of key risks at whole programme/whole system level that can only be mitigated through an effective System Integration approach. Without effective System Integration, there are likely to be significantly more issues and defects that arise during formal Testing or in early life that should have been mitigated earlier when cost and time for rectification is much less. A separate System Integration strategy has been developed for the programme and aligned with this testing strategy.

20. **Agile Principles.** A summary of Agile is included in Appendix 2. Wholesale Agile methodologies such as DSDM<sup>3</sup> and Scrum are difficult to apply to this programme as a whole (rather than the CRS) as they assume a cohesive, single design team rather than a multi-party delivery environment. However, as recommended by the most recent Government report into public IT programmes, there are a number of underpinning Agile principles that can be applied to the Switching Programme. Specifically:

- **Collaboration and Team Working.** For example, cross-party sharing of design information as designs progress, particularly at the interface points, and joint resolution of emerging issues (similar to the use of SMIP Design Forums)
- **Prototyping/incremental development.** For example, early drops of build and test information ahead of main test phases to de-risk (SMIP examples are pre-User Interface Testing, Pre-SIT and GBCS Integration Testing for Industry)
- **Change Management.** As per SMIP and wider lessons learned, an effective means of managing issue, change and configuration during DBT that spans party boundaries with incentives to respond and resolve issues quickly.
- **Iterative release of capability into live environment.** This will be considered by Transition. However, even if a 'Big Bang' release is opted for in terms of participants, iterative release of functionality should be considered to progressively move towards next day switching.

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<sup>3</sup> Dynamic Systems Development Method

## Key Risks

21. As outlined above, this testing strategy has been tailored from applicable best practice and lessons learned to suit the particular risks for the programme that can be mitigated by an effective testing regime. The key risks identified are summarised in Table 3 below together with the proposed mitigations where effective testing forms part of those mitigations.

<b>Risk</b>	<b>Mitigation Approaches</b>
Political and programme pressure to achieve early delivery results in testing phases being compressed.	Clearly defined scope of testing with detailed (left to right) plans and clear entry/exit criteria agreed up front Criteria should be quality not time driven and not contingent Strong Governance to protect Testing and ensure compliance.
Testing within a multi-party delivery environment leads to lack of clarity over responsibilities of parties and inconsistent quality of testing.	Clear testing roles and responsibilities agreed at outset. Regular and open reporting. Regular engagement with customers, stakeholders and users throughout DBT phase. Use of specialist Systems Integrator, or oversight by another party fulfilling a systems integration role, to assure testing meets required standards and timelines across all parties.
Complex solution to be delivered in challenging timelines may prevent all aspects being tested prior to release.	Adopt a risk based approach to testing with a focus on solution areas and interfaces that are key to achieving high priority requirements. Adopt 'Left to Right' planning to ensure sufficient time is allocated and maintained for testing in line with risk appetite.
Programme plan fails to deliver successfully 'first time', with significant impact on effective operation of the retail energy market.	Provide progressive assurance through a phased testing approach aligned with wider delivery (V-model). Testing forms coherent part of broader assurance approach Clear entry/exit criteria agreed for each phase with regular progress reporting. Independent assurance commissioned for higher risk/ higher criticality areas.
Emergent issues and change occurring during the DBT phase requires rework leading to time and cost impacts.	Application of Agile principles where these can mitigate risks of emergent issues prior to full scale testing. Effective Change Management arrangements. Possible use of specialist System Integrator, or oversight by another party fulfilling a systems integration role, coupled with an effective Design Authority function as part of wider governance.
Poor data integrity and availability limits benefits realised from new arrangements.	Support testing of Data Cleanse & Migration approach/mechanisms. Test the solution's ability to deal with corrupt and incomplete data as specified in the requirement specifications.

Table 3 – Programme Risks Relevant to Testing Strategy

## Testing Phases and Organisations

22. It is usual for testing to occur through a number of phases that mirror the design, build and integration strategy for the system being implemented. To implement any complex system, the whole solution or end-to-end system normally has to be broken down into sub-systems, modules and components (e.g. hardware, software and

firmware). These are then designed, built, integrated and tested in controlled circumstances, progressively building the system 'bottom-up' from the components and modules into sub-systems and finally the overall system. Where a system (IT system) supports business functions and processes, it also has to be tested with the intended business processes and other services and systems intended for the new operating environment.

23. In the multi-party environment relevant to the Switching Programme, application of this best practice principle has the added consideration that the integration and testing also have to align with organisational aspects. As each party (organisation) will deliver one or more components or sub-systems of the end-to-end system (including changes required to legacy systems), testing must first take place within those individual organisations to confirm their readiness to bring together their parts to enable cross-party integration and testing building up to full end-to-end testing.

24. In line with the TOM v2<sup>4</sup> and utilising the best practice principles of progressively testing through defined phases, learning the lessons from programmes such as SMIP<sup>5</sup> which are undertaking this activity in the same multi-party environment, the test phases proposed for the Switching programme are shown in Figure 1.

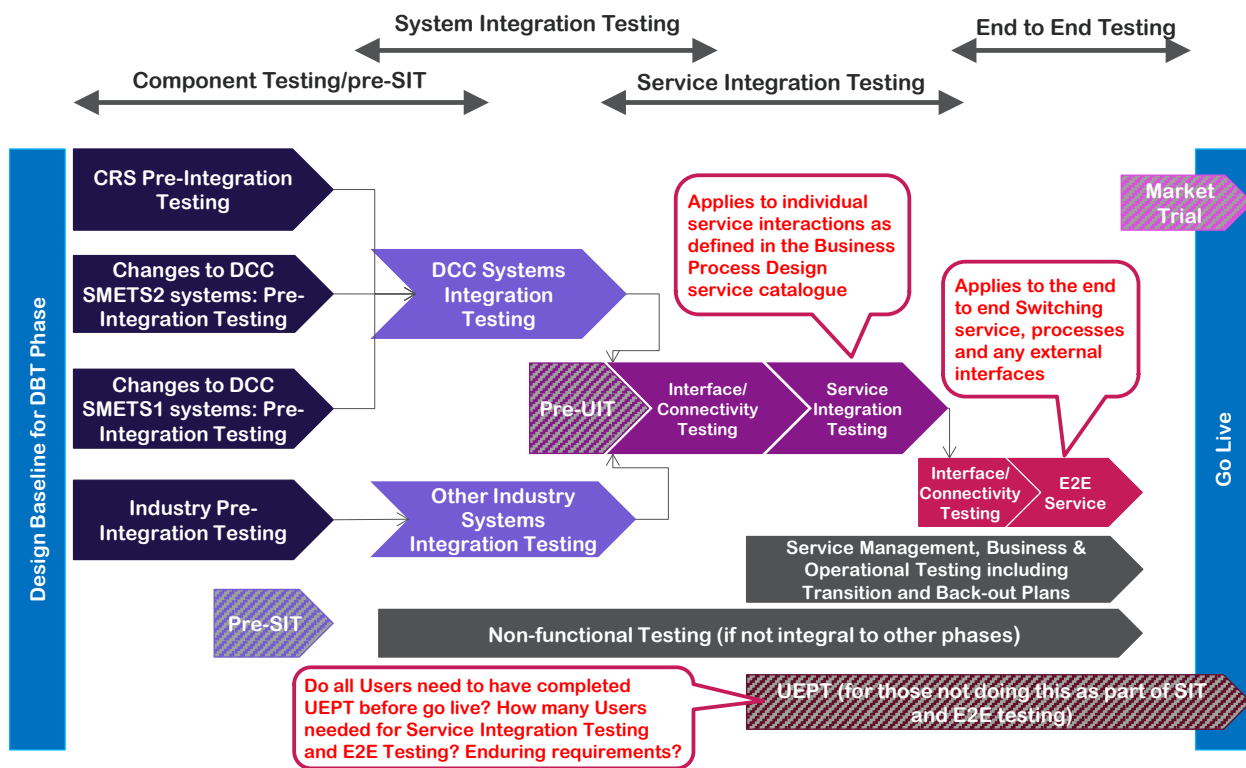


Figure 1 – Test Phases and Associated Organisations for Faster, Reliable Switching

<sup>4</sup> See paragraphs 12.12 to 12.31 of version 2 of the Target Operating Model and Delivery Approach

<sup>5</sup> Smart Metering Implementation Programme Joint Test Strategy version 3.5 dated 09/04/2015

25. The main test phases (pre-Integration Testing, System Integration Testing, Service Integration Testing and End-to-End Testing) are shown in Figure 1 together with Non-functional and Service Management test phases which may end up being an integral part of the main test phases or stand-alone test phases in their own right. Figure 1 also includes some 'discretionary' or 'informal' test phases (pre-Systems Integration Testing, Pre-User Interface Testing, User Entry Process Testing and a Market Trial).

#### Testing in the Delivery Context

26. The 'V' model represents best practice delivery of complex end-to-end systems like the energy Switching Programme.<sup>6</sup> In a 'V' model, the component parts of a complex system are identified, designed and built, and then integrated and tested progressively, building up to ensure that the full system is robust and cohesive. How the Test Phases for the Switching Programme (as identified in Figure 1) fit into a proposed 'V' model is shown in Figure 2.

27. These progressive test phases, as well as mirroring the integration and aggregation of solution components into the overall system, also gradually move from lab based testing to testing in live or live-like/production environments to validate that the system can be operated and supported in the business as usual environment to achieve the objectives and benefits. This is likely to be particularly true of the Operational/Service Management testing and any Market Trial, but also the End to End and User Entry Process Testing.

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<sup>6</sup> As per Appendix 2, this best practice 'V' model is generally accepted across Software Engineering, Systems Engineering, IT Service Management and Project Management, albeit modified in some cases utilising Agile



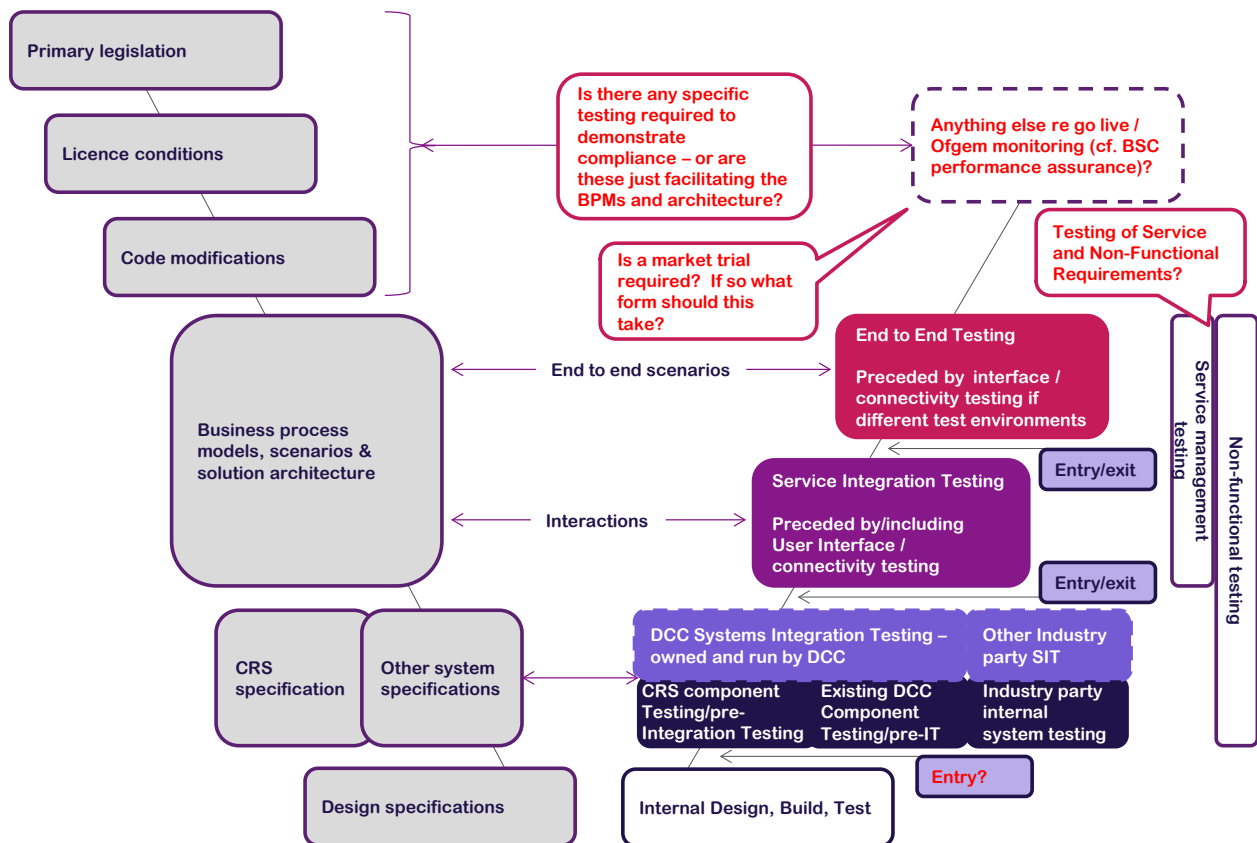


Figure 2 – Test Phases in 'V' Model Delivery Context

28. Figure 2 shows how each test phase (on the right hand side of the V) enables the actual designed and built system to be verified functionally and non-functionally at each level of abstraction (components, sub-systems and end-to-end system) matched to the specifications and requirements defined at that level (on the left hand side of the V). As the new switching system is an information based system, it is necessary as part of this testing regime to ensure the system supports the target business process model for the new switching arrangements and satisfies any associated Use Cases and/or Business Scenarios developed together with the Operational Requirements and Service Management model<sup>7</sup>.

#### Definition and Purpose of Each Test Phase

29. The test phases are defined and explained at Appendix 3. These definitions generally follow those used in SMIP as per paragraph 12.13 of the TOM except where specified. This list of potential test phases does not include any post go-live testing for ongoing modifications (major and minor releases) to the new switching arrangements. Consideration of the enduring testing requirement should be covered in the programme Testing Management Plan produced at DLS stage (see below).

<sup>7</sup> The target Business Process Model, Use Cases, Business Scenarios, Operational Requirements and Service Management model are all being produced as part of the Business Process Design workstream

30. The programme level Testing Management Plan (discussed below and at Appendix 5) will outline a detailed testing approach for each of the test phases, which will be further broken down into more granular test stages. Development of a detailed approach for each test stage requires a detailed understanding of the design specifics of the proposed switching solution, which will not be available before the DLS stage of the project. For this reason we have not set out detailed testing approaches at this point in the programme.

### Testing Roles

31. To examine allocation of appropriate responsibilities for testing through the progressive test phases defined above, it is first necessary to understand the roles to be performed within each testing phase; from execution of the tests through to approval of the results. Figure 3 below delineates between four main roles applicable to each test phase, which are further described below. All parties using or contributing to the new switching arrangements should expect to undertake testing and so, as a minimum, individual parties will need to execute and manage their testing in accordance with Figure 3 below.

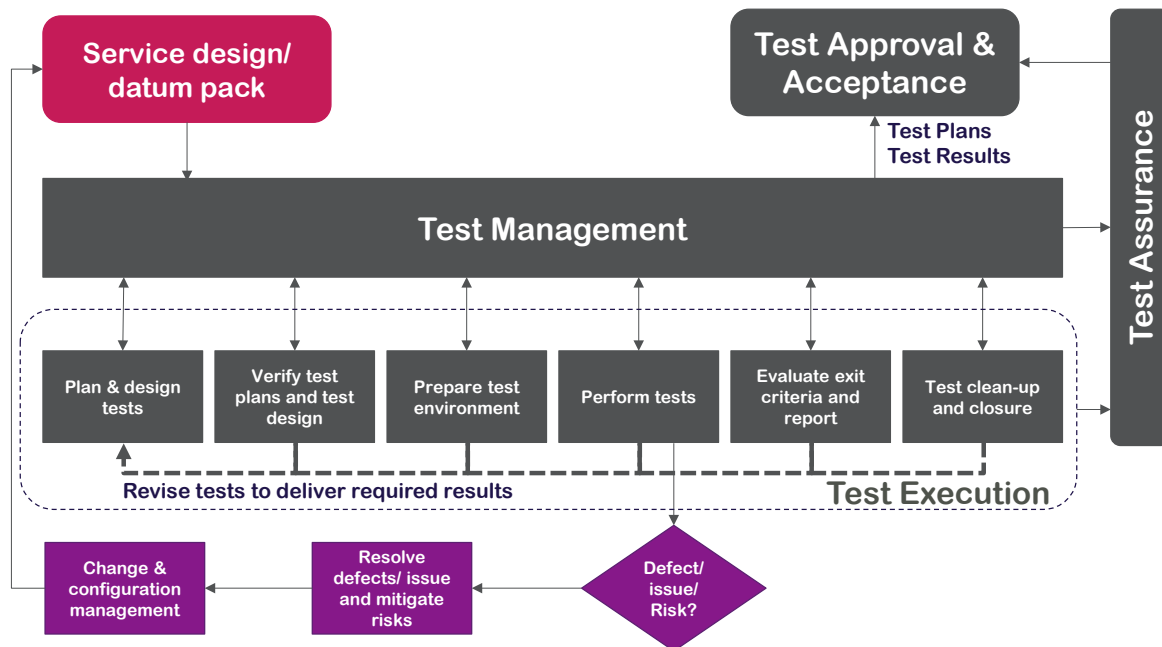


Figure 3 – Testing Roles

32. **Test Execution.** This involves the design and planning of the specific Test Stages within a Test Phase in line with the agreed test approach and define entry/exit criteria (including test scripts and test specifications), verification of these tests designs and plans, preparing the 'test environment' (including test data, test stubs, labs and tools), performing the tests, evaluating the results against the exit criteria, reporting and test clean-up and closure. Within the Switching Programme, this will take place at two levels: within individual parties including the CRS Provider for pre-

IT and any SIT that can take place at that level, and at a cross-party level for the later, cross-party test phases.

33. **Test Management.** As for Test Execution, Test Management occurs at two levels in the context of the Switching Programme. There will be a Test Management function within each of the parties involved in the new Switching arrangements; probably part of their testing department if they have one. There will also be a requirement for Test Management at the 'whole programme' level to ensure the multi-party test phases (Service Integration Testing, E2E testing, etc.) are planned and managed and that individual parties' testing is co-ordinated within the context of the whole programme. Test Management involves the planning, scheduling, co-ordination and monitoring of all testing activity in line with the Test Management Plan.
34. **Test Approval & Acceptance.** Key Testing deliverables and documentation will need to be reviewed and approved by an appropriate authority within the overall governance arrangements agreed for DBT. This will include entry and exit criteria for each testing phase. Additionally, acceptance will be required that an individual party is ready to enter a test stage (i.e. meets all the entry criteria) and that a test phase has successfully completed (i.e. all exit criteria have been met).
35. **Test Assurance**<sup>8</sup>. In line with the evolving Governance & Assurance arrangements being developed for the DBT phase of the programme, all aspects of testing will need to be subject to the agreed Assurance regime just like any other aspect of the programme. This can include self-assurance and a range of external/independent assurance methods such as:
- Quality Gate Reviews
  - Test Witnessing
  - Test Observation
  - Test Quality Audits
  - Product Inspections
  - Document Review.

#### Testing Deliverables and Documentation

36. A range of deliverables and documentation will need to be developed both leading up to and during the DBT phase of the programme. The key deliverables and documents expected are described in Appendix 5 together with timescales and responsibilities for their production.

#### Test Issue, Change and Configuration Management

37. As represented in Figure 3, Testing will reveal defects or non-conformances in the developed solution, and a process for managing these defects is outlined in Figure 3. This process must resolve 'issues' swiftly with a resolution which is 'best for the programme'. Subsequent investigation of the issue may reveal that it was a problem

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<sup>8</sup> Note, Test Assurance in this context means the assurance of Testing outputs and processes not Testing's contribution to overall programme Assurance

with the test regime or that testing had indeed highlighted a valid solution defect. In either case, and depending on the severity of the issue, it is likely that a change will need to be made to either the testing regime or the solution design. This change will need to be agreed, developed and implemented by the relevant party or parties affected and any required tests repeated.

38. When a change is implemented, it is vital that any impacts on other areas are considered (especially at the interface points) and that the configurations of design baselines, documentation and testing environments, etc. are carefully controlled and aligned across all parties. This is one of the reasons that issues are so costly and time-consuming to rectify during formal testing hence the importance of considering methods to reveal and fix any issues ahead of formal testing; i.e. during design and build.
39. The Governance and Assurance work package covers Issue, Change and Configuration Management methods and approaches at a high level. However, this area is so vital to a cost-effective DBT phase, particularly in a multi-party delivery environment, that it is recommended that further work is undertaken to ensure effective 'design management arrangements' at the whole programme/whole solution level are developed for delivery of the new switching arrangements, including Issue and Defect Resolution and Change and Configuration Management. This could be developed as a part of the System Integration strategy, and should consider the application of Agile principles where appropriate.

#### Test Coverage and Prioritisation

40. In accordance with the 'V' model in Figure 2, the test scripts for each formal test stage within a test phase will need to be mapped back to the corresponding design document and the requirements document by means of a Requirements Traceability Matrix, in order to measure and verify the *breadth* of test coverage (i.e. the extent of the testing).
41. The *depth* of test coverage (i.e. how "thoroughly" each solution element is tested) will need to be determined by the risk appetite informed through a risk assessment of:
  - the business importance of the various solution elements
  - the technical probability of test issues being present in each solution element.
42. This risk assessment should also be used to prioritise test planning and execution activities. Each test will need to be prioritised by the relevant stakeholders<sup>9</sup> in terms of its business impact (i.e. if the solution element covered by the test failed in live use, what would be the impact on the solution and market) and technical probability (i.e. how likely is it that test issues will be present in the solution element). This

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<sup>9</sup> E.g. Design Authority, Programme Director; potentially based on recommendations from a System Integrator

prioritisation could use a High, Medium, Low scale in order to group tests into three categories, e.g.:

1 – tests which cover solution elements that a) are very likely to contain test issues and/or b) would cause major business and/or customer impact if they failed

2 – tests which cover solution elements that a) are likely to contain test issues and/or b) would cause significant business and/or customer impact if they failed

3 – tests which cover solution elements that a) are unlikely to contain test issues and/or b) would cause only minor business and/or customer impact if they failed.

43. Detailed arrangements and roles and responsibilities for test coverage and prioritisation will be developed as part of the programme level Test Management Plan to be produced during DLS.

#### Testing Entry and Exit Criteria

44. The following generic Entry Criteria will gate the entry of all Test Phases:

- Test Approach for Test Phase signed-off
- Test Scripts, Test Data and other pre-requisites in place
- Test Phase Complete Certificate for preceding Test Phase issued, unless the plan is to overlap Test Phases
- Approval to Proceed Certificate issued by relevant body.

45. The following generic Exit Criteria will gate the exit of all Test Phases:

- production of agreed Work Off Plans for any outstanding Test Issues that occurred in the Test Phase
- compliance with all Test Requirements
- Agreed criteria for sentencing defects of differing severity/priority
- Test Stage Complete Certificates issued for all Test Stages in the Test Phase.

46. Specific Entry and Exit Criteria for each test phase will be listed in the relevant Test Approaches to be documented within the programme Testing Management Plan. Specific Entry and Exit Criteria for each Test Stage within a phase will be listed in the relevant Test Plan document produced and approved as described in Appendix 5.

#### Next Steps – Requirements for the DLS and Enactment Phases

47. As mentioned previously, there are many interdependencies between Testing and other areas of the programme, notably the Solution Architecture, Operational Requirements and Transition Strategy. This version of the testing strategy has taken into account those areas as far as possible noting that they are still undergoing development at the point of writing. Given this remaining uncertainty, it is recommended that the testing strategy continues to be refined and matured during the DLS phase as these related areas develop and mature.

48. A strategy needs a clear management plan to allow that strategy to be effectively enacted by all the parties involved in a controlled and consistent way. It is therefore

recommended that an overall programme Testing Management Plan be developed during the DLS phase as per Appendix 5. This will ensure that all individual parties involved in implementation of the new switching arrangements develop their (organisation) specific Testing plans for the test phases and stages they are responsible for in a way that responds to the overall programme level Testing Management Plan.

## Recommended Approach

49. The extent of testing in any project will depend on the risk appetite of those running the project and those impacted by the outputs of the project. More testing will add cost and complexity, but will reduce the risk of undetected defects and non-conformances impacting on live operations. Because the ability for customers to switch is critical to the UK's retail energy industry, we have assumed a low risk appetite and hence the need for effective testing of the new arrangements.
50. This is fully recognised in the TOM v2<sup>10</sup> where testing of the new switching arrangements through a series of testing phases is defined as an integral part of the implementation of the new arrangements. This testing strategy therefore builds from the TOM and does not consider a 'do nothing' option as part of the options considered for testing. Failure to implement an appropriate testing regime for any new switching arrangements would burden retail energy markets with an unacceptable level of risk. The options identified and assessed below therefore consider some discretionary test phases and allocation of some of the roles and responsibilities for the cross-party test phases.

### Test Phases: Non-Discretionary (Formal) and Discretionary (Informal) Testing

51. We recommend that the following test *phases* are undertaken irrespective of the final design of the new switching arrangements:
- Pre-Integration Testing;
  - Systems Integration Testing;
  - Service Integration Testing;
  - End-to-End Testing;
  - Operational/Service Management Testing; and
  - Non-functional Testing (for requirements not fully covered by the previous phases).
52. The detailed approaches and test stages required for each of these test phases will be developed in the DLS phase of the programme (see Appendix 5), tailored as appropriate to the final solution design. These detailed approaches and test stages will be documented in the programme level Test Management Plan to be developed in DLS (see Appendix 5).

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<sup>10</sup> Target Operating Model v2 pp 50-57

53. As part of this, and based on the risks relevant to the final solution design, test coverage will be determined and prioritised as discussed above. At this point it will also be possible to more accurately determine testing costs, resources and timescales for the test phases noting that there could be a discussion on trade-offs between risk, time and cost at this stage in the programme.
54. The remaining test phases not considered 'non-discretionary' (formal) however need some further examination and assessment in light of a range of factors.
55. In Appendix 6 we have undertaken initial assessment for the discretionary (informal) test phases using a range of applicable factors, including: Delivery (Cost, Time and Quality); the ability to mitigate/address the risks and dependencies identified in Tables 1 and 3; and alignment with relevant Design Principles (particularly, Reliability, Competition, Robustness, Cost/Benefit and Implementation). Based on this assessment, we recommend that a range of testing de-risking techniques (e.g. prototyping, sharing of design information, test stubs, sandpit testing, etc.) are developed and utilised to de-risk formal testing. These techniques should be carefully targeted on those interfaces and requirements areas with greatest assessed risk.
56. It is further recommended that the development of a stand-alone set of tests (UEPT) should be undertaken to allow Users of the new switching arrangements to demonstrate their ability to interoperate with the CRS and their readiness to meet their obligations under the new switching arrangements. This UEPT will enable User readiness testing to take place outside, and in parallel with, the main formal test phases and should subsequently be made available on an enduring basis for testing the readiness of new market entrants.
57. Further work should be undertaken to understand the value and scope of a 'Market Trial' in addition to the other test phases described and its relationship with any proposed 'Pilot Phase' or controlled/limited/interim release if this is utilised as part of the Transition strategy. A decision on whether to include a Market Trial should be taken once this work is complete following finalisation of the transition strategy.

#### Testing Responsibilities: Cross-Party Testing

58. Some different options available for the responsible parties to undertake the Testing Roles outlined in the section above can be found in Table 4.
59. We have not developed any separate options for apportioning responsibility in the Approval and Acceptance roles in this paper. Ensuring Approval and Acceptance of testing documents, deliverables, results and participant readiness should align with the relevant proposals in the Governance & Assurance and System Integration work packages.

60. Similarly, responsibilities for Testing Assurance should be aligned with the wider assurance proposals the Governance and Assurance and System Integration work packages. These proposals reflect a mix of self-assurance and independent assurance approaches aligned to the programme’s assessment of risk in the various aspects of and parties involved in the Testing regime.

61. We have not developed any options for apportioning responsibility in Test Execution and Management for the pre-IT and SIT phases within this paper. The parties who are responsible for designing and building their part of the switching solution should determine who is responsible for execution and management of any testing prior to Service Integration Testing/UEPT and this should be documented in their relevant Test Plans. This ensures alignment of responsibility with accountability.

62. For the Service Integration, End-to-End, Operational/Service Management and any cross-party Non-functional test phases, appropriate parties who could undertake Execution and Management of these cross-party test phases have been outlined in Table 4 below.

63. A ‘relevant party’ in this case means the party with overall responsibility for implementation of the part of the switching system being tested. For example, this could refer to changes to a supplier’s processes, systems and interfaces, in which case the relevant party would be the supplier themselves; if it refers to the central switching service, the relevant party would be DCC or another CRS provider.

Test Phase	Execution	Management	Approval/ Acceptance	Assurance
Pre-Integration	Relevant party	Relevant party	Ofgem Code Bodies DA/System Integrator  Could allow self-approval in low risk areas (with assurance)	Self-Assure or Independent Assurance If independent could be: DA/System Integrator; Code Bodies or Third Party
System Integration	Relevant party (as applicable)	Relevant Party		
Service Integration	CRS Provider DCC	CRS Provider DCC		
End-to-End	Industry Party	Industry Party		
Non-Functional	Code bodies DA/System Integrator	Code Bodies DA/System Integrator		
Service/Operational				
User Entry	Designed by CRS Provider, DCC or DA/SI but undertaken by relevant User			

Table 4 – Testing Responsibilities for Switching

64. The options for Test Execution and Management for the cross-party test phases are assessed in Appendix 6 using the same factors and scoring as for the test phase options. We recommend that an independent, specialist body be appointed to undertake Test Execution and Management of the cross-party Test Phases. This



should ideally be a sub-role of a specialist System Integrator providing direct support to an Ofgem-led DA, or an enhanced DA function. Alternatively, it could be undertaken by DCC directly supporting Ofgem as the Authority. This body should also be allocated responsibility for overall management and co-ordination of the whole testing programme at 'whole solution, whole programme' level.

## Summary of Recommendations

65. A comprehensive testing regime with a series of defined and well-designed test phases (as proposed in this strategy) should be implemented.
66. The evolving Governance and Assurance regime should ensure that this strategy is preserved and enacted faithfully through the detailed delivery and procurement plans for the new arrangements as they are developed and implemented through DLS, Enactment and DBT.
67. The following test phases should be undertaken irrespective of the final design of the new switching arrangements:
  - Pre-Integration Testing
  - Systems Integration Testing
  - Service Integration Testing
  - End to End Testing
  - Operational/Service Management Testing
  - Non-functional Testing (for requirements not fully covered by the previous phases)
68. A range of de-risking techniques (e.g. prototyping, sharing of design information, test stubs, sandpit testing, etc.) are developed and utilised to de-risk formal testing, albeit carefully targeted on those interfaces and requirements areas with greatest assessed risk. This would be the responsibility of a System Integrator if one is utilised or otherwise the responsible party for management and co-ordination of cross-party (whole solution) design, build, integration and testing.
69. A programme level Test Management Plan will be developed during the DLS phase. This will define how the programme-wide testing strategy will be realised through all involved parties allowing them to develop their individual testing plans. The Test Management Plan should cover (for each test phase and for the testing programme as a whole):
  - Testing approaches including appropriate test stages for each test phase
  - Test coverage and prioritisation
  - Test issue, change and configuration management
  - Monitoring and reporting
  - Detailed roles and responsibilities including for each phase and stage
  - Deliverables from each test phase and test stage
  - Test environments, labs, tools and test stubs

- Entry/Exit criteria
  - Testing quality and assurance;
70. Testing should include a stand-alone set of tests (UEPT) allowing Users to demonstrate their ability to interoperate with the CRS and their readiness to operate such that they can meet their obligations under the new switching arrangements. This UEPT will enable User readiness testing to take place outside, and in parallel with, the main formal test phases and should be made available on an enduring basis for testing the readiness of new market entrants
71. The value and potential scope of a 'Market Trial' needs to be further examined in addition to the other test phases described and its relationship with any proposed 'Pilot Phase' or limited/controlled/interim release if utilised as part of the Transition strategy. A decision on whether to include a Market Trial should be taken once this work is complete following finalisation of the transition strategy.
72. The post go-live (enduring) testing requirements should be defined linked to the agreed approach for ongoing modifications and release of updates and fixes (patches). This is important to ensure relevant aspects of the DBT testing regime are retained and maintained for steady state management of the new arrangements.
73. A separate but interrelated System Integration Strategy is developed for switching that considers a range of system integration functions to be performed and who is best placed to perform them, including the potential use of a specialist system integrator to support Ofgem and the Design Authority. This should also consider the application of Agile principles to the programme implementation, such as prototyping.
74. An independent, specialist body should be appointed to undertake Test Execution and Management of all cross-party test phases and for managing and co-ordinating all aspects of testing of the new arrangements at whole programme/whole solution level. This could be a sub-role of a specialist System Integrator providing direct support to an Ofgem-led DA, or an enhanced DA function. Alternatively, it could potentially be undertaken by DCC directly supporting the Ofgem as the Authority. This will need further assessment once the System Integration strategy is finalized.
75. Approval and Acceptance of testing documents, deliverables, results and readiness should align with the governance proposals in the Governance & Assurance work package as well as the System Integration work package.
76. Testing Assurance should align with the assurance proposals in the Governance & Assurance work package, and potentially the System integration work package. That is that a range of assurance methods are adopted with a mix of self-assurance and independent assurance aligned to the programme's assessment of risk in the various aspects of and parties involved in the Testing regime.

77. Test Execution and Management for pre-IT and SIT should be undertaken by the responsible party for their part of the solution, with appropriate assurance as above.
78. Effective 'design management' arrangements at the whole programme/whole solution level should be developed for delivery of the new switching arrangements, including Issue and Defect Resolution and Change and Configuration Management. These are currently outlined in the Governance and Assurance arrangements but will need further definition as part of Systems Integration strategy, including consideration of the application of Agile principles where appropriate.
79. This testing strategy will be further developed and refined during the DLS phase to reflect the functional and non-functional requirements of the final solution architecture, and in terms of the finalised Transition Strategy. The identified dependencies in particular should continue to be monitored and reflected into the testing strategy until an overall stable baseline is achieved; likely to be at Design Baseline 4 (DB4).

## Appendices

## Appendix 1 – Product Description

Product title	<b>Testing Strategy</b>
Format / Presentation	Document/slides
Deliverable Purpose	To set out the high-level approach that should be taken to testing the new switching arrangements to ensure it is ready for go-live.
Composition	<p>Paper(s) and/or slides covering:</p> <ul style="list-style-type: none"> <li>• The problem to be addressed and what we are aiming to achieve</li> <li>• Previous testing plans that have been used in other major cross-industry programmes, to include what worked well/not so well</li> <li>• Good practice, including v-models and other models</li> <li>• High-level options for testing</li> <li>• High-level analysis of the options and an assessment of these against the Design Principles</li> <li>• Implications of the testing approach for the length of the DBT phase and the go-live date</li> <li>• A recommendation and justification</li> <li>• Links and dependencies with other workstreams</li> </ul>
Inbound Dependencies	<p>Influenced by, rather than hard dependencies:</p> <ul style="list-style-type: none"> <li>• DS governance strategy product</li> <li>• Transition strategy</li> <li>• BPD process maps and solution architecture options shortlist</li> </ul>
Outbound Dependencies	<ul style="list-style-type: none"> <li>• Reg Design and Commercial for DLS phase</li> <li>• Baseline 1</li> <li>• Impact assessment RFI</li> <li>• Programme plan</li> </ul>

### Resources

Product Approver (Accountable):	Design Authority		
Product Owner (Responsible):	David Liversidge		
Supported By:	Graeme Barton, Barry Coughlan		
Delivery from:	Jan 2016	Due date:	Oct 2016

### Reviews

Reviewers (Consult/inform):	Design Team, User Group, EDAG, Workstream leads	Design team:	Feb – Oct 2016
		User Group:	Apr 2016, Aug/Sep 2016
		EDAG:	Sep 2016
		Design Authority:	Sep 2016
Acceptance criteria:	Range of options assessed, thorough analysis against Design Principles, and a clear recommendation. Where a recommendation is not possible, options shortlisted for consultation.		
Date of final version:	Oct 2016		

## Appendix 2 – Summary of Best Practice, Standards and Lessons Learned

[see separate document]

## Appendix 3 – Test Phase Definitions and Explanation

**Pre-Integration Testing (Pre-IT).** In the context of Switching, this refers to the testing that individual parties (including the CRS Provider) will undertake to test that the solution components they are responsible for designing and building met their functional and non-functional requirements. This may include new components or changes to existing ones. Pre-IT will vary across parties, but will generally involve Unit Testing, Link Testing, Component Testing and Acceptance Testing.

**System Integration Testing (SIT).** In the context of Switching, this refers to bringing together solution components into interoperable sub-systems within individual party boundaries. As a minimum, this will include the CRS as a defined sub-system and its integration with existing DCC systems and services.

**Service Integration Testing.** In the context of Switching, this refers to the testing of individual service interactions between parties and the CRS using a set of service-based interface tests. This will normally begin with some sort of Interface Testing such as Connectivity Test and potentially a User Entry Process Test (see below) before going beyond the interface to test that parties' can meet their service-based requirements. Note: a defined minimum number of representative parties (Suppliers, DNOs, Gas Transporters and others) will be required to partake in Service Integration Testing to demonstrate their interaction with the CRS supports the new arrangements but not all parties. The remaining parties not involved in this phase will still need to undertake some sort of User Entry Process Test to demonstrate their ability to interface with the CRS and their readiness to participate in the new switching arrangements.

**End to End (E2E) Testing.** In the context of Switching, E2E testing refers to the verification that the 'whole solution' (i.e. all services across all parties involved and using the IT systems and business processes developed) will support the Switching Use Cases and/or Business Scenarios defined<sup>11</sup>. As for Service Integration Testing, this does not need to include all parties just a representative sample of those who have passed pre-IT and SIT if applicable.

**Non-Functional Testing.** In the context of Switching, this involves the testing of non-functional requirements. Non-functional requirements will generally be tested as an integral part of the previous test phases described, but there may be some non-functional requirements for which specific, separate system level tests are required; e.g. Security. Some non-functional requirements may also be tested as part of Operational/Service Management Testing described below, e.g. Service Level Agreements, Resilience, Disaster Recovery, Back-up and Restoration, Business Continuity Planning and Performance testing.

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<sup>11</sup> Note: this is different to E2E testing defined in the SMIP context which is a defined 12 month period in which UEPT continues plus ongoing device testing with the DCC solution

**Operational/Service Management Testing.** In the context of Switching, this involves the testing of Operational Requirements (e.g. Service Availability) and the intended Service Management model (covering aspects such as Help Desks, Incident Management, etc. in the live environment). Its purpose is to ensure the solution: can be installed and configured in the live environment; can be operated by the Service Management function under normal and exceptional conditions; and meets its Service Level Agreements.

**User Entry Process Testing (UEPT).** In the context of Switching, this refers to a defined set of test that any current or new market participant will need to undertake to demonstrate their readiness to utilise the CRS and to operate so they meet the programmes specification and delivery quality gates. As mentioned above, this could be performed as an integral part of the Service Integration and End to End Testing (for a representative sample of Users) or as a separate test phase for those not involved in these formal test phases or for new market entrants as a when required.

**Market Trial.** This is different from a test in that it usually takes place within a representative sub-set of the live environment using some of the intended user base; albeit under controlled circumstances that emulates the real energy retail market environment and before formal launch. In the context of Switching, there could be some overlap with Operational/Service Management testing, but a well-designed market trial could give increased confidence (reduced risk) to Users and other stakeholders that the new switching arrangements will support effective operation of the energy retail market as intended when it goes live. This may be particularly relevant if a 'big bang' transition is undertaken where a market trial could in effect act to de-risk this higher risk transition strategy. There is also a need to clarify the relationship between any market trial and a Pilot phase which is being discussed as part of the proposed Transition strategy.

**Informal (De-risking) Testing (for example Pre-Systems Integration Testing (Pre-SIT) and Pre-User Interface Testing (Pre-UIT)).** These are essentially a means of de-risking the main formal testing phases through the provision of a variety of approaches such as:

- manual exchange and desk checking of sample interface files;
- enabling parties' test environments to connect to [the CRS] Sandpit environments for early checking of sample service requests and responses;
- early sharing of design interpretations of interface specifications across parties;
- Test Stubs<sup>12</sup>; and other early prototyping approaches.

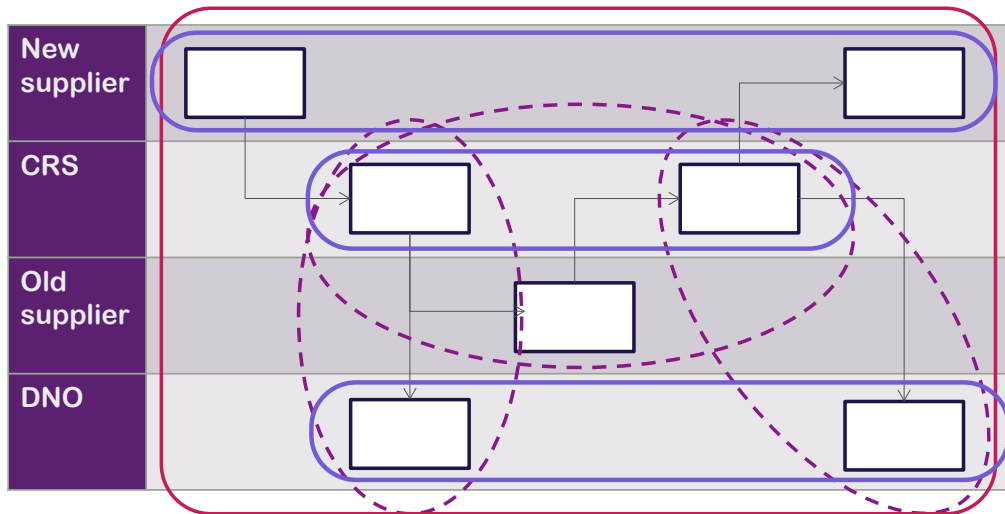
Essentially, this is an application of the Agile principles mentioned earlier and, although it could be seen as adding cost, its value is to reduce issues arising in the formal testing phases where time and cost of rectification would be much larger.

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<sup>12</sup> Test Stubs are simulations of as yet unbuilt modules or components of the solution which allow other aspects of the system to be tested early, when they are ready, in advance of the need for all parts of the system to have been fully developed. This supports an incremental development approach and prevents the need to wait until all parts of a system have been built before issues and defects can be identified and resolved.



The diagram below provides an illustrative representation of the new switching arrangements to support understanding of the scope of the main Test Phases described above.



This diagram is illustrative only

Key

- Pre-Integration Testing
- Service Integration Testing
- System Integration Test (SIT)
- End-to-End Testing

**Test Phases in the Switching Solution Context**

## Appendix 4 – Testing Roles

The main testing roles are described below.

**Test Execution.** This involves the design and planning of the specific Test Stages within a Test Phase in line with the agreed test approach and define entry/exit criteria (including test scripts and test specifications), verification of these tests designs and plans, preparing the 'test environment' (including test data, stubs, labs and tools), performing the tests, evaluating the results against the exit criteria, reporting and test clean-up and closure. Within the Switching Programme, this will take place at two levels: within individual parties including the CRS Provider for pre-IT and any SIT that can take place at that level, and at a cross-party level for the later, cross-party test phases.

**Test Management.** As for Test Execution, Test Management occurs at two levels in the context of the Switching Programme. There will be a Test Management function within each of the parties involved in the new Switching arrangements; probably part of their testing department if they have one. There will also be a requirement for Test Management at the 'whole programme' level to ensure the multi-party test phases (Service Integration Testing, E2E testing, etc.) are planned and managed and that individual parties' testing is co-ordinated within the context of the whole programme. Test Management involves the planning, scheduling, co-ordination and monitoring of all testing activity in line with the Test Management Plan.

**Test Approval & Acceptance.** Key Testing deliverables and documentation will need to be reviewed and approved by an appropriate authority within the overall governance arrangements agreed for DBT. This will include entry and exit criteria for each testing phase. Additionally, acceptance will be required that an individual party is ready to enter a test stage (i.e. meets all the entry criteria) and that a test phase has successfully completed (i.e. all exit criteria have been met).

**Test Assurance**<sup>13</sup>. In line with the evolving Governance & Assurance arrangements being developed for the DBT phase of the programme, all aspects of testing will need to be subject to the agreed Assurance regime just like any other aspect of the programme. This can include self-assurance and a range of external/independent assurance methods such as:

- Quality Gate Reviews
- Test Witnessing
- Test Observation
- Test Quality Audits
- Product Inspections
- Document Review.

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<sup>13</sup> Note, Test Assurance in this context means the assurance of Testing outputs and processes not Testing's contribution to overall programme Assurance

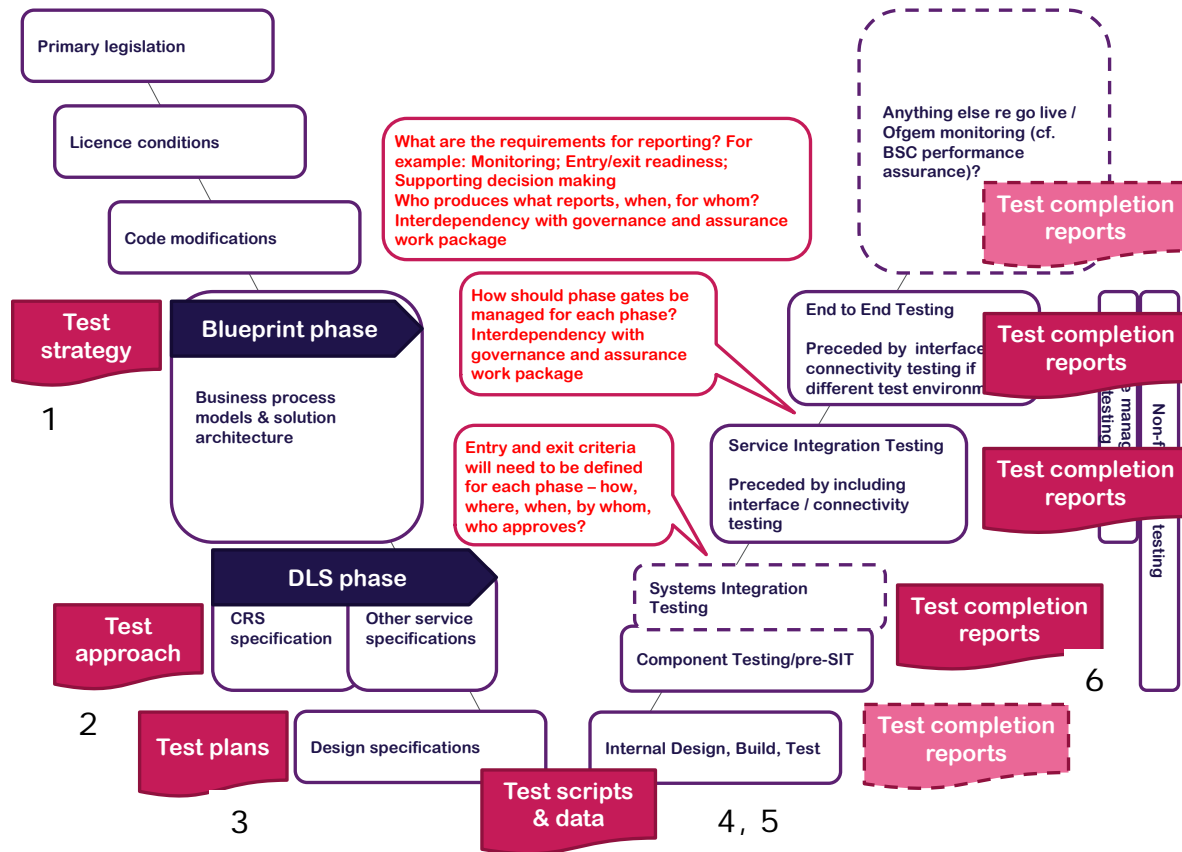
## Appendix 5 – Testing Deliverables and Documentation

The key deliverables and documentation that would be expected during the life of the programme are summarised in the table below.

<b>Document/Deliverable</b>	<b>Purpose/Scope</b>	<b>Who Produces</b>	<b>When</b>
1. Testing Strategy	To define the overall objectives and roles and responsibilities	Ofgem (accountable) supported by DCC (responsible)	By end of Blueprint, but refined during DLS
2. Programme Level Testing Management Plan (including Approach for each Test Phase)	To define the approach to be adopted for each Test Phase, including roles and responsibilities	Ofgem (accountable) supported by DCC (responsible)	By end of DLS
3. Individual Test Plans (for each phase and stage within a phase)	These cover how each test phase and each stage within each phase will be conducted by each party	Relevant party responsible for management and execution of a Test Phase or Test Stage	A minimum time (to be specified) prior to each Test Phase/Stage
4. Test Scripts, Test Specs and Requirements Traceability Matrix	These ensure the test design exercises the elements of the solution being tested in line with the applicable functional and non-functional requirements	Responsible testing party (with appropriate assurance)	In line with individual test plans, but prior to each Test Phase/Stage. Consider re-use and sharing where possible. May be retained for enduring testing.
5. Test Data, Stubs, Environments, Labs and Tools	These are software and hardware products developed to enable the execution of representative tests as designed	Responsible testing party (with appropriate assurance)	Set up prior to and maintained for duration of testing. Should consider re-use where possible. Some items may need to be retained for enduring testing
6. Test Reports (Readiness, Progress and Completion)	Required to authorise start of a test (against entry criteria), monitoring of progress in line with plan, and to accept completion (against exit criteria)	Responsible testing party (with appropriate assurance)	Prior to, during and at completion of each test – submitted to relevant decision-making authority

### Main Testing Deliverables and Documentation for Switching

In the diagram below, some of the key documents and deliverables are overlaid against the V model to show typically where they would be expected to be generated and needed. As can be seen in this diagram, the only document expected to be produced at this (Blueprint) stage in the programme, is the testing strategy (this document). As the programme progresses into the DLS phase, the strategy must be further refined to reflect the evolving solution design and testing plans developed to describe how this strategy will be put in place and enacted across the parties involved.



### Deliverables and Documentation in V Model Context

## Appendix 6 – Options Assessment

The following matrix has been used to assess the options based on a Red (R), Amber (A), Yellow (Y), and Green (G) scoring against each of the factors relevant to the particular option being evaluated.

<b>Evaluation Category</b>	<b>Cost (Net)</b>	<b>Time (Net)</b>	<b>Quality (of Test outcomes)</b>	<b>Risk Reduction potential</b>	<b>Alignment with Design Principles</b>
Key to scoring (Red, Amber, Yellow, Green)	G = Likely to provide an overall cost-benefit Y – Likely to be cost neutral or costs are not significant A – Significant costs with benefits uncertain R – Not cost-effective; net cost overall	G = Likely to provide an overall time benefit Y – Likely to be neutral on time or schedule increases are not significant A – Significant time penalty with benefits uncertain R – Not time-effective; net delay overall	G – makes a significant positive contribution to achievement of outcomes Y – Makes a positive contribution to outcomes but with uncertainty A – May impact negatively on required outcomes R – likely to undermine required outcomes	G – significantly mitigates one or more of the key risks identified Y – May mitigate one or more risks but contribution uncertain A – Unlikely to mitigate any of the key risks identified R – may increase the level or risk exposure	G – significantly supports one or more design principles Y – Significantly supports one or more design principles but may have some small negative impacts A – May support one or more design principles but negatively affects others R – Potentially at odds with one or more design principles

### Options Assessment Matrix for Test Phase Options

<b>Test Phase</b>	<b>Cost (Net)</b>	<b>Time (Net)</b>	<b>Quality (of Test outcomes)</b>	<b>Risk Reduction potential</b>	<b>Alignment with Design Principles</b>
Informal/De-risking (pre-UIT and pre-SIT)	Would be an additional cost but should be net saving if targeted – see risk reduction	Could take additional time up front but should be a net saving if targeted – see risk reduction	Learns Lessons and Best Practice plus aligns with principles of progressive assurance	Could significantly mitigate formal testing issues and risks hence save time and cost	Could provide higher confidence, improve cost/benefits and enable consumers to gain benefits of faster, reliable switching earlier

UEPT	Would need additional costs to design as a stand-alone set of readiness tests	Should save time by enabling most users to undertake UEPT outside of/ in parallel with other Test Phases	Learns lessons from SMIP. Ensures consistent assessment of readiness of all Users. Clear entry criteria for new market entrants	De-risks main formal Test Phases (does not require all Users to participate) but could risk having to re-do UEPT if problems found in later stages. Reduces risk of incoming market participants disrupting the arrangements	Support Competition by enabling all Users to be ready at Go-Live and New Market Entrants. Should provide high confidence that all Users are ready at Go Live (and exclude those that are not)
Market Trial	May represent significant cost to Users	Could delay formal 'launch'	Learns lessons (e.g. Green Deal).	Could help further de-risk solution and help reduce early life issues	Provides greater confidence prior to go Live. May be seen as giving competitive advantage to those involved in the Trial. May delay benefits to Customers

Options Assessment Matrix for Test Responsibility Options

<b>Responsibility</b>	<b>Cost</b>	<b>Time</b>	<b>Quality</b>	<b>Risk Reduction</b>	<b>Alignment with Design Principles</b>
Test Execution & Management for cross-party test phases undertaken by <b>CRS Provider</b>	Role would be won under competition as part of the CRS procurement	Would be brought on board at same time as CRS Provider – no continuity from previous phases	May conflict with CRS delivery responsibilities (cf DSP role in SMIP). Testing capability may be seen as secondary to CRS provision in any selection process	Puts responsibility with solution component that has most complex interfaces but may be tempted to focus overly on CRS	Independent body – not seen as interfering with market competition. However Testing role would conflict with CRS delivery role to blur roles and responsibilities

Test Execution & Management for cross-party test phases undertaken by <b>DCC</b>	Costs would be subject to current DCC license and pricing control – although not tested by competition for this role	DCC could naturally evolve into this role from Test Strategy & Planning work in Blueprint and DLS	Has recent skills and experience from SMIP but may not have 'deep' test execution & management experience as this was done by DSP	DCC could take independent overview of interfaces and other solution risk areas across all parties but may focus overly on DCC elements	Independent in terms of market but may not be seen as fully independent in terms of solution and testing priorities and focus given responsibility for SMIP and CRS
Test Execution & Management for cross-party test phases undertaken by <b>Industry Party</b> ; e.g. Xoserve;	Costs similar to DCC point? – i.e. in line with current licensing conditions for that party?	Involved in Blueprint and DLS work so could take this forward without much loss of continuity	May not have full skills and capability to undertake breadth and depth of role required	May not be seen as fully objective and independent. May not have intimate knowledge of solution	May not be seen as fully independent in terms of solution and testing priorities given it will own part of current/new solution so could be a conflict in roles
Test Execution & Management for cross-party test phases undertaken by <b>DA (Ofgem) or specialist SI</b> on behalf of DA	Ofgem would compete (direct or via DCC) for specialist SI if they felt they did not have in-house skills to do this – may reduce cost but adds cost to run competition	Specialist SI could be procured before CRS provider to get up to speed if required, but adds time	Enhanced DA or use of specialist SI to support DA would ensure specialist Testing skills and experience were in place	Should be well placed to identify and manage risks at whole solution level with close coupling to design ownership and knowledge base within DA	Independent and authoritative body aligned to Ofgem in its role as DA. Roles and Responsibilities of SI in relation to DA and wider Governance would need to be clarified

<p>Test Execution &amp; Management for cross-party testing undertaken by <b>Code Bodies</b></p>	<p>Costs uncertain – presumably Code Bodies would need to enhance their current resources</p>	<p>Would take time for Code Bodies to get up to speed and develop required capability</p>	<p>Do not have background or specialist skills in terms of testing of this scale and complexity</p>	<p>Potentially has levers and structures to ensure parties comply but may be less focused on technical risks</p>	<p>Independent body already involved with ensuring compliance against codes. However, lack of skills and capability risks effective and robust implementation</p>
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