Imperial College London

NERA Economic Consulting

DNV·GL

ENGINEERING RECOMMENDATION P2 REVIEW (PHASE 1)

Project Initiation Paper

Energy Networks Association

Report No.: 16011094/110, Rev. 001
Document No.: 16011094/110
Date: 13/4/2015

Project name:	Engineering Recommendation P2 Review (Phase 1)	DNV GL Energy Advisory
Report title:	Project Initiation Paper	PSP UK
Customer:	Energy Networks Association 6th Floor, Dean Bradley House 52 Horseferry Road London SW1P 2AF	Palace House 3 Cathedral Street London SE1 9DE Tel: +44 (0) 203 170 8165 04478894
Contact person:	D Spillet	
Date of issue:	13/4/2015	
Project No.:	16011094	
Organisation unit:	EA UK	
Report No.:	16011094/110, Rev. 001	
Document No.:	16011094/110	

Applicable contract(s) governing the provision of this Report:

Objective:

This Project Initiation Paper (PIP) highlights the key objectives of the overall Engineering Recommendation P2/6 Review project to industry stakeholders. It is the initial communication with all stakeholders; it outlines the process as well as the expectations on stakeholder engagement.

Prepared by:	Verified by:	Approved by:
Colin MacKenzie Head of Section	Alan Birch Principal Consultant	Ljubomir Mitrasevic Principal Consultant
[Name] [title]	[Name] [title]	
[Name] [title]	[Name] [title]	

DNV GL Distribution:

☒ Unrestricted distribution (internal and external)
☐ Unrestricted distribution within DNV GL
☐ Limited distribution within DNV GL after 3 years
☐ No distribution (confidential)
☐ Secret

Keywords:
execution

Rev. No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
000	23/3/2015	Draft for internal DCRP P2 WG review	C MacKenzie	A Birch	
001	13/4/2015	Final Issue for Publication	C MacKenzie	A Birch	L Mitrasevic

Table of contents

1 INTRODUCTION

In January 2014 the Distribution Code Review Panel[1] P2 Working Group (DCRP P2 WG) through the Energy Network Association[2] (ENA) engaged a consortium consisting of DNV GL[3], Imperial College London (ICL)[4] and NERA[5] (the Consortium) in a project to carry out a full back to basics review of Engineering Recommendation P2/6. The project commenced in February 2015 with the development of a Project Initiation Paper (PIP).

The PIP presented here highlights the key objectives of the overall Engineering Recommendation P2/6 Review project to industry stakeholders. It is the initial communication with all stakeholders; it outlines the process as well as the expectations on stakeholder engagement.

The PIP has also been developed into a PowerPoint presentation so that it can be widely presented to stakeholders.

1 The Distribution Code Review Panel (DCRP) is the body responsible for overseeing the maintenance and development of the Distribution Code and its subordinate documents. Those subordinate documents include Engineering Recommendation P2/6. The ENA is the service provider to the DCRP for the physical maintenance of the Code and its subordinate documents.

2 Energy Networks Association is the industry body for UK energy transmission and distribution licence holders and is the voice and agent of the energy networks sector. ENA acts as a strategic focus and channel of communication for the industry and aims to promote the interests, growth, good standing and competitiveness of the industry. They also provide a forum for discussion among company members, and so facilitate communication and sharing of experience across the energy networks sector

3 DNV GL is a Global certification and advisory business working in the maritime, oil and gas, business assurance and energy sectors.

4 Imperial College London is a university of world-class education and research in science, engineering and medicine, with particular regard to their application in industry, commerce and healthcare.

5 NERA Economic Consulting is a global firm of experts dedicated to applying economic, finance, and quantitative principles to complex business and legal challenges.

2 PROJECT DEFINITIONS

2.1 Background to Project

Engineering Recommendation P2 has been in place since the 1950s and has played a major role in the development of secure, reliable distribution networks. Whilst a number of changes have been made over the years, notably the introduction of P2/5 in 1978, the document has served the industry well for over 30 years.

P2 is a 'deterministic' standard and is largely focused around ensuring sufficient capacity is available to meet the 'peak demand' within a manner and timeframe consistent with the 'group demand' (or put simply, the size of network) in question. P2 is also 'risk based' to such an extent that larger 'load groups' are in general deserving of a higher level of security.

The most fundamental issue regarding the future evolution of the P2 standard is whether it prescribes economically efficient investments, given many changes affecting the energy market at present, including the (anticipated) prolific deployment of non-network technologies and the changing role of the customer. This gives rise to the need for a fundamental review of the baseline philosophy of distribution network operation and design to ensure that the UK Government's energy policy objectives can continue to be met in a cost effective and pragmatic way.

The requirement for a fundamental review of Engineering Recommendation P2 has been recognised by Network Licensees (i.e. the electricity Distribution Network Operators (DNO) companies and National Grid) for some time. The Licensees therefore believe that it is timely to undertake a comprehensive review of Engineering Recommendation P2 in relation to customer and system requirements and to develop an understanding of what is required to facilitate the long term development of networks.

The fundamental review of ER P2/6 is being directed by the Distribution Code Review Panel P2 Working Group (DCRP P2 WG) through the Energy Network Association (ENA).

The review is formed of two distinct phases. **Phase 1** is essentially a comprehensive research, analysis and modelling engagement and consultation process carried out by the Consortium with direction and support provided by the DCRP P2 WG and the ENA. Network licensees have no preconceived approach to future security standards. The spectrum of possibilities ranges from a modification and update of the current arrangements, development of a completely new approach starting from first principles, through to recommending removal of any deterministic planning standard, relying instead on DNOs' regulatory incentives and other legislation to motivate efficient network design. The essential task of Phase 1 is to research, develop and communicate a range of options for the overall approach to structure and detail the appropriate level of network security standards and then to propose how such options can be evaluated. The Consortium will then evaluate these agreed options, and recommend the most appropriate approach that should be taken forwards into **Phase 2**, and ultimately codified.

Phase 1, which is the subject of this PIP, will pose some fundamental questions about the means of providing the most appropriate level of security of supply to customers, via a combination of network assets, customer owned assets, and both technical and commercial operational management techniques, and as such will be of great interest to many stakeholders. Hence as part of this phase it will be important to widely consult with such stakeholders throughout the process.

2.2 The Way Forward Phase 1

It is the view of the DCRP P2 WG and the Consortium (DNV GL, ICL and NERA) that a fundamental review must essentially entail imagining a world where ER P2 does not exist and trying to ascertain what the best approach to addressing security of supply in distribution networks is, based on today's parameters. There are potentially a number of options that may emerge from carrying out such an assessment, namely; to keep the standard as it is, to amend or rewrite it, or to eliminate it all together, possibly replacing it with another mechanism. It will be important that any change, when placed alongside the wider regulatory framework to which DNOs are subject, motivates and supports the efficient planning and development of their networks to meet the needs of customers. Specifically, it is important that DNOs are encouraged, as far as possible, to provide the economically efficient level of network capacity, accounting for the trade-offs between the costs of adding capacity, the value such capacity additions provide to consumers and other network users through improved resilience, and the costs of "smart" alternatives.

While the DCRP P2 WG will direct the review project, DNV GL will coordinate the Phase 1 review project (i.e. take the role of Project Management Office (PMO)) as well as lead the informal and formal consultation activities. Imperial College will focus on in-depth analyses of the performance of alternative network operation and design standards, while NERA will centre their work on the interaction / interface between the security standards and the regulatory framework, EU codes, capacity mechanism and balancing services significant code review (SCR). The ENA is a key member of the DCRP P2 WG and will also facilitate industry support, meetings and stakeholder events.

The DCRP P2 WG and the Consortium believes its approach, which contains a combination of different activities will lead to Phase 1 review outputs that are a) well guided and robust and b) based upon widespread industry consensus. This can only speed up and de-risk any subsequent Phase 2 implementation of changes that may be recommended at the end of the initial assignment.

A major output of the Phase 1 work will be to identify alternative options for updating distribution network design standards, potentially including operational standards, while considering their strengths and weakness under different future development scenarios. This will be based on an established cost benefit framework[6] that will involve assessment of the performance of alternative options in relation to:

(a) characterised and quantified service quality delivered to end user customers, considering frequency and duration of outages together with risk profiles and robustness associated with construction outages, common mode failures and high impact events (considering the corresponding costs),

(b) application of advanced automatic control schemes and/or area-wide operational measures that might be considered to contribute to security of supply,

(c) in combination with non-network technologies, such as demand side response, distributed generation and energy storage, and

(d) investment cost in network assets,

(e) while taking into account the regulatory framework, EU codes, and market design changes.

This would be a key deliverable to any subsequent Phase 2 work that will prioritise options identified based on a number of criteria defined through workshops with the DCRP P2 WG and consultations with stakeholders.

---

[6] Cost benefit framework established by Imperial College London. Discussed in Section 4.1 Model Framework.

2.3 Main Challenges

Although the distribution networks, designed in accordance with the historic deterministic standards, have broadly delivered secure and reliable supplies to customers, the key issue regarding the future evolution of the standard is associated with the question of efficiency of the use and potential reinforcement of existing assets and the role that advanced, non-network technologies could play in the future development and delivery of security of supply to consumers. A fundamental review of the philosophy of distribution network operation and design is needed to inform the industry, consumers, regulator and government, in order to facilitate a cost effective delivery of the UK Government energy policy objectives. Overall, there are two key areas of interests:

1. What is the level of security performance delivered to end user consumers by the present network design standard/practices? Is the present network design standard efficient? Does it deliver value for money to all network customers? Does it deliver the level of security customers wish now and in the future and are willing to pay for? In other words, does it balance the cost of network infrastructure with the security benefits delivered to distribution network customers now and into the future? This area will require considering the difference between theoretical and actual performance of the present standard as in practice many 11kV and LV designs are considerably more secure than the P2/6 standard requires and the account of security benefits from embedded generation in network planning can vary in practice.
2. Given that the present network design standards require that network security is provided through asset redundancy, will this impose a barrier for the innovation in the network operation and design and prevent implementation of technically effective and economically efficient solutions that enhance the utilisation of the existing network assets and maximise value for money to network customers?

Under these two key areas, there are a significant number of more specific issues to consider:

(a) The degree of security provided by the deterministic security criteria, using generic rules applied to all situations, will not be optimal in individual instances as the cost of providing the prescribed level of redundancy is not compared with the reliability profile (cost) delivered (the standard however does allow a departure from a defined level of security subject to detailed risk and economic studies). The evaluation of service quality that different consumers actually experience is critical for conducting the cost-benefit analysis of alternative network design approaches.

(b) The binary approach to risk as in the present deterministic standard is fundamentally problematic: system operation in a particular condition is considered to be exposed to no risk at all if the occurrence of faults, from a preselected set of contingences, do not violate the operational limits; while the system is considered to operate at an unacceptable level of risk if the occurrence of a credible contingency would cause some violations of operating limits. Clearly, neither of these is correct, as the system is indeed exposed to risks of failure and outages even if no preselected contingency leads to violations of operating constraints, and the risk of some violations may be acceptable if these can be eliminated by an appropriate (post fault) corrective action that can include a fast response of flexible demand or some form of distributed generation. Probabilistic consideration of the interruption risk profile that individual consumers are exposed to would therefore be required to address this issue.

(c) The lack of differentiation between construction and maintenance outages in the present distribution planning standards may present a significant problem given the expectation of considerable asset replacement in the future. This is likely to affect particularly large Demand Groups[7].

(d) In many cases, asset redundancy may not be a very good proxy for actual security delivered. In this context, it is important to recognize that deterministic standards assume that all contingencies are equally likely, which is clearly problematic: for example, faults on a long exposed line are much more frequent than failures of a closely monitored transformer.

(e) Understanding of the parameters that can be used for measuring the reliability of supply received by consumers has considerably improved in recent decades with a shift from energy not supplied type indices to service outputs such as frequency and duration of interruptions and customer damage functions[8]. Furthermore, there is no explicit recognition that the reliability indices are not deterministic but inherently stochastic parameters. Consideration of these effects are required, allowing, as required by the assignment, to value reliability using either complex customer damage functions, or more traditional approaches to valuing un-served energy based on an assumed level of the value of lost load (VoLL).

(f) The present standard does not deal well with common mode failures and it does not provide any guidance for dealing with High Impact Low Probability events. Resilience of the network when exposed to common mode failures and high impact low probability events should be explicitly recognised.

(g) Over the past decade, there has been a marked improvement in the reliability of much of the UK's electrical distribution networks through the Interruptions Incentive Scheme, which is not explicitly recognised in the present planning standards. Furthermore, the focus of the Interruptions Incentive Scheme has been on overall system performance rather than on individual customer focused indices. System indices capture the impact of network behaviour on an "average" customer, while the security of supply seen by real customers will be radically different from these summary indices currently used to drive network development.

(h) There is a growing interest in incorporating non-network solutions (such as flexible generation and demand, new storage technologies, dynamic line rating, automatic network monitoring and control based on new information and communication technology etc.) in the operation and design of future distribution networks. It is not, however, clear to what extent the application of such solutions changes the security of supply delivered to the end consumers – the reliability and availability of light current control systems is fundamentally different to that of power system components. This is clearly critical for quantifying the ability of non-network solutions to substitute network assets.

(i) At present, the choice that many network users (both demand and generation) can exercise in relation to their security of supply is limited. This may be a barrier for connections, particularly for generation type users. If such choice is to be offered to users, understanding of the network

---

7 As demonstrated in KEMA/Imperial report to Ofgem ("Review of Distribution Network Design and Performance Criteria", G06-1646 Rev 003, 19 July 2007, Kema Limited.)

8 Value of Lost Load (VoLL) is the estimated amount that customers receiving electricity would be willing to pay to avoid a disruption in their electricity service. The value of these losses can be expressed as a customer damage function (CDF). A CDF can be defined as:

Loss (£/kW) = ***f*** (duration, season, time of day, notice etc.)

Based on the calculated outage cost, a CDF can be obtained for various customer groups.

reliability profile will be essential (in addition to the development of reliability differentiating charging / reward mechanisms).

(j) The scope of the present network standard is limited to the compliance at a particular point in time looking forward based on demand estimates, but given the uncertainty in penetration levels of various low carbon demand and generation technologies in distribution networks, it may be desirable to extend the scope of the standard and consider cost-effective network planning under uncertainty, particularly taking advantage of smart grid technologies.

(k) In the longer time scale the introduction of smart metering and in-home energy management devices may facilitate reliability-based choices of consumption. Rather than having full interruptions and indiscriminate demand curtailment in case of constraints, it may be possible to prioritise categories of demand within the home and hence facilitate network management at lower cost to customers.

Although some improvements of the existing network design standards have been made to recognise the contribution that distributed generation could make to network security, this was carried out without reviewing the fundamental principles on which the standard is based[9]. Therefore, service quality profiles delivered to customers by the distribution network and cost-benefit performance of the existing standard need to be fully reviewed and understood. Furthermore, there are also compliance issues associated with the interface between distribution and transmission standards (i.e. the National Electricity Transmission System Security and Quality of Supply Standards / NETS SQSS) that need to be addressed. This is exacerbated by the fact that NETS SQSS is a design and operation standard, while Engineering Recommendation P2/6 only deals with network design and does not directly deal with post-contingency control that could be facilitated by non-network technologies such as flexible / controllable distributed generation or demand side response.

While challenges in Phase 1 (above) are associated with addressing fundamental principles and identifying alternative options for future standards, the main challenge for Phase 2 will be to produce implementable security standards that will balance the cost efficiency of the standard and the complexity of implementation. This creates a need for a major stakeholder engagement exercise in Phase 1 enabling in-depth discussion about the strengths and weaknesses of the proposed options and trade-offs between overall efficiency of the standard and simplicity and transparency requirements. A lack of stakeholder involvement in a task of this magnitude can be a recipe for disaster and the common scenario is that the output(s) are not accepted by industry and therefore become another legacy item, rather than something that can genuinely drive through any change that may be needed. It is the DCRP P2 WG's and the Consortium's belief that a well-structured Phase 1 will lead to a better end result and consequently less work for Phase 2. Indeed, formatting and codifying the standards can be extremely labour intensive if the terms of reference are not clearly defined and relevant stakeholders are not on board with the process.

9 Reference to Engineering Recommendation p2/6.

3 REVIEW PROCESS (PHASE 1)

The overall approach underlying the proposed work, in Phase 1 of the review, is to carry out a comprehensive research, modelling, engagement and consultation process. Figure 1 outlines the proposed process. The process consists of 9 Work Streams, one of which is an optional addition (work stream 4). This Project Initiation Paper and the associated planned stakeholder work shop form the key tasks in Work Stream 1.

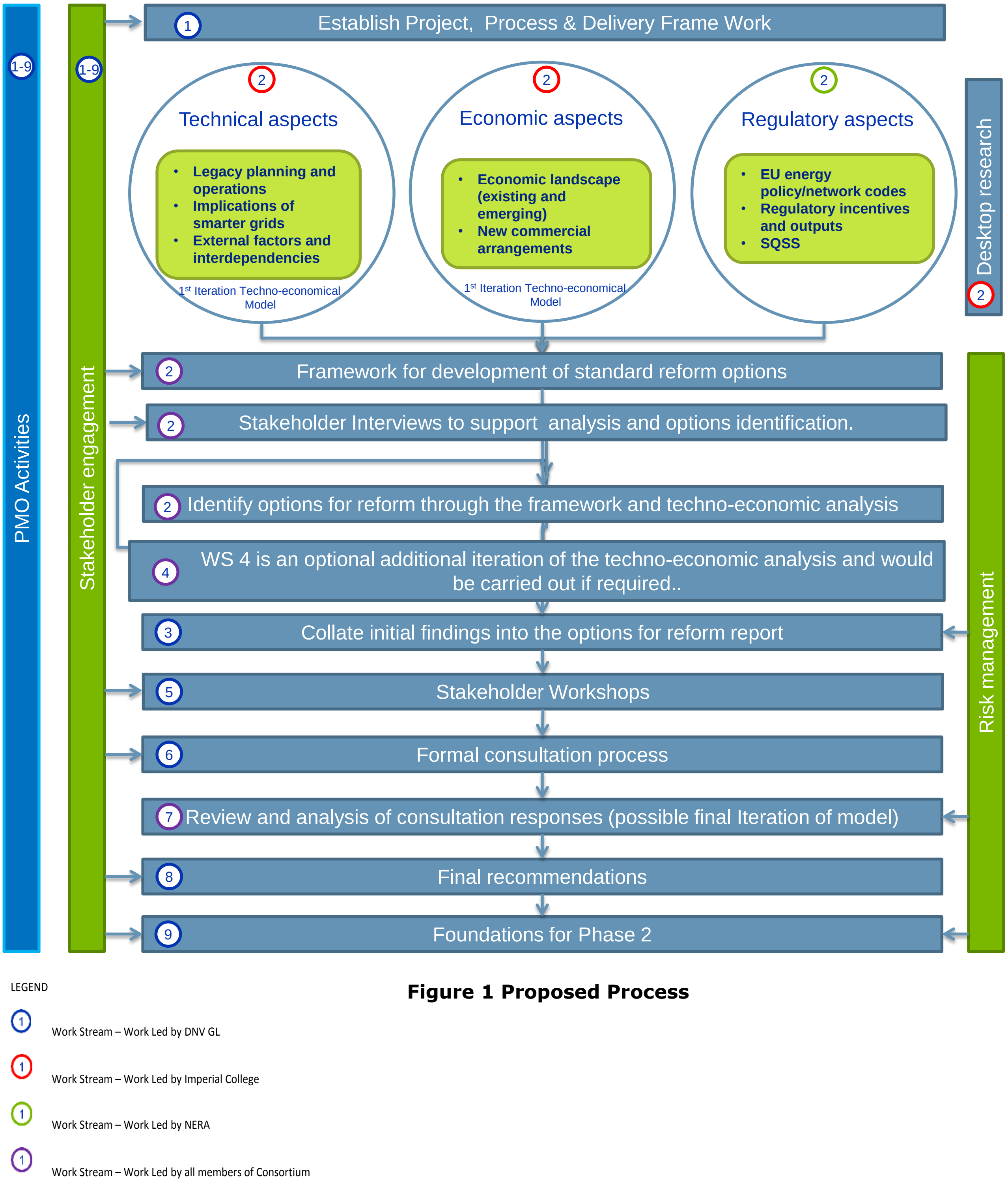

Figure 1 Proposed Process

The scope of the technical and economic aspects (primarily Work Stream 2) is further summarised in Figure 2.

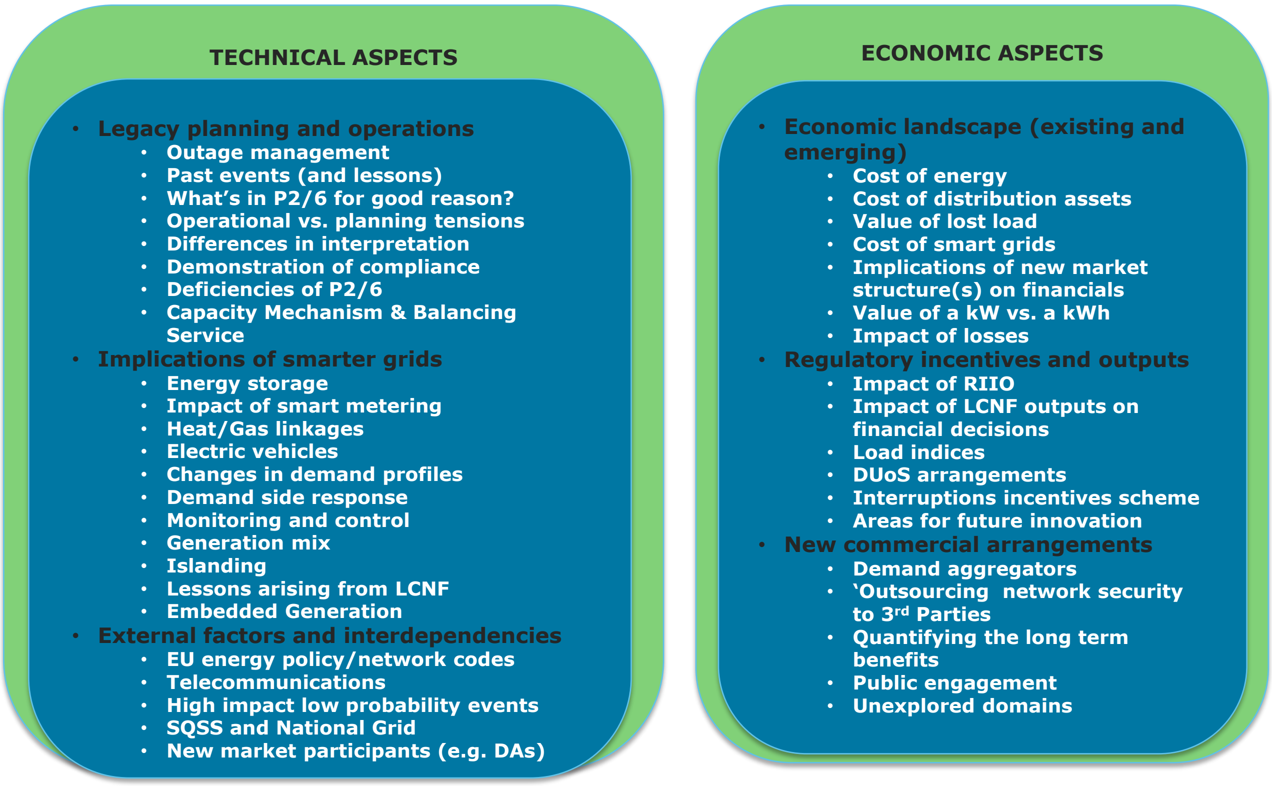

Figure 2 Scope of techno-economic model

Subsequent sections describe the approach in detail.

An overview of the framework used to assess alternative design standard proposals is provided in Section 3.1 and is a fundamental part of the Work Stream 2 activities discussed in Section 3.2. Work Steams 3 to 9 are outlined in sections 3.3 to 3.9 respectively. Of key importance is the stakeholder engagement plan which is outlined in section 3.10.

3.1 Framework for the development of future network design standards

For developing any new network security standards, it is critical to examine the cost effectiveness of the standard, and its ability to balance the cost of interruptions against the cost of network infrastructure, which will involve application of alternative (i.e. alternative to expected Energy Not Supplied which underpins the current standard) indices such as Value of Lost Load (VoLL) and customer damage functions. In high level terms, this cost-benefit framework will involve application of the Imperial College optimisation models to identify the costs of a "perfectly designed" or "economically efficient" network, which will be compared with the costs of a system designed and built in compliance with P2/6. This will involve consideration of not only the expected cost of interruptions (using both of VoLL and customer damage function concepts) but also distributions of these costs that would enable risk profiles associated with different network designs to be established and included in the cost-benefit methodology. This framework will enable consideration of alternative network design standards that could potentially replace (refine or improve) P2/6, and evaluate how much of the gap they would close between the current P2/6 and the economically efficient system. It should be noted that an identified alternative network design standard option may not be shown to close this gap.

In addition to these potential quantifiable savings from reform of P2/6, the framework for cost-benefit analysis will also need to account for more qualitative considerations, such as the transparency and simplicity of proposed design standards, and the ease with which DNOs' compliance with these standards can be appraised in the future – for example to demonstrate licence compliance. Part of the stakeholder engagement process will assist in accounting for these more qualitative aspects in the overall evaluation framework. The influence of the DCRP P2 WG will also greatly assist in assessing the impact of the more qualitative aspects in the assessment framework.

Further detail of the Imperial College optimisation models are discussed in section 3.1.1.

3.1.1 Imperial College Model Framework

In the context of Work Stream 2, the overall aim of the proposed work, in its first phase, is to carry out a fundamental cost-benefit analysis, from first principles, of the performance of alternative distribution network design philosophies considering the quality of service delivered to end user consumers and the associated network investment and outage costs. This analysis is completed while optimising the use of advanced network control technologies (e.g. active network management, dynamic line rating) including demand side response, distributed generation and energy storage technologies. The key objective of this will be to inform the debate and develop options for the evolution of the present distribution network design standard in order to support the development of efficient, secure and sustainable electricity distribution networks and facilitate cost effective transition to a low carbon future.

Specifically, this work will identify alternative approaches to updating existing and developing distribution network design and operational standards, while considering their advantages and disadvantages under different future development scenarios. This will include characterising and quantifying the service quality delivered to end user customers (considering frequency and duration of outages and corresponding costs) that is compared with network investment and operating cost. Given the probabilistic nature of network failures, a probabilistic cost-benefit based framework will be a benchmark for assessing different options for the development of network design standards. As indicated in the figure below, a probabilistic approach can provide the basis for risks of supply interruptions to be understood, quantified and managed through optimising the amount of the network capacity that should be made available to network users in both operational and investment time horizons. Essentially, this approach will enable the costs of network investment to be balanced against the benefits that the released network capacity delivers to the network users.

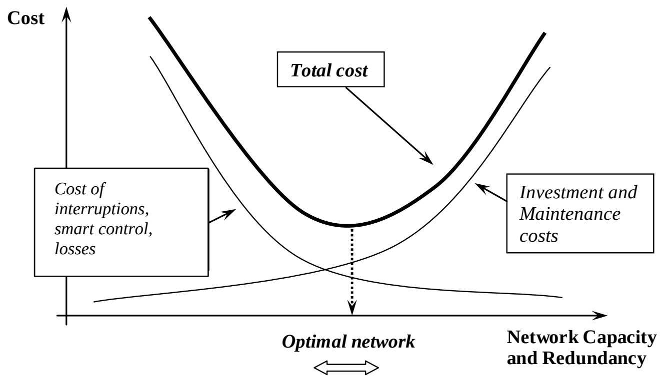

Figure 3 Probabilistic cost-benefits analysis framework for distribution network operation and planning (balancing of network operation costs that includes cost of service interruptions and application of alternative non-network control technologies, with cost of investment in network assets)

Furthermore, a probabilistic approach will provide a framework within which both network and non-network solutions, such as flexible demand and generation, can be objectively compared and thus solve network problems. Therefore, this framework would provide a benchmark for assessing economic efficiency of any future standard.

After assessing an array of alternative options, this work will also support the identification of the network standards that are both efficient and implementable by DNOs. Thus, in Phase 2 of the review, the ultimate aim will be balancing the level of complexity that may be associated with the optimum standards against the need for simplicity and transparency, and thus drafting a preliminary code that can be widely consulted and revised by stakeholders.

To undertake such assessments of alternative network design standards, Imperial College's specialised large-scale probabilistic distribution network models will be applied. The majority of existing reliability tools and techniques in the context of distribution network planning focus on the average or expected performance of the system. In addition to these, Imperial College has developed a number of optimisation and simulation models for network design and operation, which can explicitly characterise the network reliability performance as well as the service quality profile delivered to an individual customer. Clearly, this approach will support a detailed and explicit representation of the effects of alternative network design and operation strategies, involving both network and non-network solutions, on customer reliability of supply. This is critical since the actual service quality delivered by distribution networks to individual customers varies massively and is generally very different from the system-wide reliability indices.

As indicated in the figure below, the use of Imperial College's tools enables a complete characterisation of security of supply experienced by individual customers, in terms of frequency and duration of contingent events. Red and green lines represent the probability that frequency and duration will be less than or greater than 5%, respectively. For example, there is 5% probability that the number of outages will exceed 15 for this particular group of customers, and also 5% probability that the annual outage duration of consumers supplied from this particular distribution transformer will be greater than 75.7 hours.

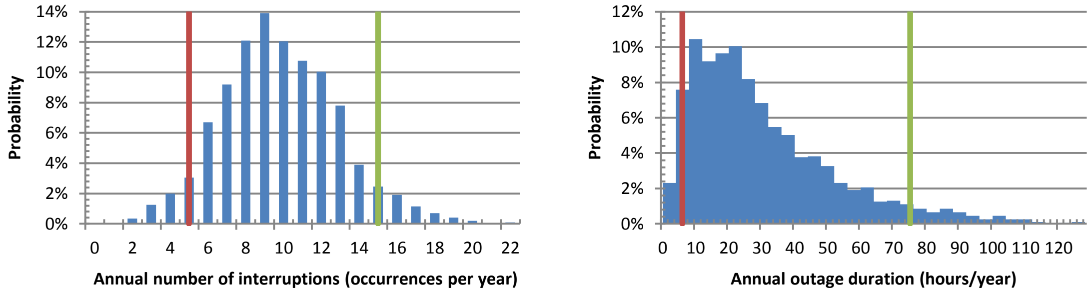

Figure 4 Impact of inherent variability of security of supply

Information about the variability of these indices is critical for determining the cost-benefit case for a particular network operation and design approach and also vital for establishing the robustness and risks associated with any alternative design and operation standards. Similarly, when the impacts of construction outages are considered, it will be essential that the risk profile of alternative provisional supplies are understood and quantified, which is a key feature of Imperial College’s models.

The figure below shows the variability of reliability performance indicators associated with individual load points (more than 45,000 distribution transformers) across the HV network of a GB DNO. It is observed that there are a significant number of load points with the probability of experiencing more than 5 interruptions per annum with the total duration of outages exceeding 18 hours, is greater than 0.5 (i.e. 50%), although the frequency and duration of outages for a large proportion of the load points is expected to be relatively low. It is observed that although the entire network is built in accordance with P2/6, the actual service quality performance experienced by individual consumers widely varies. Hence, understanding the impact of alternative network operation and design approaches on the outage frequency and duration will be a key aspect of the review work. This is critical as the cost associated with interruption of services is highly non-linear, particularly in relation to duration of outages, and hence “system” based indices (e.g. CIs and CMLs) are not sufficient for establishing the balance between the network investment cost and benefits delivered to network users.

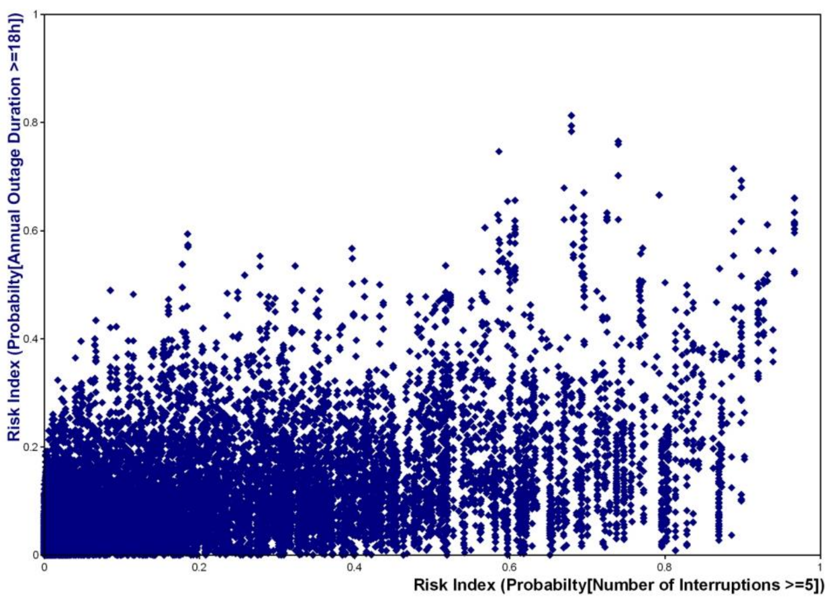

Figure 5 Risk indices of outage frequency and duration of different load points across the distribution network of a UK DNO

Imperial College's tools take account of an array of advanced concepts and models to assess system features that affect distribution network security performance including in particular:

- Common mode failures of network infrastructure through the application of Markov based reliability models;
- Risks associated with extended construction outages and the role and benefits of infrastructure reserves and provisional supplies;
- Role of flexible generation, demand response and energy storage technologies in enhancing the utilisation of existing network assets.

Imperial College has utilised these applications in a number of projects with industry and academic papers, including the 2007 KEMA/Imperial College report where strength and weaknesses of the existing ER P2 were discussed. Further detail of the Imperial College model framework elements are discussed in Work Stream 2.1 in section 3.2.2.

3.2 Work Stream 2 - Assessment of P2/6 and Identifying Options for Reform

Work-stream 2 aims to provide the analysis required to (1) understand the impact of P2/6 in its current form, and (2) identify the options for improvement and reform. The outputs produced through Work-stream 2 will feed into the Options Report that constitutes Work-stream 3 (see below).

The analysis to be performed under Work-stream 2 covers a number of topics, and entails comprehensive desktop research, modelling of key issues and gathering of stakeholder input activity to identify the current impact of P2/6. Amongst the primarily areas of focus are the following:

- Analysis of the distribution network service quality performance associated with the present network design standard and alternative options for its update;
- Assessment of risk associated with asset replacement, common mode failures and high impact events;
- Analysis of the impacts of Smart Grid solutions on security of supply;
- Assessment of impacts of alternative control and operation strategies on security of supply;
- Loss inclusive design of distribution networks and impact on security of supply;
- Interface between distribution network standards and the regulatory framework (RIIO), EU codes, capacity mechanism and balancing services significant code review, and
- Defining the interface between distribution network standards and IIS and SQSS.

WS2.1 to WS2.9 will be led by either Imperial College or NERA as they are all related to the techno-economic model. WS2.0 will support these elements and will be conducted by DNV GL.

3.2.1 WS2.0 Stakeholder interviews

Led by:	DNV GL
Key Stakeholders:	DNOs, National Grid, Demand Aggregators, Suppliers, DGs, 3rd parties, Ofgem, DECC

Using the scope of the techno-economic model as a reference (Figure 2), the Consortium will conduct a series of structured interviews with a variety of different stakeholders. These will help support the modelling activities and ensuring that relevant industry participants feel that 'they have laid their cards on the table' with regards to the final output. As far as the DNOs are concerned, it is envisaged that interviews would be conducted with those setting planning policy, operational engineers (i.e. those that have experience of operating the network or managing outages), LCNF teams (i.e. those looking at future developments and new technologies) and regulatory/commercial teams (i.e. those concerned with the impact of any change to P2 in terms of change control and financial management). Each of the DNOs would be interviewed, remembering that the application policy of P2 may vary from one DNO to another. The interviews would be conducted based on a structured questionnaire developed by the consortium to derive the information and views required. Questionnaires may be sent to interviewees prior to the interview to allow interviewees time to consider their responses.

As far as the other stakeholders are concerned e.g. TSOs, Aggregators, Suppliers, DGs, Generators, IDNOs, OFTOs and Whitehall (Ofgem, DECC), a more general view will be sought on the areas in Figure 2 and clearly some areas may not be applicable to all parties. Views will be derived via the Work Stream 1 wider stakeholder workshop and possibly follow-up telephone interviews.

3.2.2 WS2.1 Scope and framework for assessing security performance and measures of characteristic network designs

Led by:	Imperial College
Key Stakeholders:	DCRP P2 WG, DECC, Ofgem, DNOs
Anticipated No. of Workshops:	1

Given that the measure of the underlying risk in ER P2/6 is based on Expected Energy Not Supplied (EENS), in this task, we will investigate a spectrum of alternative measures for quantifying security of supply experienced by customers. The strengths and weaknesses of various customer risk measures, particularly focusing on frequency and duration of outages and customer damage functions, will be evaluated. Given its probabilistic nature, the consumer reliability indices will be represented by the probabilistic density functions rather than expected values only. This is essential for understanding of the risks profile associated with service quality delivered to network customers and for assessing the robustness of the alternative network design strategies.

Historically, electricity networks are planned on the basis that all consumers place the same value on continuity of supply and use of their appliances when required. Furthermore, it has been assumed that the continuity of supply is binary: electricity supply is 100% available under normal operating conditions (all devices can be used) or not at all under outage conditions can (none of the devices be used). This historic approach usually characterised by valuing avoided interruptions using a single value of lost load (VoLL), although widely understood and recognised, is overly simplistic. First, the estimation of VoLL is subject to considerable uncertainty, driven by the fact that the damage caused by interruptions is different for different classes of consumers, in different locations, and at different times of the year/day. Also, smart metering coupled to in-home energy management devices could change the way customers value supply continuity through facilitating reliability-based consumption choices. By setting design standards that allow networks to be planned in accordance with the differing priorities of different categories of in-house demand, it may be possible to develop and operate networks at lower costs to customers.

In this task the Consortium will therefore develop their existing models to allow a range of alternative approaches to valuing interruptions to be taken. For instance, we may analyse cases in which the value of interruptions is simply at VoLL, e.g. drawing on recent studies, such as those prepared for DECC, that estimate VoLL. The Consortium will also consider other cases in which the valuation of avoided interruptions is represented by a customer damage function, such that value depends on the customer type(s) affected, timing and frequency of outages, and duration of the outage. In all cases, the value of reliability-differentiated continuity of supply service will be assessed through comparisons with the historical approach to security with having full interruptions and indiscriminate demand curtailment in case of constraints.

In order to support a broad range of network designs with associated network cost characteristics and corresponding performance (which can be found in operation and planning practices), the Consortium will develop a high-level probabilistic approach for assessing the security of supply delivered to the end consumer under different conditions. We will also establish a set of characteristic network designs, across the range of Group Demand levels and populate these with relevant technical, cost and performance data.

The key activities of this Task include:

(a) Carry out a critical review of recent studies on quantifying costs of interruptions and identify strengths and weaknesses of different customer risk measures including EENS, frequency and duration of outages and different approaches to costing interruptions.
(b) Gather network and load data (across all voltage levels and demand groups), and statistics associated with network failures, outages and service restoration procedures.
(c) Establish a set of characteristic network designs, across the range of Group Demand levels and populate these with relevant technical, cost and performance data. This will involve characterisation of failure and repair rates through not only average values but also a range of associated probability distributions.
(d) Based on the range of Imperial College models for assessing distribution network reliability performance, the Consortium will establish key high-level modelling approaches for assessing key load-point focused security indices, including evaluation of the average values of the key indices based on Markov models but also their distributions through full Monte Carlo based models. This will then be used to assess not only the cost of interruptions, in terms of expected values (using both VoLL and customer damage function concepts) but also distributions of these costs that would enable risk profiles associated with different network designs to be established and analysed.
(e) Selected case studies will be carried out to demonstrate and agree the range of model outcomes that will be used in subsequent tasks.

The output will be a framework for the development of future network design standards.

3.2.3 WS2.2 Service quality and cost effectiveness of the present network design practises

Led by: Imperial College
Key Stakeholders: DCRP P2 WG, National Grid, Ofgem, DECC
Anticipated No. of Workshops: 2

For developing new network security standards, it is important to understand two key aspects of the present standard (a) the service quality inherent in the present network design practices (which may deliver networks with a security in excess of that required by P2/6) and implicit in the design standards, including contribution of distributed generation (b) the cost effectiveness of the standard, and its ability to the balance cost of interruptions against the cost of network infrastructure, which will involve application of alternative indices such as VoLL and customer damage functions (see previous sub-section). The Consortium will carry out a high-level analysis of average reliability performance, including an examination of the variability of key service quality indicators, and assess the risk profile implicit in the present network standard across different Group Demand (GD) levels and selected network configurations. This will include an analysis of typical configurations covering all voltage levels while considering networks of different topologies, such as rural, sub-rural/urban and urban. The probability density functions of various measures of reliability performance will be estimated by application of suitably designed probabilistic analysis techniques. This will facilitate comparisons of the level of security of supply implicit within the present standard with alternative formulations. Furthermore, the reliability analysis will be combined with the various forms of customer damage functions, in order to estimate the monetary value of unreliability and to inform the optimal network design. This will also enable an evaluation of the magnitudes of VoLL and characterisation of the Customer Damage Functions that are implicit in the present standard. This would also include analysis of the appropriateness of demand group definitions and treatment of interconnection/ transfer capacity.

Key activities of this task will include:

(a) Based on samples of real distribution networks and the set of characteristic networks created across all voltage levels and group demands, analysis will carried out to assess service quality delivered to consumers by the present network design practices. This will include rural, sub-rural/urban and urban network topologies and different consumer mixes across different demand groups. Understanding the actual performance of the present network security standard will be important when developing alternative network design propositions. This will include evaluation of various reliability indices in the form of expected values, and also the risk profile driven by the variability of key parameters.

(b) Cost benefit analysis for the existing network design practices will be carried out to assess the efficiency of the present network design standard. Alternative indices based on VoLL and customer damage functions, and criteria, considering both expected interruption costs and distributions of costs, will be used out to inform the debate regarding the business case for the existing design practices. Some sensitivity analysis is envisaged to demonstrate the impact of various key parameters and assess the robustness of the present practice.

(c) Assessing by how much the assumed cost of interruptions affects the fundamental design of networks, particularly when considering different consumer mixes. This will be used to inform the debate regarding the question of "who/what are future distribution networks being built for"? It will also be important in accounting for how uncertainties around the value of avoided interruptions (including how this varies across customer classes) feed through into network planning decisions.

(d) High-level analysis will be carried out to establish appropriateness of demand group definitions and treatment of interconnection/transfer capability.

The output will be a summary report that will feed into the 'options' milestone report.

3.2.4 WS2.3 Risk associated with asset replacement, common mode failures and high impact events

Led by: Imperial College
Key Stakeholders: DCRP P2 WG, National Grid, Ofgem, DECC
Anticipated No. of Workshops: Part of WS2.2

The acceleration of major asset replacement programmes introduces risks not explicitly recognized when the planning standards were developed. Some construction outages will potentially last for long periods, thus exposing potentially large numbers of customers to an increased risk of loss of supply, unless comprehensive contingency measures for emergency restorations are established. The lack of differentiation between construction and maintenance outages in the distribution planning standards represents a significant shortcoming given that a period of potentially considerable asset replacement is underway. The Consortium will conduct high-level assessments of materiality of this effect and estimate the risk profiles of supply security for typical configuration characteristics for large Demand Groups. This will, for example, include consideration of the appropriateness of the specified return to service periods (outage duration) for a first circuit outage and hence the period at risk of a second circuit outage.

Furthermore, the present standard does not address explicitly common-mode faults. These may be relevant when considering overhead line (OHL) circuits on the same tower or laying multiple cables in the same trench (that are expected to provide redundancy for one another), or especially the loss of a busbar or switchboard. This may be a particularly material issue for large demand groups exposed to potentially high risks of common-mode failures. Furthermore, this task will also analyse the significance of high impact low probability events and alternatives for dealing with prolonged outages. The Consortium will also consider the cost of interruptions and represent it through a non-linear function of the outage duration (see above).

Key activities of this task will include:

(a) Carry out high-level assessment of the risk profiles of security of supply associated with typical configurations for large Demand Groups and impact of different constriction outage durations. This will also include establishing the principles of the cost-benefit analysis associated with alternative supply arrangements for construction outages.

(b) Assess the driving factors and the importance and materiality of considering common-mode failures. Case studies will be carried out on the established set of characteristic network designs, particularly associated with large demand groups, with particular focus on parallel circuits and losses of busbars and switchboards[10].

(c) Carry out high-level assessment of high-impact low-probability events, such as blackouts of critical districts, outages driven by very extreme weather conditions[11] and consequences of significant reductions in demand diversity following prolonged outages will be carried out to identify key indicators, assess their importance and assess the benefits of expenditure on reliability improvements / mitigation measures of reducing their impact on the security of supply.

10 It is recognised that in the future common mode failures could relate to external factors e.g. computer failure of a DSM aggregator.

11 This relates to weather events that are considerably more extreme than a 1 in 10 year event.

The output will be a summary report that will feed into the 'options' milestone report.

3.2.5 WS2.4 Impact of Smart Grid technologies on service quality risk profile

Led by: Imperial College
Key Stakeholders: DCRP P2 WG, National Grid, Ofgem, DECC
Anticipated No. of Workshops: Part of WS2.2

A high-level assessment to quantify benefits from flexible generation, responsive demand including storage, to security of supply will be carried out. A range of generic case studies with characteristic parameters for various flexible generation and demand technologies will be carried out to assess the ability of these non-network solutions to substitute network assets without degrading the reliability performance seen by the end consumers. Imperial College's recent analysis suggest that when assessing the contribution of demand side response contribution to network security, it may be appropriate to consider response time, duration, energy recovery characteristics and cyclic sustainability. In this context, diversity effects associated with multiple demand side response providers/aggregators will be considered. This task will also include assessment of the role and value of advanced network technologies, such as automation and remote control of switchgear, soft Normally Open Points (NOPs), on-line voltage regulators, in enhancing the security of supply. The Consortium proposes to apply Imperial College's models with embedded Monte Carlo techniques to estimate effects of these technologies in enhancing security of supply (through mostly reducing outage time).

This task will also consider benefits of permitting islanding-mode operation of the distribution system in order to minimise interruptions in customer supply after the occurrence of severe low probability and high impact events.

This task will be carried out in the context of different time frames (2020, 2030 and 2050), considering the future changes in the GB generation mix and the increasing growth in the penetration of distributed generation and demand composition. This will involve consideration of effects associated with a lack of system inertia, exports from distributed generation and challenges that electrified heat and transport sector may bring.

Spatial and temporal properties of demand growth are characterised by a significant degree of uncertainty. In this context, non-network technologies may provide flexibility and make the future network reinforcement more certain and hence cost effective in the long run. This would create the option value of non-network technologies, through temporarily postponing investment decisions until more accurate information regarding the spatial and temporal properties of demand growth becomes available, while not compromising the service quality performance experienced by customers. It may be appropriate that such considerations become a part of the future network design standard. Furthermore, this may have implications for the regulatory framework associated with cost recovery for network and non-network solutions, which will also be considered in this work (see Work Stream 2.7 following).

Key activities of this task will include:

(a) Through illustrative case studies on the established set of representative network designs, identify alternative criteria for incorporating non-network solutions in future network planning standards, on a non-discriminatory basis. This will in particular include:
   - Distributed generation of different technologies, response times and availabilities.
   - Responsive demand, considering availability, response time, duration, energy recovery characteristics and cyclic sustainability.

- Energy storage technologies.

(b) Identify alternative approaches to assessing the contribution that these technologies could make to network security in the case when they also provide other system support services, such as deferent forms of reserve and/or frequency response services. This will be supported by relevant case studies.

(c) Identify the role and value of advanced network technologies including automation and remote control of switchgear, application of soft NOPs, on-line voltage regulators, in enhancing the security of supply. Alternatives for including islanding-mode of operation will be identified.

(d) Identify alternative approaches to dealing with uncertainty in future developments when designing distribution networks (particularly in the context of integration of low carbon demand and generation technologies in distribution networks) in order to facilitate the debate of the role and scope of future network security standards. In this context, modelling will be carried out to demonstrate possible evolution of the compliance requirement, considering present only, or also a least-cost compliance approach considering uncertainty in future development.

The output will be a summary report that will feed into the 'options' milestone report.

3.2.6 WS2.5 Assessment of impacts of alternative control and operation strategies on security of supply

Led by:	Imperial College
Key Stakeholders:	DCRP P2 WG, National Grid, Ofgem, DECC
Anticipated No. of Workshops:	Part of WS2.2

While the previous task focuses on the contribution of various Smart Grid technologies[12] to security of supply, this task centres on assessing the implications on network control and operation strategies (including those affecting new technology) required to enable these technologies to contribute to security of supply while simultaneously enhancing the ability of the distribution network to accommodate increased levels of demand and generation (and hence power transfers). Hence, in this task we will consider alternative control and operation strategies that can be implemented through advanced Distribution Management Systems (DMS) and/or through distributing control functions among various controllers, and accompanying commercial arrangements that would support the use of demand and generation resources in supporting security of supply. This task will identify appropriate software and Information Communications Technology (ICT) infrastructures that will support the implementation of advanced network operation practices (e.g. use of state estimation, control scheduling algorithms and supporting Remote Transmission Unit (RTU) measurements and communication).

Currently, real time distribution network control is largely preventive with very little real-time control (except supply restoration), and security of supply is delivered through preserving sufficient margins in loading of network assets. These margins may be reduced without degrading security of supply, provided that a portfolio of corrective control actions is effectively optimised. Given that a higher degree of integration and participation of corrective control will require an increased reliance on ICT infrastructure, the security risks associated with these technologies need to be assessed. The key aspect of this work is consideration of both advantages and constraints associated with new monitoring, control and

[12] These technologies include embedded generation, voltage control technologies (tap-changing transformers, shunt compensation, in-line voltage regulators), energy storage technologies, responsive demand (smart appliances, electric vehicles), dynamic line rating etc.

communication technology, reflected in the latency (time to operate), common mode failures and reliability of response.

This Task will involve several activities:

(a) Carry out wide consultation with industry and relevant stakeholders regarding the changes in real time network operation and control facilitated by appropriate software and ICT infrastructures that will be required to facilitate the transition to a smart grid paradigm, focusing on the impact on security of supply. Analysis of experiences and lessons from LCNF projects and associated trials will also inform this task.

(b) Carry out high-level case studies to estimate key drivers that will impact the risk profile of future actively managed distribution networks. This will include exposure to common mode failures associated with ICT infrastructure.

(c) Identify the role of emerging commercial arrangements that would support the use of non-network resources (e.g. demand side and generation sources) in supporting security of supply.

The output will be a summary report that will feed into the 'options' milestone report.

3.2.7 WS2.6 Loss inclusive design of distribution networks and impact on security of supply

Led by: Imperial College
Key Stakeholders: DCRP P2 WG, National Grid, Ofgem, DECC
Anticipated No. of Workshops: Part of WS2.2

The present policies for distribution circuit design are driven by security of supply criteria and the cost of losses has not historically been given adequate consideration. Recent regulation developments through RIIO encourage implementation of minimum life-cycle cost distribution network design that balances the capital investment against the cost of the system losses. Imperial College's recent modelling demonstrates that the optimal peak utilisation of distribution network circuits (LV and HV in particular) should be very low. The implication of this on network reliability may be significant as the optimal network capacity should be much larger than peak demand, which would provide additional headroom and increase reliability of supply. However this effect has never been quantified and the purpose of this Task will be to assess the implication of minimum-life cost driven network design on security of supply.

This Task will involve several activities:

(a) Based on Imperial College's loss-inclusive, minimum life-cycle cost LV and HV network designs, using the established set of characteristic LV and HV networks, we will carry out modelling to assess the impact on network reliability performance.

(b) Identify implications on the future network security standards and opportunities that this may open to cost-effectively further improving reliability performance through enhancing flexibility and reconfiguration capabilities of LV and HV networks.

The output will be a summary report that will feed into the 'options' milestone report.

3.2.8 WS2.7 Alignment of security of supply standard in distribution networks with other codes and schemes

Led by:	NERA
Key Stakeholders:	DCRP P2 WG, National Grid, Ofgem, DECC
Anticipated No. of Workshops:	Part of WS2.2

Network planning standards interact with a wide range of other schemes, codes and regulatory arrangements in the British (and wider EU) electricity market. As part of this task, therefore, the Consortium will examine the interactions of the options set out through the preceding tasks with a range of other arrangements discussed in the following sub-sections.

3.2.8.1 WS2.7.1 The RIIO Framework and the Interruption Incentive Scheme

The need to incentivise efficient development of networks interacts with many aspects of the DNOs' regulatory arrangements. Although network planning standards impose certain requirements on companies through their licence conditions, the signals imposed by the regulatory framework within which DNOs and TOs operate may create incentives for network owners to divert from the efficient solutions envisaged by enhanced planning standards, e.g. because the RIIO framework provides them with incentives to provide more or less capacity than the planning standards suggest is appropriate. Specifically, it is not necessarily sufficient to mandate that DNOs or TOs follow specific design standards; they also need financial incentives to deliver the efficient level of investment in a timely fashion.

At present, the regulatory tools employed to promote efficient investment include the Interruptions Incentive Scheme (IIS), and the regulatory oversight of business plans that occur through periodic reviews of companies' price controls. Accordingly, our terms of reference requests a review of the IIS that considers its strengths and weaknesses and its relation to the network design standards.

This specific review of the IIS will include consideration of a shift from the aggregated system-level indices of security of supply ("average" customer) towards customer centred indices. This will also include direct consideration of the link between changes in network design and consequent system reliability delivered to end consumers. Furthermore, the importance of the variability of different indices will be explicitly considered. The Consortium will also examine if reliance on incentive arrangements as a main driver for network planning is appropriate and consider potential problems associated with exposing consumers to higher risks of supply interruptions, even if this risk is not very visible to the regulator and customers. As this is expected to be particularly relevant to EHV networks, we may also analyse various substation designs and spare transformer availability.

However, more generally, the Consortium will also consider, drawing on NERA's expertise of regulation and the RIIO framework, the practicality of the solutions proposed as part of this study, and assess the extent to which they will encourage efficient behaviour by the DNOs in reality. The Consortium will also consider a range of other factors, such as the ease with which it will be possible to assess companies' compliance with new planning standards, and the ability of companies to justify investments to the regulator with reference to new planning standards.

3.2.8.2 WS2.7.2 NETS SQSS

Another area with which any proposed revisions to network planning standards may interact is the NETS SQSS. The Consortium will therefore also address the existing disconnects between the distribution and transmission security standards and the recognition of non-network solutions. In addition, synergies and conflicts among different applications of flexible distributed generation and demand, including storage, for transmission and distribution security of supply will be identified, considering the degree of coincidence between transmission and distribution requirements. This will also include consideration of alternative less-firm connection approaches, particularly for generators and the treatment of flexible generation (and flexible demand) at the interface with the transmission network standards (NETS SQSS), including reactive power effects.

3.2.8.3 WS2.7.3 Charging arrangements

It may also be important to account for the incentives placed on network users by the prevailing charging arrangements for distribution and transmission network usage. For example, although a particular pattern of investment may be optimal in theory, network users' responses to the cost signals conveyed to them through network charges means they may act in a way that is not efficient in reality.

- Work to design network design standards should not just assume "optimal" behaviour on the part of network users, as in reality network users respond to the commercial cost signals to which they are exposed by the regulatory and market arrangements; and
- New network design standards may create a need for reform of charging arrangements to reflect the costs network companies incur when users connect to their systems. The Consortium will highlight areas where we consider this to be the case.

3.2.8.4 WS2.7.4 Capacity and balancing markets

It will also be important to account for the rapidly changing regulatory and market frameworks prevailing in the British and wider European markets. For example, it is likely that some of the proposals set out in this study will have overlaps with the policy changes that have been, or will be, implemented through the EMR programme, Project TransmiT, the cash out review or the proposed EU network codes.

In particular, the contribution of flexible distributed generation and demand, including storage, to system-wide benefits (e.g. frequency regulation, balancing services, energy arbitrage, generation security) will be considered, identifying the synergies and conflicts of the applications of distributed flexibility between distribution network and system-wide security. For example, flexible demand may respond to an array of system prices of energy, capacity and balancing services and thus its efficient operation will need to balance the costs and benefits across multiple markets and sectors, including the support to distribution system security of supply and network investment.

The contribution of flexible distributed generation and demand, including storage, to system-wide benefits (e.g. frequency regulation, balancing services, energy arbitrage, generation security) will be considered, identifying the synergies and conflicts of the applications of distributed flexibility between distribution network and system-wide security. For example, flexible demand may respond to an array of system prices of energy, capacity and balancing services and thus its efficient operation will need to balance the costs and benefits across multiple markets and sectors, including the support to distribution system security of supply and network investment.

The output will be a summary report that will feed into the 'options' milestone report. The outputs from Work Stream 2.9 will be merged with the results of Work Stream 8.

3.2.9 WS2.9 Options for future development of distribution network standard

Led by: All members of consortium
Key Stakeholders: DCRP P2 WG, Ofgem, DECC
Anticipated No. of Workshops: 2

Based on the analysis of the future distribution network operation and designs under different future development scenarios, a range of options, from incremental updates of the present deterministic standard to a full probabilistic standard, will be considered and discussed.

The Consortium will then evaluate the range of options using the cost benefit framework established as part of Work-stream 1. This cost benefit framework will consider the (quantitative and qualitative) costs and benefits of:

- Different service quality delivered to end customers, assessing frequency and duration of outages together with risk profile and robustness associated with construction outages, common mode failures and high impact events.
- Options for incorporation of demand side response, distributed generation and energy storage technologies in the future network design standards will be discussed, while considering application of advanced automatic control schemes and/or area-wide operational measures that might contribute to security.

Furthermore, the Consortium will also consider the appropriateness of conducting experiments within present LCNF projects in order to inform the analysis and the development of alternative distribution network standards.

Objective: Assess the alternative frameworks for the development of security standards including consideration of deterministic and probabilistic approaches, and the concept of consumer choice driven network security.

The key activities of this task are:

(a) The Consortium will provide a high-level overview of network planning standards adopted in different jurisdictions in Europe, New Zealand, North and South America, particularly focusing on recent changes in network design standards. This review will draw primarily on the existing experience of the Imperial College team and their recent work conducted elsewhere in the world that has led to reform of network planning standards.
(b) Consideration of the scope of future network standards in terms of dealing with growing uncertainties in future developments.
(c) Consideration of probabilistic standards for which grid investment tests based on cost benefit analysis would be defined. Strengths and weaknesses would be identified through illustrative examples.
(d) Based on full probability assessment, alternative approaches to developing deterministic standards options with granular N-2, N-1, and N-0 approaches will be considered. Importance/relevance of Demand Groups will be considered, including the possibility of differentiation between rural, sub-urban and urban areas and for various consumer mixes and type of assets. Strengths and weaknesses would be illustrated through examples.
(e) Mixed probabilistic and deterministic frameworks for the development of future standards will be performed. Strengths and weaknesses would be addressed through illustrative examples.

(f) Options for developing market-based mechanisms for delivering cost effective network security will be considered. Advanced Imperial College models will be used to carry out illustrative case studies to identify key features of the consumer choice driven network design, as opposed to prescribed network security standard. Strengths and weaknesses of this approach will be discussed.

(g) Where key parameters are uncertain, The Consortium will perform sensitivity analysis to understand the robustness and risk of the above findings.

3.2.10 Work Stream 2 Deliverables

In summary the following outputs will be delivered from Work Stream 2:

- A series of short papers covering the outputs from WS2.1 through WS2.9.
- A summary report covering key highlights from the stakeholder engagement/interview activities.
- 1st iteration of the Techno-economic Model.

3.3 Work Stream 3 - P2/6 Options Report

The options report will be a 'formal' product of workshops with the DCRP P2 WG that will examine the deliverables from Work Stream 2 and derive a range of options that will inform the processes in Work Stream 5.

3.4 Work Stream 4 – Techno-economic model (2nd Iteration) - Optional

It should be noted that Work Stream 4 will be carried out, if in discussion with DCRP P2 WG there is a requirement for further, more in depth modelling and analysis. If necessary the 2nd iteration of the techno-economic models could be carried out during phase 2 to confirm one option to proceed within phase 2 if a single option is not fully identified at phase 1.

3.5 Work Stream 5 Stakeholder Engagement Workshops

Led by: DNV GL
Key Stakeholders: DCRP P2 WG, Ofgem, DECC
Anticipated 2 of Workshops: 2 and a series of teleconferences

This Stakeholder Engagement will be conducted in an Industry wide workshop format. The workshops will focus on introducing and discussing the deliverables from Work Stream 3 (both quantitative and qualitative exercises). The workshop will critically examine the proposed options, their underlying assumptions and the implications on both the technical and economic models. In addition to the key stake holders listed, other potential stakeholders would include DNOs, TSOs, Aggregators, Suppliers, DGs, Generators, IDNOs, OFTOs and Whitehall. Potential stake holders would not include the general public.

3.6 Work Stream 6 - Formal Strategy Consultation for P2

Led by: DNV GL
Key Stakeholders: All those previously engaged

The Strategy Consultation will be a comprehensive call for consultation that will include an in-depth discussion on the proposed approaches/options. The consultation will aim to 'formally' uncover how the industry views the emerging proposals via a series of targeted questions. Whilst some of the issues and concerns from stakeholders may have been uncovered in Work Stream 5, the intention is to gather written feedback on some of the more pertinent issues and concerns. Gathering written evidence on stakeholder views will speed up any subsequent consultation and decision making process that Ofgem may need to undertake; particularly if the outputs lead to a need for changes to the distribution licence for example. In addition to the key stake holders listed under Work Stream 5, other potential stakeholders would include DNOs, TSOs, Aggregators, Suppliers, DGs, Generators, IDNOs, OFTOs and Whitehall. Potential stake holders would not include the general public.

As well as the strategy consultation itself, the Consortium has made provision for an additional, more intimate workshop with Ofgem to provide an early insight as to what the recommended outputs might be. This will allow Ofgem to factor this into its planning process.

3.7 Work Stream 7 – Detailed review and analysis

Led by: DNV GL
Key Stakeholders: DCRP P2 WG

This Work Stream is focused on collating the consultation responses and is largely an administrative exercise. A number of decisions will need to be made however as to which items to take into account for the final Phase 1 Report (Work Stream 8).

The output will be a tabulated view of all question responses and actions to be taken with regards to the final Phase 1 Report.

3.8 Work Stream 8 - Final Recommendation

Led by: DNV GL
Key Stakeholders: DCRP P2 WG and all those previously engaged

The final Phase 1 report will lay out the arguments and all the supporting evidence for the development route for any new standard while critically highlighting the benefits of such a route. The report will also contain the following items:

- Overview of the modelling approach and methodology;
- Description of assumptions, case studies and input data;
- Cost, benefit and risk results under the probabilistic framework;
- Interpretation of results and identification of key drivers;
- Description of alternative security standards;
- Cost, benefit and risk results under alternative security standards;

- Strengths and weaknesses of alternative security standards, and
- Policy and regulatory analysis of results and alignment with other codes.

3.9 Work Stream 9 - Programme of work for Phase 2

Led by: All members of the consortium
Key Stakeholders: DCRP P2 WG
Anticipated No. of Workshops: 2

Workshops will scope the work needed to implement the final recommendations from Phase 1 that will be undertaken in Phase 2. The programme will outline the mechanisms for executing the following:

- The research and development to create the revised arrangements;
- The work required to codify the proposed arrangements;
- Consultation work required with the appropriate stakeholders, and
- Creation of all the relevant formal documentation.

The output will be a work programme for Phase 2 with an associated project plan and supporting documentation.

3.10 Stakeholder Engagement Plan

As illustrated in section 4.0, the project is structured around a number of work streams which have a high degree of dependency on each other and the input of relevant stakeholders. The work stream interactions with stakeholders are outlined at a high level in the table following.

Work Stream	Activity
WS1	Industry briefing paper (Project Initiation Paper) – describing who, why, how – what is required of them. Explaining why it is necessary to ensure that risk vs. cost is reviewed at this juncture.
WS2	Stakeholder interviews – gather insights from different companies and different personnel (includes: DNOs, DGs, 3rd parties, Suppliers, NG, Ofgem, DECC etc.).
WS5	Stakeholder workshops to gain feedback on P2 options.

WS6	Go out to consultation on the options.
WS8	Make final recommendation visible and demonstrate what the work programme has delivered.
WS9	Brief industry on what will happen next (Phase 2 work programme).

A detailed stakeholder engagement plan will be developed, agreed with the DCRP P2 WG and circulated by the ENA to all stakeholders. In this document, the Consortium will detail the stakeholder events and interactions that are planned and provide a view as to the level and type of inputs that will be invited from all relevant parties.

The development of the stakeholder plan will ensure that the process of revising the future approach for distribution network operation and design and the setting of industry planning standards is transparent, clearly communicated and well known and understood by all industry parties.

The plan has been drafted in order to:

- Raise awareness of the overall project and its objectives;
- Communicate and detail the approach to be adopted by the consortium, including the key questions and issues to be addressed by the project;
- Seek and encourage feedback and interaction with wider industry parties and direct users of P2/6, to give all stakeholders a chance to contribute to the outcome;
- Establish early buy-in and ownership from all relevant stakeholders;
- Ensure industry consensus can be reached;
- Make the implementation (following final recommendation) easier: if rationale is well documented and understood, and
- Provide for a cost efficient and quality project delivery.

3.11 Programme

The high level review programme is provided below.

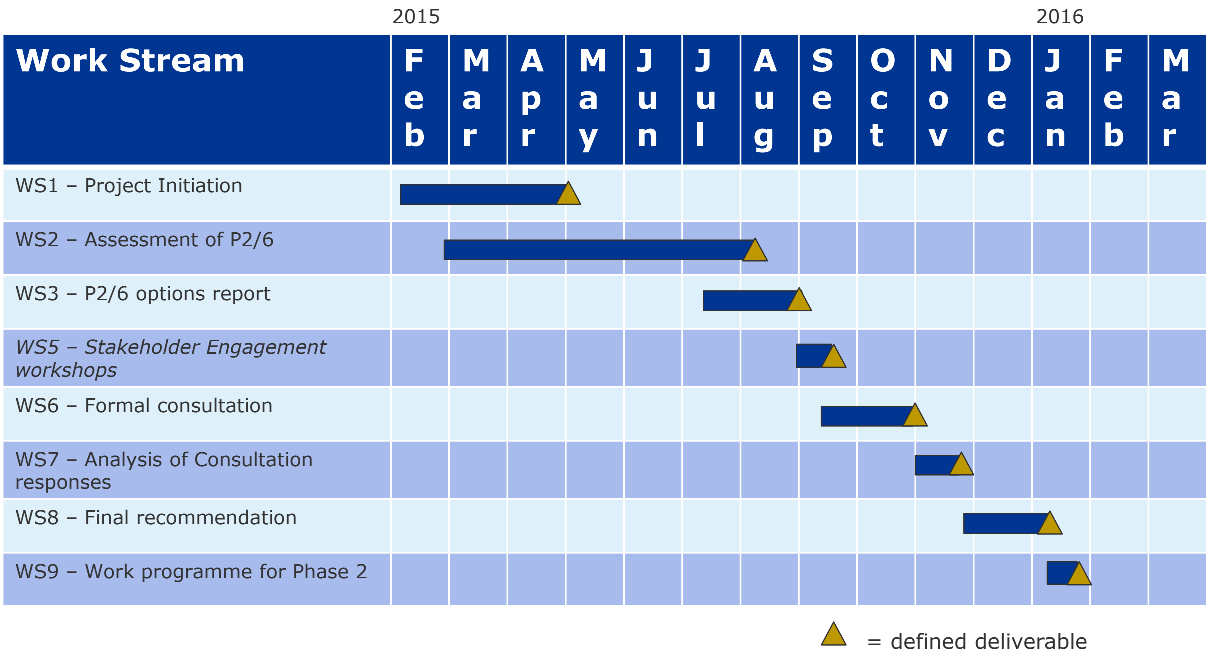

Figure 6 High level programme

3.12 The Consortium Team

The key team members and roles are identified in the diagram below.

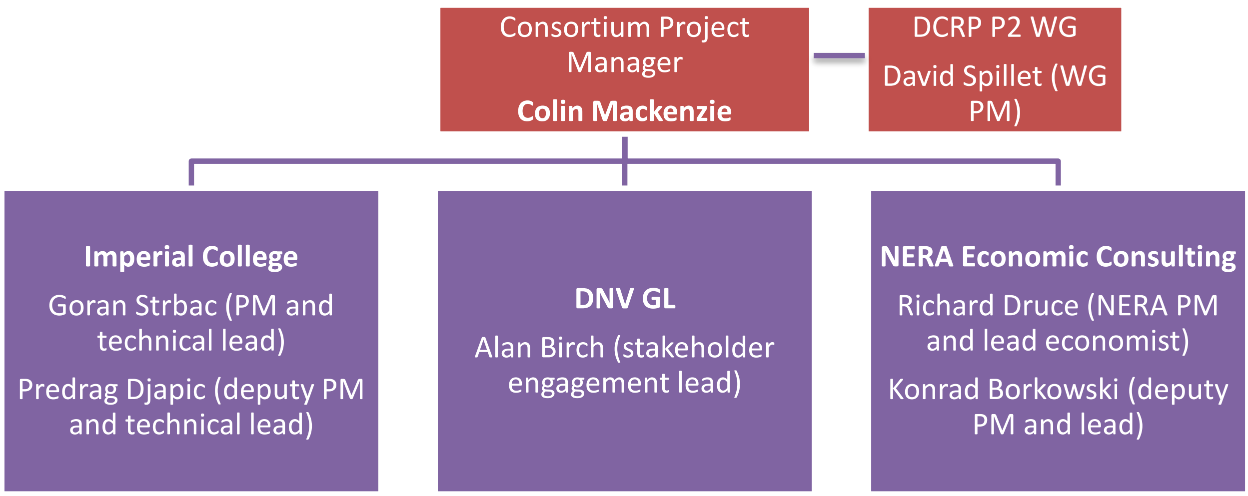

Figure 7 The Consortium team structure

4 IN CONCLUSION

This Project Initiation Paper (PIP) highlights the key objectives of the overall Engineering Recommendation P2/6 Review project to industry stakeholders. It is part of the initial communication with all stakeholders and outlines the process as well as the expectations on stakeholder engagement.

The PIP will be presented at an initial stakeholder event on Friday 1st May 2015 (in central London). This paper is aimed at providing some of the supporting documentation around the aims, context, process, and stakeholder engagement behind the slide deck that will be presented at the initial stakeholder event. To this end the PIP has been provided in advance of the initial stakeholder event.

About DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.