



Document 10
Asset Category – Civils (Capex & Opex)
SPN

Asset Stewardship Report
2014

Helen Amare

Document History

Version	Date	Details	Originator	Revision Class	Section Update
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1.1		Minor changes to volumes in table 6 to align with PIMS/RIGS			7.2.1
		Columns added to table 6 to include the RIGS tables and Rows corresponding to each line			7.2.1
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Version	Date	Details	Originator	Revision Class	Section Update
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	26/02/2014	Section 7.2.8 re-written to align ASR inspection and maintenance costs and expenditures with RIGs tables	H. Amare	Major	7.2.8
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1.3	25/03/2014	Addressed comments from Strategy and Regulations. Civil works driven by other asset replacement and project specific lines mapped to Civil asset replacement lines included in the civils plan.	H. Amare	Major	Section 1.1 and 7.2.9

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1.0 Executive Summary

1.1 Scope

Note: All expenditure and volumes described and justified in this document are based on the 19th February 2014 Strategy and Regulation NAMP.

Non-load related expenditure (NLRE) of Civil assets refers to the investment in replacement of all substation building components and surrounds that has been assessed as poor condition requiring replacement, security-related improvements to Grid, Primary and Distribution substation sites in response to increasing levels of trespass, risk based flood protection (Refer to UK Power Network's RIIO-ED1 Flooding Protection document for more detail), oil containment works required by environmental legislation and essential cable bridge refurbishment, cable tunnel refurbishment and inspection and maintenance of these assets across the South Eastern Power Networks (SPN). The plan also includes Civil works driven by other plant replacements.

This plan details the capital expenditure (CAPEX) and operational expenditure (OPEX) of civil assets.

Replacement, refurbishment, inspection and maintenance costs for civil assets are held in the following locations in Ofgem and UK Power Networks investment planning documents. Listed below are the high level asset categories and their relevant RIGs table and NAMP line number.

Investment type		ED1 (£k)	NAMP line	RIGs
Replacement of building components and surrounds		20,657	1.47	CV6
Substation Security (including the expenditure for distribution substation locking replacement detailed in section 2.2. This is a once off programme with a total value of £5.1m)		14,566	1.08	CV8
Substation Flood Protection		3,815	1.47	CV11
Oil Containment		2,719	1.30	CV12
Cable Bridge and	refurbishment,	530	1.47	CV6

	inspection and maintenance	640	2.30, 2.32	CV13
Cable Tunnel,	refurbishment	825	1.47	CV6
	inspection and maintenance	878	2.30, 2.32	CV13
Safety		1,863	1.20	CV8
Inspection and maintenance		24,646	2.30,2.32, 2.33, 2.34	CV13
Total Expenditure (Condition driven civil works)		71,139		
Civils expenditure associated with other asset replacement project		21,401		CV6
Total Expenditure (Including civil works driven by other asset replacement and project specific lines mapped to CV6)		92,540		

Table 1: Investment areas

1.2 Investment Strategy

In the DPCR5 price control period levels of risk and dereliction have driven a level of investment significantly in excess of our regulatory allowances. Increasing level of defects and deteriorated conditions civil assets has highlighted the need to increase the requirements for interventions.

The investment strategy in RIIO-ED1 is to:

- Replace civil assets that are in poor condition.
- Protect the environment from our equipment – oil bunding
- Maintain good and affordable levels of service to customers by protecting critical equipment from environment – security and flood protection
- Inspect and maintain civil assets so that we maintain the level of risk on the network and we can respond to urgent issues.

1.3 ED1 Proposal

The expenditure forecasts for civil assets have been developed based on condition data and historic work volumes. Key assumption made in developing the plan is historic work volumes, deteriorating conditions and age profile of the assets. This

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also shows assets are now at point where a large replacement work is required. Forecast expenditure required for Civil assets in the SPN Licence area in ED1 is £93m.

The RIIO ED1 proposed expenditure profile is set to reflect the current DPCR5 spend.

Expenditure for some civil assets in ED1 has reduced while for some assets the expenditure has increased: the overall increase over the DPCR5 out turn for condition driven civil works is 6% as shown in table 2. Given that the £5.1m of the investment required in ED1 is driven by industrial wide need to replace “patent expired” locks then our ED1 proposal represents a 1% reduction on DPCR5 expenditures.

The availability of more extensive and more accurate in-house data has led to a better understanding of the condition of Civils assets which, in order to maintain the overall level of asset condition, has highlighted the need to increase in the requirement to refurbish, repair or replace the assets (refer to section 3 increasing number of assets requiring replacement). An in-house Health Indices model is being developed for civil assets to which will contribute to the achievement of continual improvement of data quality and works programming.

The table below shows the civil expenditure for the SPN network for ED1 and DPCR5 period.

Licence Area	Total Costs (£k)		
	DPCR5 out turn pro rata to 8 years (condition driven civil works)	ED1 (condition driven civil works)	(including civil works driven by other asset replacement projects and project specific lines mapped to CV6)

SPN	67,008	71,139	
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Table 2 Forecast Expenditure

There has been investment in improving data quality during DPCR5. Better quality and completeness of data in recent years has led to identification of greater number of condition 3 and 4 assets requiring replacement or refurbishment. There is now more historical information and better asset information.

1.4 Innovation

UK Power Networks are developing alternative designs of the traditional brick and block switch houses that are expected to reduce future maintenance and refurbishment costs.

We are also trialling a new product (Geo bund) to be used to bund existing and new transformers as a replacement to the traditional concrete bund. A trial of this product has been carried out and delivered at a primary site in EPN. Initial cost estimates indicate a saving of 15% and shorter installation time, on site trials are currently being undertaken in order to validate these claims.

1.5 Risks and Opportunities

	Description of similarly likely opportunities or risks arising in ED1 period	Level of (efficiencies)/cost growth (£'m)
Opportunity	Subject to results of trials UK Power Networks may consider wider use of geomembrane for bunding of existing transformers - applicable to approximately 50% of the transformers	Potentially 0.5 % reduction of ED1 investment
Risk	Improved inspection regime high lights increased number of deteriorated assets	Potentially 10% increase of ED1 investment
Risk	Future modelling by the Environment Agency indicates increase flood levels which lead to	Potentially 0.5% increase of ED1

	increased height of flood protection design levels	investment
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Table 3 risks and opportunities

2 Description of Civil assets

This document details UK Power Network’s non-load related expenditure (NLRE) proposals for replacement, refurbishment, inspection and maintenance of civil assets.

For the purpose of this plan the civil assets have been divided into 6 subheadings:

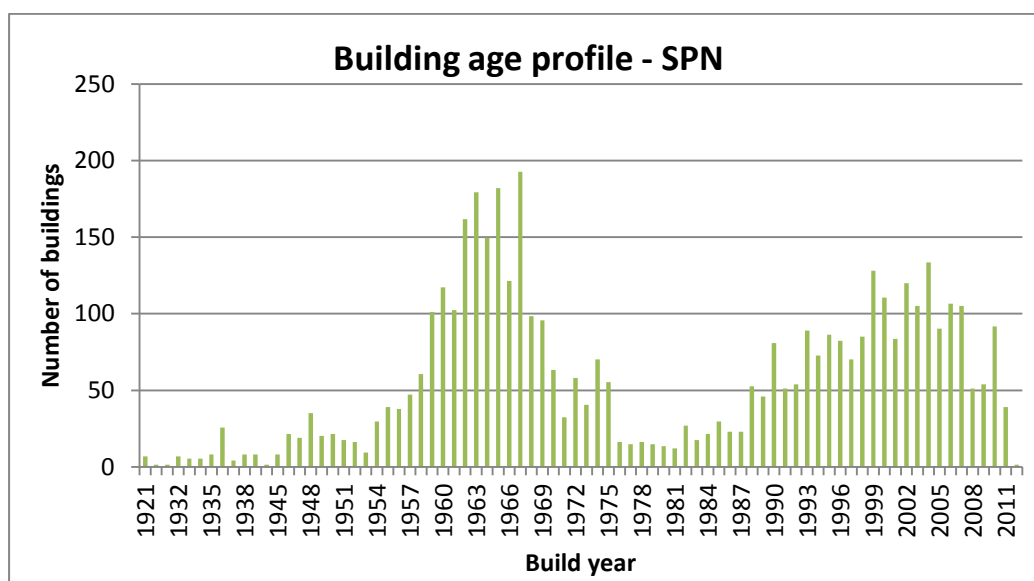
- Substation Building Components and Surrounds.
- Substation security.
- Substation Flood protection.
- Oil Containment.
- Cable Tunnels.
- Cable Bridges.

The plan also details the inspection and maintenance of the above civil assets.

2.1 Substation Building Components and Surrounds

There are 22,554 Distribution substation sites and 508 operational Grid and Primary sites in the SPN network.

There are 6,951 secondary buildings, 421 primary building and 309 grid substation buildings in SPN recorded in Ellipse. The civil replacement programme provides for the replacement of Grid, Primary and Distribution substation building components and surrounds that have been identified as condition 4 (refer to section 4.1 for condition grading of assets).



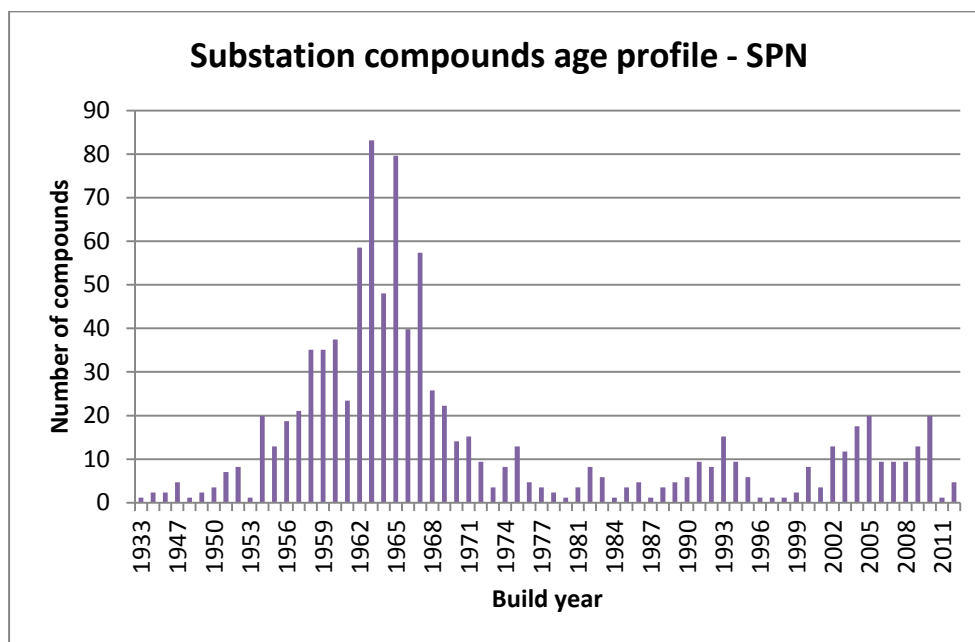


Figure 1 Typical civil assets age profiles

As shown on the graph above, due to most of the buildings being installed during the 1960s the age profile of the buildings is now at a point where targeted replacement and improved inspection and maintenance are required and significant investment throughout ED1 and ED2 is necessary.

2.2 Substation Security

The security improvement programme allows for specific security-related improvements to Grid, Primary and Distribution substation sites in response to increasing levels of trespass. Security improvement works at Grid, Primary and Distribution substations include fitting new operational locks, fixing anti-scaling toppings to fence, installing new padlocks, fixing bollards to sites and fixing security grille to openings. Additional anti-climbing measures are applied to fences and buildings where there is a high risk of unauthorised entry and metal theft. This programme also includes lock upgrade installation at distribution substations. The total expenditure value of this programme in ED1 is £5.1m.

2.3 Substation Flood Protection

A total of 83 Grid and Primary substation sites have been identified in SPN as being in potential flood risk areas as highlighted by existing Environment Agency flood maps.

The Flood defences would be a combination of reinforced concrete bund walls, concrete block walls, concrete slabs and protective waterproof membranes. There is a clearly defined UK Power Network's flooding programme in place for the remainder of DPCR5 which is being closely monitored together with a clearly defined programme for ED1. Refer to sections 3.3 and 7.2.3 for more detail. A flooding strategy document is also available for more detail.



Figure 2 Example of flooded UK Power Network Substation

2.4 Oil Containment

Accidental leakage or spillage of significant quantities of oil in a substation can pose a risk to the environment. Increasingly soils contaminated with oil are being classified as 'hazardous waste' and incurring waste disposal fees of £100-150/tonne. This programme deals with bund refurbishment and retro-bunding of existing transformers on sites where the risk to the environment is highest.

Over time significant amounts of oil from leaking plant can build up within the ground strata. This programme also includes cleaning of oil contaminated site to prevent external pollution.

All Grid and Primary Substations have been assessed and prioritised based on their potential risk to Ground Water sources, Surface Water (e.g. rivers and streams) and the sites proximity to an environmentally sensitive area. There is a clearly defined UK Power Network's works programme in place for the remainder of DPCR5 which is being closely monitored together with a clearly defined programme for ED1. Refer to sections 3.4 and 7.2.4 for more detail.

2.5 Cable Tunnels

Cable tunnels are a series of underground structures comprising of shafts, tunnel sections and ancillary equipment used to install 132/33/11kV cables. Access is typically through shaft head houses and the tunnel complex is reached through series of steps or ladders. Tunnels are typically located under major roads throughout the SPN region.

The construction types used on UK Power Networks tunnel are:

- Bolted cast concrete segments circular section.
- Bolted cast iron segments circular section.
- Wedge concrete segments circular section (no bolts).
- Square section poured concrete.
- Brick built construction circular or square section

There are 7 cable tunnels in SPN listed in the Table below; their total length is approximately 1220m. Refer to sections 3.5 and 7.2.5 for more detail.

Tunnel Name	Tunnel Length (m)
Brighton Town 33kv Tunnel	325
Croydon B Tunnel	80
Northfleet A2 East Tunnel	120
Sittingbourne Grid Tunnel	180
Northfleet A2 West Tunnel	120
Kingston Grid	140
Factory Lane	230

List of Cable Bridges in SPN

2.6 Cable Bridges

Rail Crossing Riddlesdown Track Kenley	East Stour Crossing Newton Road Ashford
Between Railway Lines Langley Pk Rd Sutton	Romney Marsh Road Adj Ashford Intl Station
River Mole Waterway Road Leatherhead	Trumpet Bridge Ashford
River Wey Brooklands Pipe Bridge	Jemmet Road Gantry Ashford
River Wey Brooklands Road Bridge	Jemmet Road Footbridge Ashford
Whites Pond Stream Lower Beeding	Victoria Road Footbridge Ashford
River Wey Navigation Adhjaent To Grid	Hythe Military Canal Twiss Road
Gatwick Stream South Xing Three Bridges	Hythe Military Canal Dymchurch Road
Gatwick Stream Middle Xing Three Bridges	Hythe Military Canal Scanlons Road
Gatwick Stream North Xing Three Bridges	Hythe Military Canal Stade Street
Teville Stream Willowbrook Road Worthing	North Stream Crossing Adj Hoo Sewage Wks
Wickford Bridge Pulborough	Middle Stream Crossing Adj Hoo Sewage Wks
Horsey Sewer Hammonds Dr East Eastbourne	South Stream Crossing Adj Hoo Sewage Wks
Kingsmead Rd West Stour Xing Canterbury	North Drain Kingsnorth Site Boundary
Kingsmead Rd East Stour Xing Canterbury	South Drain Kingsnorth Site Boundary
Tovil Cable Bridge River Medway Maidstone	Steyning Grid Access Road
River Dour Park Place Dover	Maidstone; High Level Crossing
River Dour Bowling Green Dover	

Where circuits cross railway lines, rivers, roads etc. structures are constructed to support and protect the cables; these are generically known as Cable Bridges.

There are 35 cable bridges in SPN listed on the Table below.

Failure to secure and protect cable bridges can lead to the need for more costly refurbishment expenditure. All identified cable bridges have been surveyed and where appropriate mitigations are in place. Refer to sections 3.6 and 7.2.6.

2.7 Safety

This programme addresses activities associated with the identification and removal of asbestos from substations. Asbestos removal or encapsulation is considered where periodic inspection reveals a situation where a previously sealed or encapsulated asbestos containing material has become exposed, and has deteriorated to the extent

where release of fibres is possible. In this situation encapsulation or removal shall be considered.

3 Investment Drivers

3.1 Substation Building Components and Surrounds

The failure of civil assets can lead to environmental and safety issues affect quality of supply, compromise the security of the system and in worst cases result in a large number of supply interruptions. The main investment driver is therefore the condition of the asset.

Replacement of poor condition substation buildings and enclosures will reduce the deterioration of substations and reduce the risk of trespass. It will also increase the number of sites that comply with the requirements of the ESQC Regulations 2002 *“Enclose the substation where necessary to prevent, as far as reasonably practicable, danger or unauthorised access”*.

Assets are replaced once they reach Condition 4. Due to most of the network being installed during the 1960s and the deteriorating conditions of the assets, the age profile of buildings and building components a large replacement programme will continue to be required throughout ED1.

It is anticipated that the ongoing inspection process will find new replacement works due to degradation. The following charts show that condition 4 of civil assets raised by year, are increasing.

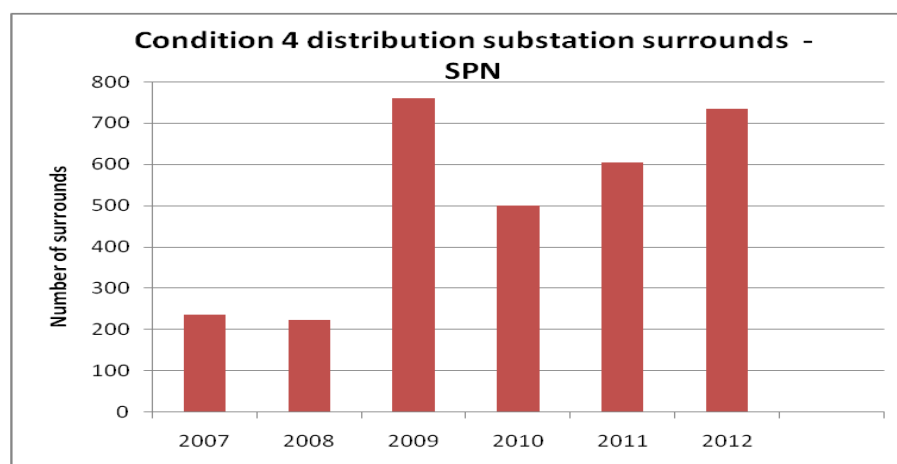
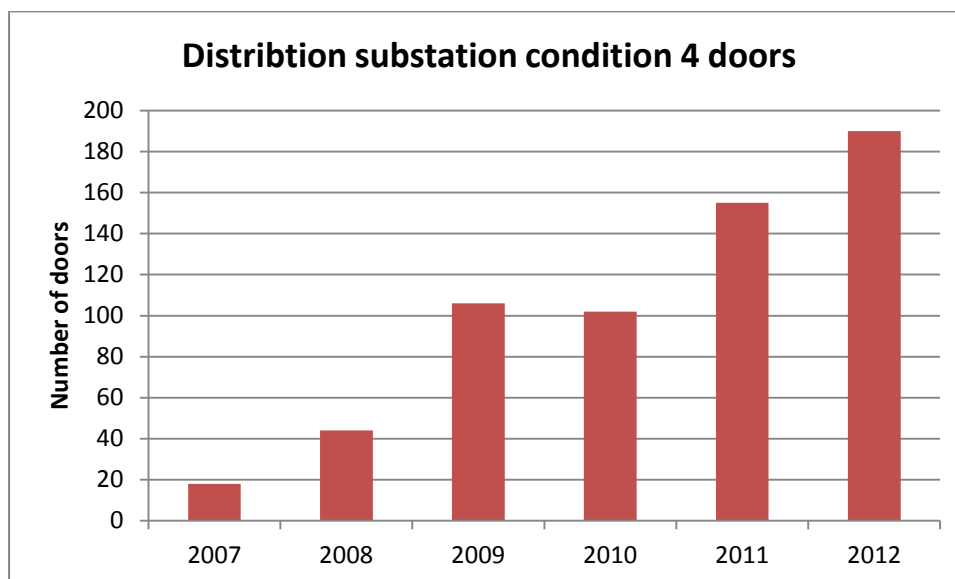


Figure 3 Condition 4 doors and surrounds raised by year

The increase in reported Condition 4 assets is primarily due to more detailed and targeted inspections. This is leading to a better understanding of asset risk and is allowing more efficient interventions which are more closely focused on the building components and structures which are becoming unserviceable.

3.2 Substation Security

UK Power Networks is experiencing high levels of metal theft where unauthorised intruders have entered operational sites and removed earthing conductors.

The numbers of metal thefts had recently created a greater need for enhanced sub-station security.

Metal Theft Report (volume)				
Year	2009	2010	2011	2012
SPN	162	620	825	640

Table 4 Metal theft report

Levels of metal theft has in the past been very closely linked to the price of scrap metals, which at present are near their record highs again and due to stay high for at least a number of years.

UK Power networks is undertaking mitigation to enhance security at sites identified as being vulnerable to unauthorised access by installation of alarms/CCTV and the application of anti-vandal paint to exposed earthing.

UK Power Networks is undertaking different substation security enhancement works in order to:

- Reduce the risk of theft and associated damage to buildings and equipment.
- Provide safety to the general public and children in particular.
- Provide a safe working environment for those authorised to be working in them.
- Maintain compliance with legal requirements including those arising from non-compliance with the ESQC regulations 2002.
- Prevent loss of supply of electricity to customer due to vandalism or theft.
- Achieve a reduction in costs which invariably result from rectifying the consequences of site incursion.

3.3 Substation Flood protection

Flooding events across England and Wales have highlighted the vulnerability of electricity substations to major flood incidents and called into question existing levels of flood protection. More general concerns over global warming and rising sea levels also brings into question whether historic levels of protection from flooding will be adequate in the future.

Combined with concerns over climate change and predicted rises in sea level the Minister of Energy, via the Department for Business Enterprise and Regulatory Reform (BERR), called for a review. The resulting review document, The Pitt Review released in June 2009, considered the causes and societal and economic impacts of a major flood event and made a number of recommendations regarding the protection of public and private assets and Critical National Infrastructure.

In order to implement the Pitt Review recommendations and reduce the risk risks associated with a flood event it is essential that UK Power Networks addresses the issue of flooding through protecting its existing highest risk sites, through its designs for new substations and during modifications/reinforcement of existing substation sites.

Department of Energy and Climate Change (DECC) recommended DNOs should consider all forms of flooding and as a result UK Power Networks investigating and developing a programme of works to protect substation assets from surface water flooding.

The benefits of protecting major substation assets from known flood risks are:

- Protect plant from damage due to flooding and reduce repair/replacement costs and timescales for repair as well as the need to commit resources. This ultimately leads to improved responses in re-establishing Network supplies to flood affected areas and customers.

- Facilitates the continuity of supplies to customers, particularly to critical infrastructure dependent on supplies to re-house others affected by floods (e.g. emergency rest centres, command centres, Accident and Emergency or Specialist hospitals etc).
- Promotes positive media and government focus.

Failure to protect major substations from flood leads to loss of supply to customers and damage to plant with enormous subsequent replacement and repair costs. The cost of replacing the plant/equipment on a grid site would be £2.5 million. It should be noted that from the Pitt report (itself a response to the devastating floods in 2007), 40% of the recommendations focused on ensuring continuity and protection of electricity supply infrastructure in the event of flooding.

3.4 Oil Containment

SHE 01 006 “Storage and Handling of Oils and Polluting Liquids” and DEFRA Control of Pollution (Oil Storage) (England) Regulations 2001 state that bunding should be carried out on existing transformers containing more than 200 litres of oil where these pose “significant risk” i.e. less than 10m away from any inland freshwater or coastal waters, or less than 50m away from a from a well or borehole otherwise known as a Source Protection Zones (SPZ).

While transformers are not classified as oil storage containers whilst in operation leaking transformers can pose a significant risk to ground strata, ground water and watercourses. Furthermore oil bunding is becoming more necessary as greater volumes of very old critical infrastructure are in operation. During ED1 oil leaks are examples of defects which indicated equipment may be nearing its end of life. For the reasons set out below it is necessary to consider all transformers with a potential to

contaminate, not just those in SPZ's, for assessment, retrospective decontamination and bunding works.

The Water Resources Act 1991, The Environment Act 1995 and Environmental Protection Act 1990 state that it is an offence to cause or knowingly permit the discharge of poisonous, noxious or polluting matter into relevant waters or into any underground strata. For this reason all existing non-bunded Grid and Primary transformers have been assessed with regards to the risk of pollution to ground and surface water systems, the ground strata in general and to 3rd party land including SSSI's (Site of Special Scientific Interest) and AONB's (Area of Outstanding Natural Beauty). It is expected that all outstanding non-bunded Grid and Primary transformers will be addressed during the RIIO ED1 period; this is detailed further in Section 7.2.4.

Over time significant amounts of oil from leaking plant can build up within the ground strata. Bunding or replacing a leaking transformer may prevent further oil contamination but it does not remove or control the oil already present in the ground which may, over time, still migrate to watercourses or ground water systems beyond the distances quoted in DEFRA Control of Pollution (Oil Storage) (England) Regulations 2001 or adjacent third party land. As part of the overall pollution control strategy it is proposed to extend the transformer pollution assessment to include identifying contaminated ground strata beyond the area of the transformer and to develop additional mitigation works where appropriate as part of any bunding project.

3.5 Cable Tunnels

UK Power Networks aim to maintain tunnels in a satisfactory and serviceable condition and to address structural and ancillary issues before significant works are required to stabilise the asset as defined in UK Power Networks standard document EDS 10-7004—Cable Tunnel Inspection and Maintenance. The consequence of

failure to the network, the environment and the public is considered to be considerably higher than other civil assets, it is therefore important frequent maintenance is undertaken. The maintenance of a tunnel includes all the operations necessary to maintain it in a serviceable condition indefinitely, including:

- condition assessment (inspections, testing and monitoring, structural assessments).
- routine maintenance (typically involving like-for-like replacement of the tunnel fabric to maintain efficient functioning and preserve condition. e.g. ventilation maintenance to avoid thermal runaway).
- interventions (to carry out vital repairs to and modification of the structure in response to deterioration and loss of performance, or adaptations to meet new requirements, e.g. for higher loadings, health and safety or control equipment).
- emergency actions (e.g. in response to unforeseen incidents, flooding, structural collapse).

3.6 Cable Bridges

Cable bridges and more particularly the cable circuits on/in the cable bridges are vulnerable to third party interferences.

Inspection, maintenance and refurbishment of cable bridges in accordance with UK Power Networks document EDS 10-7003 Cable Bridge Inspection and Maintenance reduces the risk of structural failure and damage to cables and EHV fluid filled cables.

There was an incident in 2009 where vandals/cable thieves set fire to a group of 132kV cables in a cable bridge in the LPN area. This resulted in supplies being interrupted to approximately 90,000 customers with several thousand customers in the environs of Dartford being without electricity supply for several days.

As a result UK Power Networks is undertaking programme of refurbishment and enhanced maintenance works of Cable Bridges so as to provide secure housing for

UK Power Networks' electrical equipment and apparatus, meet the requirements of The Electricity Safety, Quality and Continuity (ESQC) Regulations 2002 and of the licence and other regulatory provisions. Specifically:

- To protect the public and employees from danger.
- To maintain security and prevent unauthorised access.
- To ensure continuity of supply.
- Reduce structural failure and damage to cables.

3.7 Safety

Sites at all voltages have the potential to contain asbestos. Under the Control of Asbestos Regulations 2006, UK Power Networks has a duty of care to identify Asbestos Containing Materials (ACM) within its operational sites and to protect its staff from harm which could be caused by such materials.

Where ACM are suspected or confirmed an effective strategy is put in place to safely deal with the materials: this includes either removing the ACM or leaving it in place undisturbed with a safe plan to do this.

4 Asset Assessment

4.1 Condition

Inspections of civil assets (Grid and Primary) are carried out every six months and in accordance with EMS 10-0002 (Inspection and Maintenance frequency Schedule). During Inspections or Maintenance the appropriate condition measurements civil structures and buildings on Grid, Primary or distribution substation site are recorded and entered into Ellipse. This enables the condition of equipment to be recorded and analysed. The majority of condition monitoring activities is performed by field staff using a mobile device.

The condition of the Civils assets are recorded in the asset register. These indicators are usually unique to each condition point being measured but the following general theme applies across all condition indicators.

- **Condition 1** The condition is as new or very good.
- **Condition 2** The condition is satisfactory or serviceable.
- **Condition 3** An indication that either minor work is required or the condition indicates that future repair or replacement is required.
- **Condition 4** This category indicates that significant/urgent repair or replacement is required.

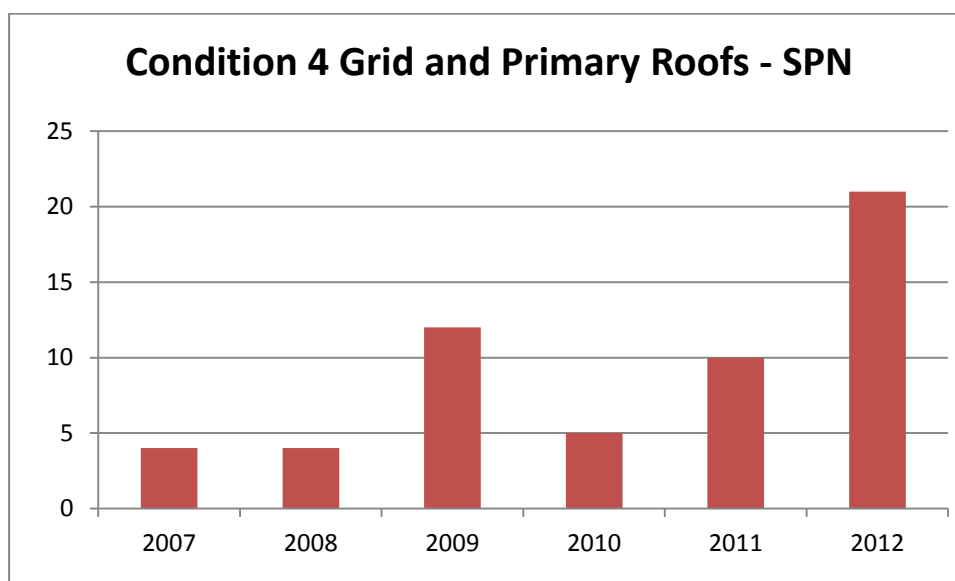
The key replacement criteria is identifying all Civil assets as having either an overall condition rating of 3 or 4 or containing associated assets with either of these ratings and improve the asset in to condition 1 or 2 rating. Replacement improves the asset into condition 1 while refurbishment improves the asset into condition 2. Refurbishment is deployed to reduce the risk and extend the asset life. Minor repairs are undertaken at condition 3 to reduce the need for major works required to recover a condition 4 situations. The refurbish/replacement decision is made on a cost benefit basis which

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delivers the more positive net present value over time Issues are re-inspected by Network Operations Project Manager as part of works scoping and work order process.

During the replacement of electrical plant it is sometimes necessary to replace or refurbish the Civil asset in order to support the long term health of the installation. Only a small proportion of our electrical plant assets will experience any refurbishment or replacement interventions in ED1 and an even smaller proportion of these interventions will require associated civil refurbishment or re-building work. Accordingly this expenditure forecast is for essential civil asset replacements which are independent of plant replacement.

Deteriorating age, frequent use and hostile environment which these assets are exposed to, are partly responsible for the increasing number of condition 4 recorded assets. However this increase in numbers is primarily happening due to a greater number of targeted inspections. This is leading to a better understanding of asset risk and is allowing more efficient interventions which are more closely focused on the building components and structures which are becoming unserviceable.



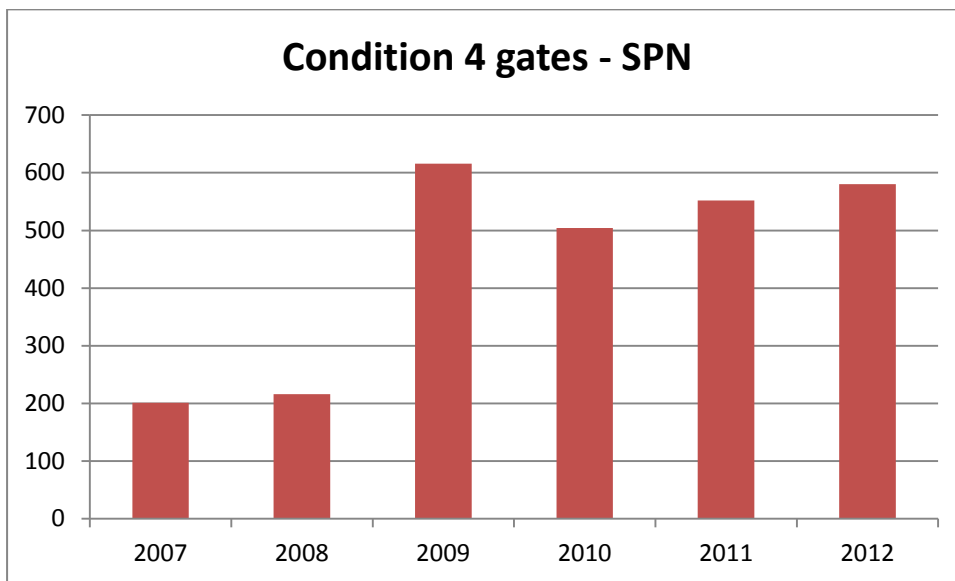


Figure 4 Condition 4 distribution substation roofs and gates

The following pictures show typical failures of civil assets across the network.



Sutton Grid – significant crack on building underpinned and stitched representing a Condition 4 building. Serious structural failure leads to more costly structural refurbishment expenditure.



Steel cross primary – severe structural damage due for replacement in 2015-2016 as part of the substation major structure replacement programme (NAMP -1.47.64)



Figure 5 Typical structural failures of buildings and structures across the network

Failure to arrest serious subsidence cracking can lead to the need for more costly structural refurbishment expenditure.

4.2 Inspection and Maintenance

UK Power Networks is responsible for the inspection and maintenance of substation sites, buildings, Cable tunnels, cable bridges and the equipment housed within them.

Assets are inspected and maintained to provide secure housing for the electrical equipment and meet the requirement of the ESQC regulations 2002 and other regulatory provisions. Inspection procedures will identify and quantify remedial works and /or asset and element replacement.

4.2.1 Substation Building Components and Surrounds

This programme covers major and minor Grid and Primary site inspections and maintenance. The inspection and maintenance requirements of civil assets are detailed in the UK Power Networks document EMS 10-6501 Maintenance and Inspection Policy for Civil Assets.

Grid and Primary sites are inspected on a cyclic basis to assess the condition of buildings and other associated civil structures. The inspection frequency of substation buildings is being changed from four month to six month during DPCR5; however the inspection is now more detailed and comprises more assets (greater focus in shorter life assets) giving better value and efficiency from substation inspections and visits. This programme also allows for fire suppression system inspection and testing and water quality testing at Grid and Primary substations. The inspection includes procedures to identify defects that might eventually lead to failure of an item of the civil structure or the civil structure itself. Maintenance of buildings and other civil structures are carried out to rectify defects following surveys and restore assets to a defined condition for continued safe and reliable service. The major activities in the civil maintenance programme are graffiti removal, vegetation clearance and maintenance of sites (Grid, Primary, and Secondary) and buildings.

This programme also addresses repairs of urgent defects and fly-tipping clearance. It also takes into account remedial works following asbestos survey, water testing, and fire risk assessment.

The main source of condition data and defects for civil assets is from substation inspectors. Inspections are carried out as per UK Power Networks inspection and maintenance policy (EMS 10-0002 Inspection and Maintenance Frequency Schedule). During inspection, defects and condition data on civil assets are collected using a Hand Held Device (HHD) and held in the Asset Register. In order to ensure

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

that a good quality data is captured, inspectors are provided with training on assessment and collection of civil asset data on a frequent basis.

The Asset Register gives each defect a criticality rating of P1-P5 and this rating signifies the timeframe in which the defect must be rectified.

Defect Criticality	Definition	Time to fix the Defect
P5	Critical	< 3 months
P4	Urgent	3 - 12 months
P3	Required	12 - 24 months
P2	Medium	24 - 48 months
P1	Low	during next maintenance, next visit

Figure 6 below shows the number of building components and surrounds defects reported since 2007. It shows that the number of defects being reported has risen five fold since 2007. Increased levels of defect reflect better surveys and greater focus on individual Civils assets leading to efficiencies detailed in Section 7.2.8.

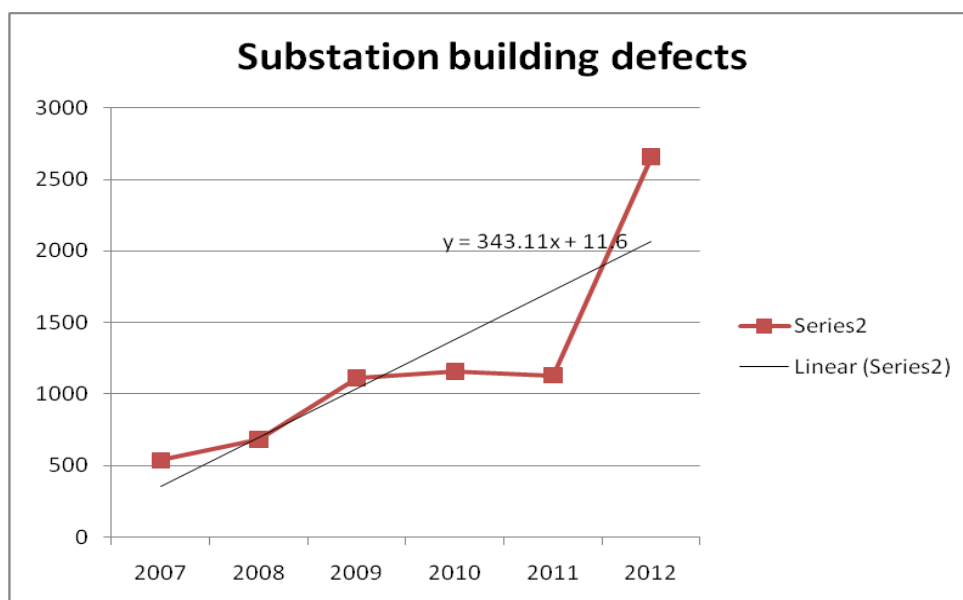


Figure 6 Volumes of building defects raised by year

2012 figures include a recovery of the back log in 2010 and 2011.

Typical defect repairs covered in this programme of work are:

- **Building defects** - Labels, heating, wiring & lighting, padlocks, disused syringes, rubbish, redundant materials, vermin, redundant plant, graffiti, guttering and downpipes, access flap, ladders, CO₂ systems, flood detectors, ventilation, sump pump, cable trench covers, water ingress, trip hazards, falling materials, vegetation, asbestos, access problems.
- **Site enclosure defects** Blocked drains, Oil interceptors, Cesspit/septic tanks, rubbish, lighting, sharps, redundant materials, open excavations, cable trench covers, trip hazards.
- **Site security defects** - Labels, third party interference, padlocks.

Allowance is made for a number of miscellaneous operational responsibilities, including demolishing abandoned/unsafe buildings.

It is difficult to predict the volume of works for defect repairs and maintenance of civil assets. As such activity in this area has been predicted on historical work volumes.

4.2.2 Cable Tunnels

Tunnels are visually inspected twice a year and fully surveyed and inspected annually. The inspection and maintenance requirements of cable tunnels are detailed in the UK Power Networks standard document EDS 10-7004.

Periodic maintenance of tunnels include: periodic testing of lighting, ventilation and alarm installations in the tunnel, six monthly exchange of sump pumps to prevent clogging and failures, cleaning out of sumps and drainage channels, removal of debris and litter from tunnels, upkeep and lubrication of access points (doors, hatches, compressed strut assisted pavement covers etc.).

The inspection will also include minor maintenance of steel ladders, handrails and landings where appropriate.

4.2.3 Cable Bridges

The inspection and maintenance requirements of cable bridges are detailed in the UK Power Networks standard document EDS 10-7003.

Maintenance of cable bridges includes re-painting surfaces, improvements to security and other maintenance works as the condition surveys and inspections deem necessary to provide continued adequate protection to the structure given the location and atmospheric conditions.

4.3 Asset age Profile

Black & Veatch (B&V) were appointed to undertake age analysis of all civil assets within Ellipse.

In order to review the age aspects associated with the replacement of civil assets the extent of the age data within the Ellipse system was assessed. Where there were gaps a proxy age was generated based upon the methodology in appendix 1. The age analysis showed that a substantial number of assets were older than the design life proposed, yet still in good condition. The analysis also showed that a significant number of assets were in poor condition but had not exceeded the proposed asset life. Therefore age alone could not be used as an indicator for replacement strategy. History and current work rates have also been used to forecast the volumes for some civil assets. The detail of the analysis is presented in appendix 1.

5 Intervention policies

5.1 Interventions: Description of intervention options evaluated

The interventions considered for civil assets are: replacement, refurbishment, maintenance and repairs.

Civil asset replacement strategies optimise expenditure plans by maximising asset life, reducing whole life costs, improving reliability and reducing short-term expenditure requirements.

	Intervention	Application	Net benefit	Typical Cost of intervention	Typical cost of asset failure
Capex	Like for like replacement	Condition 4 Roofs, gates, doors, heating, fences	New asset	10-25k (roof)	250k Damage / replacement of switchgear, outages, structural damage, health & safety risk, exposure to asbestos
	Replace with higher spec asset	Replacement of existing locking by an intelligent locking system	New asset – extend life	£500-1,000/site	5-10k/site – reduction in theft from and unauthorised entry to substation sites
	Refurbish	Cable bridges, cable tunnels, buildings	Reduce replacement	£30-40k/ cable bridge	£150-200k– collapse and replacement of asset, loss of supply, health & safety risks from removal and replacement
	Security enhancement	Grid, primary and distribution substations	Reduce theft and damage from unauthorised entry	Refer to section 7.2.2	Refer to section 7.2.2
Opex	Routine maintenance	Graffiti removal, vegetation clearance	Improved amenity Reduce further maintenance	2-5k	No financial benefit but societal benefit is reflected in reducing the potential for customer complaints and local authority notices
	Enhanced maintenance	Buildings e.g. underpinning	Reduce replacement costs	40k	150k – replacement of building

Table 5 Interventions

Typical intervention examples of civil assets are shown below.



Figure 7 Flood defence works at Newhaven Grid



Rydon primary substation bunding



Sundon 11kV primary substation bunding

Figure 8 Completed transformer oil bunds



Figure 9a West Weybridge cable bridge (before mitigation works):

Graffiti on the compound and on the supports, rusted and rotten cable covers exposing the cables to vandals. Degradation of the cable bridge has made the asset present a potential danger to public and vulnerable to vandalism and metal theft.

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

The works undertaken on this cable bridge included enhancing the security by reinforcing the palisade fencing with an inner expanded metal fence cladding. The damaged cable cladding were replaced, graffiti removed/covered over and asbestos cladding removed.



Figure 9b West Weybridge cable bridge (after mitigation works)





Typical Roof Repair

6 Innovation

6.1 Alternative Switch House Design

Changes to switch house design is being developed to design an alternative 11kV and 33kV switch house that have higher operational safety, lower environment impact, lower maintenance requirement and higher availability & reliability. The switch house will also be elevated to prevent risk of flooding.

This will reduce future maintenance and refurbishment costs. It will also improve resilience to environmental impacts by reducing CML's and CI's.

To date the alternative switch-house design has been trialled at Newhaven Town Primary and 2 sites located in the EPN licensed area; early reviews of the projects have shown a cost saving of 10-20% and, in conjunction with the build process construction and "dry-trade" material, construction times shortened.

6.2 Geotextile Membrane Bunding

We are developing a new polymer technology that could be used as an alternative to the conventional concrete bund. This new technology can easily be retrofitted to our current sites and although new to the UK is proven technology in over 9000 installations across the globe including the USA and Australia.

The alternative approach utilises the implementation of new technology as a selectively permeable membrane (hydrocarbon (oil) filter). The geotextile membrane is impregnated with a hydrocarbon absorbent polymer which allows water to pass through whilst retaining the hydrocarbon within its structure. This removes the requirement for oil discriminating pumps as well as interceptors for some of our sites; a requirement with the more traditional approach of concrete bunds. The removal of these also reduces the ongoing maintenance costs associated with our sites.

A trial of this system has been carried out and delivered at primary substation in EPN. A review of the performance of the product and the potential for efficiencies is due to be undertaken by the end of March 2014. If all conforms to the UK Power Networks standards and good practice, this system will be incorporated in to the standards.

7 ED1 Expenditure requirements for Civil Assets

7.1 Methodology

The volumes and costs used to forecast the Civil Replacement expenditure in ED1 have come from:

- Condition based assessment has been applied to different types of civil assets within Ellipse to estimate the number of civil assets in poor condition.
- Historic volumes of interventions were averaged for the last four years and the same level of activity assumed for future years.
- Where a new driver of investment or replacement has been identified a new programme of work has been drawn up. For example replacement of locks , major structure (external support structure) replacement.

A combination of condition based assessment and historic volume approach has been used to forecast the volumes and expenditure of substation building components and surrounds.

A combination of risk assessment, surveys and historic volumes of interventions has been used to forecast volumes and expenditures for security, oil containment, cable tunnels, and cable bridges.

Figure 10 shows an overview of the method used to construct the RIIO-ED1 NLRE investment plans.

External environmental impacts. e.g. greater deterioration of assets in coastal areas, can lead to an increase expenditure in rectifying conditions and defects of buildings, cable bridges and cable tunnels. Increased unauthorised access in high crime areas is likely to require additional repair / maintenance and security measures to be provided which in turn increases the expenditure for substation security.

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

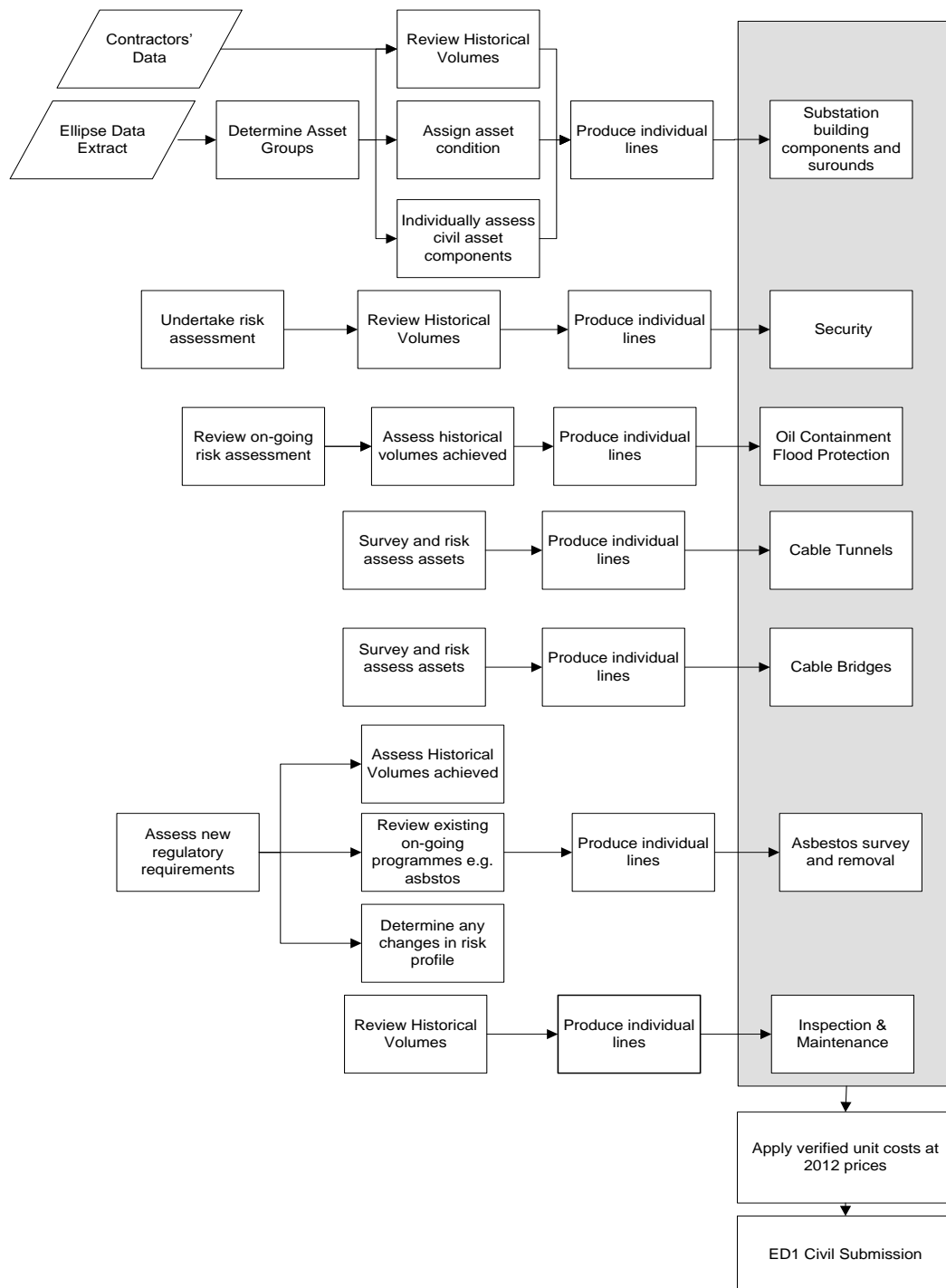


Figure 10 Process diagram showing inputs and outputs of ED1 plan of civil assets

7.2 Constructing the Plan

This section details the actual and predicted pro-rata expenditure in DPCR5 and the predicted expenditure in ED1 for the civil asset types identified in the plan. Where there is a significant variance between the two an explanation has been provided in the paragraphs following the tables.

7.2.1 Substation Building Components and Surrounds

Replacement of substation buildings and surrounds is the biggest contributor to the proposed ED1 Civil costs .The most significant investment is in:

- Replacement of distribution substation surrounds.
- Replacement of distribution substation doors.
- Replacement of distribution replacement roofs.
- Grid and primary substation rewire.

Investment	DPCR5 pro rata to 8 years (£k)	ED1 total (£k)	Variance	Total ED1 Volume	Volume Unit	RIG Table	RIG Row	Comment
Civil Enabling Work at Grid & Primary Substations	1598	1550	-48		£k			Justification 1
Replacement of Distribution Substation Brick Surround	473	663	190	208	Site	CV6	11	Justification 2
Replacement of Distribution Substation Surround (Non Brick)	7,859	8,235	376	3000	Site	CV6	11	

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Investment	DPCR5 pro rata to 8 years (£k)	ED1 total (£k)	Variance	Total ED1 Volume	Volume Unit	RIG Table	RIG Row	Comment
Replacement of Distribution Substation gates	229	255	26	136	Unit	CV6	11	
Distribution Substation building - minor asset replacement	369	460	91	736	Task	CV6	8	
Distribution Substation building - replace roof	1,130	1,231	101	280	Roof	CV6	7	Justification 3
Distribution Substation building - replace door	941	1012	71	403	Door	CV6	6	Justification 4
Distribution Substation building - rewire	2,203	878	-1325	1200	Task	CV6	8	Justification 5
Distribution Substation Building - Install New LV Service	542	167	-375	200	Site	CV6	8	Justification 6
Distribution Substation - Replace Trench Covers	2	70	68	2	Site	CV13	25	
Grid/Primary - Replace roof	892	930	38	66	Roof	CV6	16 and 17	
Grid/Primary - Replace heating	131	212	81	40	SS	CV6	16 and 17	Justification 7
Grid/Primary - Rewire	3,494	2,577	-964	55	SS	CV6	16 and 17	Justification 8
Grid/Primary - Replace compound floodlighting	97	95	-2	18	SS	CV6	16 and 17	
Grid/Primary - Replace doors	304	314	7	125	SS	CV6	16 and 17	

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Investment	DPCR5 pro rata to 8 years (£k)	ED1 total (£k)	Variance	Total ED1 Volume	Volume Unit	RIG Table	RIG Row	Comment
Grid/Primary - Replace compound trench covers	144	140	-34	96	SS	CV6	16 and 17	
Grid/Primary - internal refurbishment	2	12	10	8	SS	CV6	16 and 17	Justification 9
Beddington 132/33kV Replace GT3 & GT4 (Civil)	48	0	-48	0	£k	CV6	33	
Enhance grid and primary fencing	3,770	1,470	-2300	128	Site	CV6	16 and 17	Justification 10
Substation Major Structure Replacement	85	333	248	44	Task	CV6	16	Justification 11
Substation Pressure Relief - Explosion Vents	5	13	8	1	Site	CV6	17	Justification 12
Welfare Facility Installation at Primary Substation	237	0	-237	0	Site	CV6	16	Justification 13
Welfare Facility Removal at Primary Substation	68	0	-68	0	Site	CV6	16	
Total	24,623	20,657	-3,966					

Table 6 –Expenditure for building components and surrounds replacement

1) Civil Enabling Works at Grid & Primary Substations

This Investment type represents any works not covered by a specific line or works necessary to refurbish asset to support related development works. Expenditure is reducing as funding is to be allocated to works specific lines in order to give greater clarity of volumes and expenditure and to be able to support the development of robust programmes of works.

2) Replacement of Distribution Substation Surround (brick/non-brick)

A replacement of a fence or non brick wall around the perimeter of a Site or around a Compound. The scope of work will be either like for like replacement or replacement with a 1.8m high surround in accordance with the ESQC regulations 2002.

Table 6 shows an increase in expenditure for substation surround replacement which is being driven by the increase in condition 4s being reported year on year (see figure 11). These increasing numbers of condition 4 assets are due to a greater number of targeted inspections. This is leading to a better understanding of asset risk and is allowing more efficient interventions which are more closely focused on the building components and structures which are becoming unserviceable in addition to issues caused by trespass, graffiti, metal theft and vehicle damage of these ageing assets.

There are 20,000 secondary sites across in SPN which have some form of enclosure around the site. The proposed ED1 volumes and expenditure represent only the replacement of 16% of the total number of brick and non-brick distribution substation surrounds.

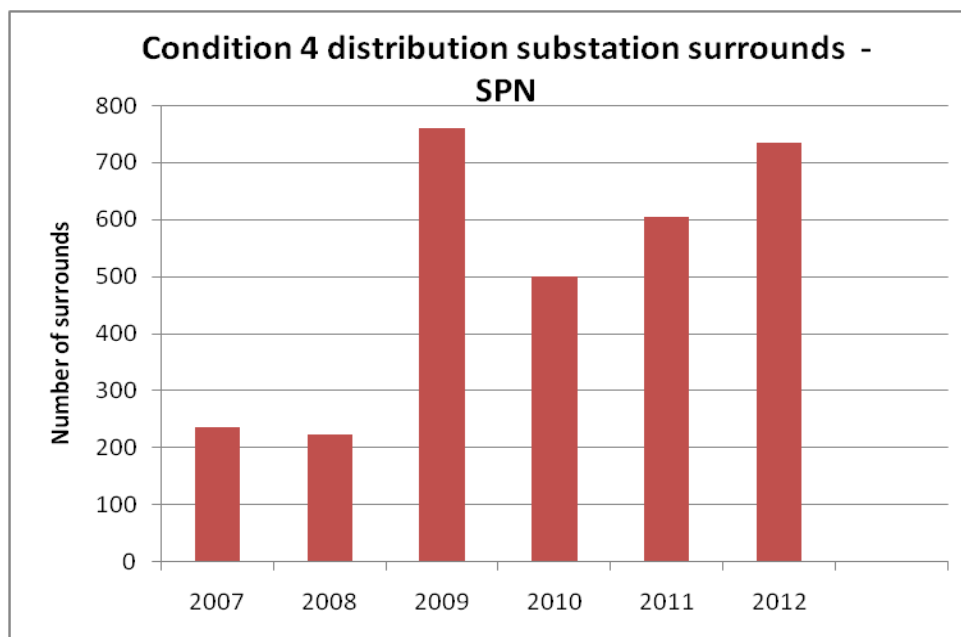


Figure 11 Distribution substation condition 4 surrounds

3) Distribution Substation building - replace roof

The ED1 expenditure represents the replacement of 4% (280) of secondary substation roofs. The figure below shows an overall increase of condition 4 secondary substation roof over the previous year's driven partly by a deteriorating asset base but primarily by a greater number and improved, more targeted inspections. This is leading to a better understanding of asset risk and is allowing more efficient interventions which are more closely focused on the building components and structures which are becoming unserviceable.

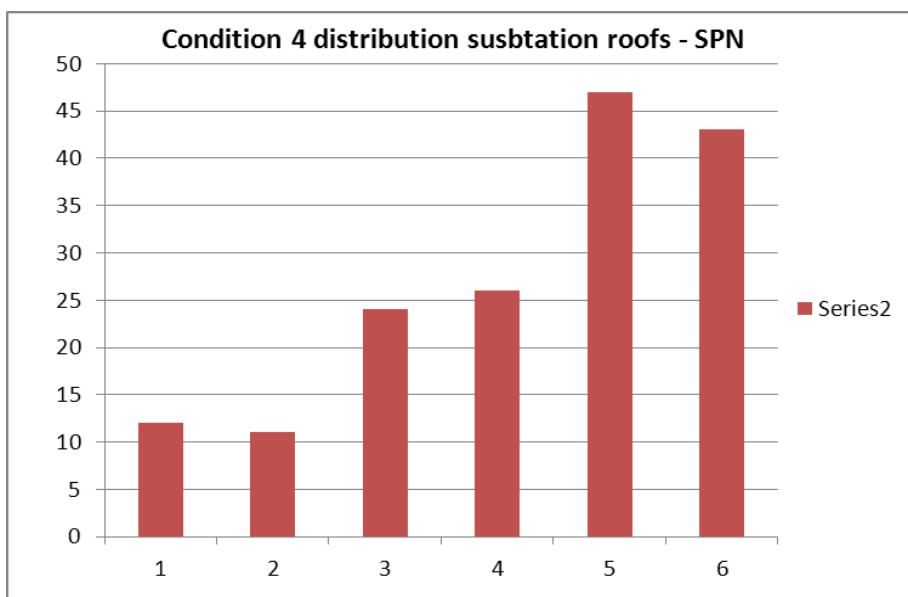


Figure 12 Distribution substation condition 4 roofs

4) Distribution Substation building - replace door

The condition chart (Figure 13) below shows an increase in condition 4s raised over the past years due to a greater number and improved, more targeted inspections. This is leading to a better understanding of asset risk and is allowing more efficient interventions which are more closely focused on the building components and structures which are becoming unserviceable.

In ED1 replacement volumes for assets can be seen to only represent a small proportion of the total number of assets. For example there are 6,951 distribution substation buildings in EPN and assuming each building to have one door, only 6% (50/year) of distribution doors will be replaced during ED1.

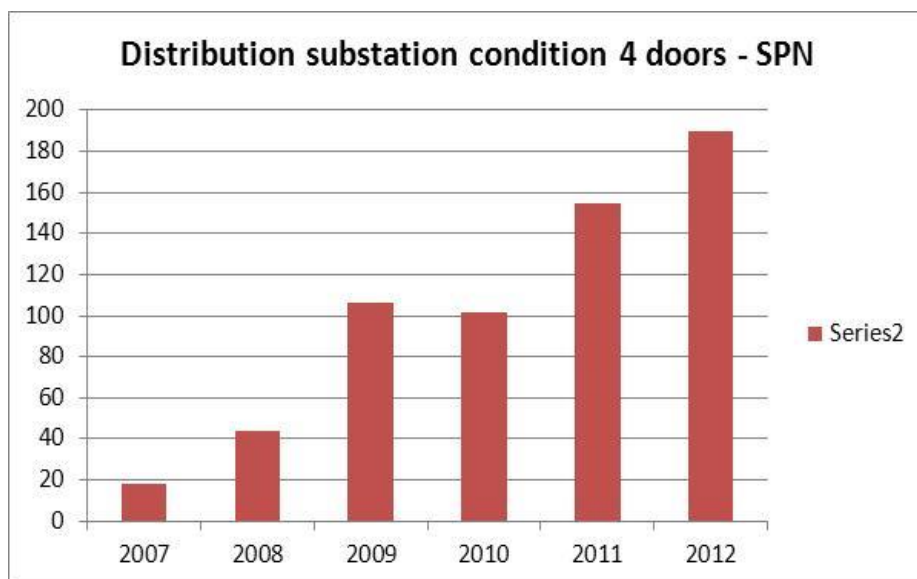


Figure 13 Distribution substation condition 4 doors

5) Distribution Substation building – rewire

Table 6 shows a 60% reduction in expenditure in distribution substation building rewire; this is due to a large number of works being undertaken and completed in DPCR5 to address existing issues. Expenditure is reducing in ED1 as replacement works are carried out and defects are rectified. The reduction in expenditure is also driven by reduced unit costs as works are to be carried out by internal staff in place of external contractors, therefore lowering lowering the UCI (unit cost indicator).

6) Distribution Substation Building - Install New LV Service

The majority of works on existing installations will be completed in DPCR5; the reduced ED1 expenditure represents ongoing LV service installations to support the rewiring of sites found to have no supply.

7) Replace heating

The replacement of heating systems is an ongoing programme of works linked to issues reported during inspections and LV rewiring and refurbishment projects. The increase in expenditure is supported by an increase of reported Condition 4 heater assets as demonstrated in Figure 14 below primarily driven by a greater number and improved, more targeted inspections. This is leading to a better understanding of

asset risk and is allowing more efficient interventions which are more closely focused on the building components and structures which are becoming unserviceable.

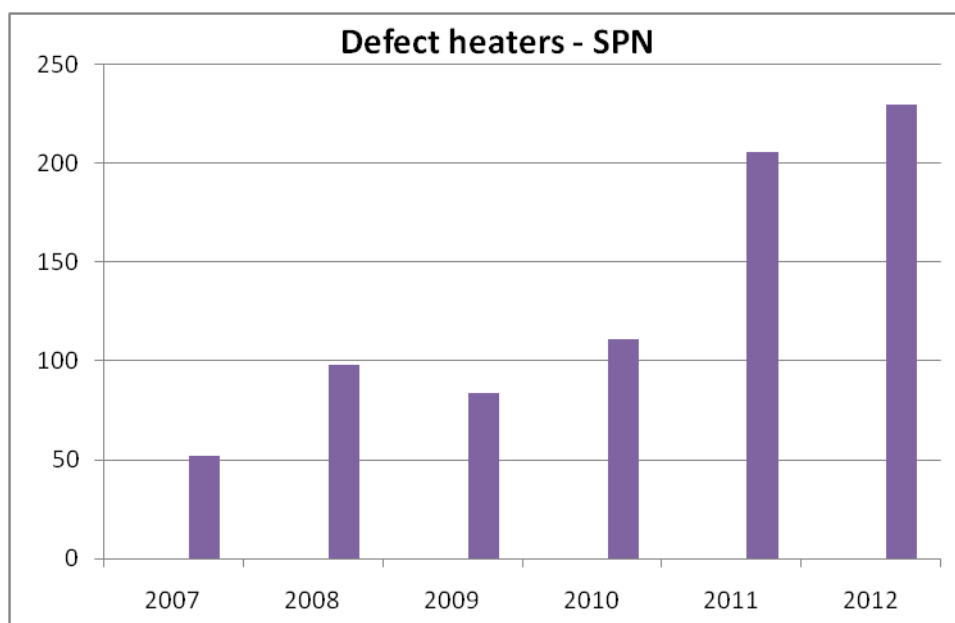


Figure 14 defect heaters

8) Grid/Primary – Rewire

Reduced programme of works in ED1 due to the majority of works being completed in DR5 leaving a limited programme of works remaining in ED1.

9) Grid/Primary Internal Refurbishment

The expenditure increase is intended to provide funding to rectify damage caused primarily by roof leakage. It is intended that the rectification of the damage or staining will reduce the number of repeated roof defect notifications following roof repair / replacement allowing a more efficient programme of monitoring and defect rectification to be developed.

10) Enhance grid and primary fencing

In SPN, this programme of work started earlier than other UK Power Networks licensed areas in DPCR4, the works programme has continued to DPCR5 and expected volumes will be reducing into ED1 as all known sites are completed.

11) Substation Major Structure Replacement

This a new programme of works planned to commence in and continuing through ED1. The works will include the replacement of outdoor structures supporting HV, EHV and 132kV electrical equipment and the replacement of Condition 4 buildings or structures such as Grid or Primary transformer enclosures not due for replacement as part of planned Network reinforcement or plant replacement. Expenditure and volumes are based on data gathered from recently completed detailed sample surveys carried out at 10% of UK Power Networks sites with open terminal equipment and an improved inspection regime due for implementation in mid-2013.

12) Substation Pressure Relief - Explosion Vents

Safety critical works were carried out prior to the commencement of DPCR5 in order to address the risk posed by the failure of known switchgear types. Throughout DPCR5 there has been little requirement to install additional vents at other substation sites and it is expected that this limited requirement will continue throughout ED1.

13) Welfare Facility Installation and removal at Primary Substation

Programmes of works due for completion in DPCR5 therefore no expenditure is predicted for ED1.

7.2.2 Substation Security

Investment	DPCR5 pro rata to 8 years (£k)	ED1 total (£k)	Variance	Total ED1 Volume	Volume Unit	RIG Table	RIG Row	Comment
Improve Grid and Primary Security	1,672	1,333	-339	232	Site	CV8	8	Justification 1
Installation of Security System at Grid Substation	1,094	2,735	1,641	40	Site	CV8	8	Justification 2
Improve Distribution Security	375	455	80	240	Site	CV8	6	Justification 1
Distribution Substation	938	5,102	4,164	7508	Site	Cv8	6	Justification 3

Lock Upgrade Installation								
Installation of Security System at Primary Substation	629	3,815	3,186	120	Site	CV8	8	Justification 2
Grid & Primary Substation Security Access System Installation	1,088	1116	28	133	Site	CV8	8	Justification 4
Newhaven Town Security Upgrade	64	0	-64	0	£k	CV8	7	Projects completed in DPCR5
Cable Bridge Security Enhancement	571	0	-571	0	Site	CV6	19	
Replace Locking at Grid Substation	445	0	-445	0	Site	CV8	8	
Replace Locking at Primary Substation	636	0	-636	0	Site	CV8	7	
Total	7,512	14,556	7,044					

Table 7 Expenditure of civil substation security

The overall increase in security enhancement expenditure in the ED1 period is driven by increased unauthorised access and metal theft in recent years.

Justification for the increase or reduction of ED1 spend and scope of works provided below:

- 1) Grid, Primary and secondary substation security improvement** works include changing or replacing stolen gate padlocks, applying, re-securing or repairing anti-vandal barriers, fitting guards, fixing anti-scaling toppings to fence, fixing bollard, fitting labels. The statutory and legislative requirements (including ESQCR and Health and Safety at Work Act driving these interventions include our duty to ensure that both our operatives and the general public are protected

from harm while we discharge our duties as an electricity distributor. Improvements to security will reduce the likelihood of entry (protecting the public) and reduce the incidents of metal theft (protecting our operatives) the risk.

Volumes are reducing for grid and primary sites in ED1 due to increased installation of security systems.

2) Installation of Security System at Grid / Primary Substation addresses security issues by installing a variety of systems tailored to the individual site requirements in order to prevent illegal access leading to theft and vandalism. Each system to include camera poles, fixed or PTZ (pan tilt zoom) cameras, detectors, lighting, IT rack and all connections back to the UK Power Networks' Security Management Centre (SMC). Sites for installation are determined by the number of previous attacks (details as supplied by Company Security) or changes in the surrounding area land use.

Justification for level of investment and number of sites for this programme of works are addressed below:

3 different attack type examples experienced in recent years (Minor, Mid Range and Major attacks) in EPN and SPN have been examined to generate an estimate of the typical security costs.

Location	Attack	Total Costs to date (not including impact of CI/CML)
MINOR Bettshangar (SPN)	3 attacks May, June, July 2012 involving sections of earthing and building roof.	£22,118 3 attacks therefore circa Estimate £7.5k per MINOR
MID RANGE Wymondley Grid (EPN)	Attacked December 2012. 132kV compound stripped of earthing.	£74,108 Estimate £74k per MID RANGE
MAJOR Holywell (EPN)	Attacked April 2010.	Security Costs – circa £101,508 to date. Repair costs estimate at £80k+ Estimate £180k per MAJOR

Table 8 Examples of substation attacks and costs

In order to estimate an approximate cost per 12 months for attacks on Grid sites during the last 4 months AIRLINE data (Dec 12 to Mar 13) on thefts has been reviewed. There were circa 40 attacks on Grid and Primary sites of which circa 17 were against Grid sites; these are categorised as:

Grid Attacks 1 Dec 12 to 31 Mar 13:

MAJOR - Nil reported @ £180k

MID RANGE x 4 reported @ £74k

MINOR X 13 reported @ £7.5k

Total for 4 months period Dec 12 to Mar 13 circa 393.5k

Cost Estimate for Attacks on GRIDS for 12 month period: $3 \times 393.5k = £1181k$. We would also expect at least 1 MAJOR attack in any 12 months period not represented in the 4 months considered at a cost of £180k.

The average cost of an installation of security system at a Grid Substation is £70k and this is less than the cost of repair for both a major and mid-range attack.

Primary Attacks 1 Dec 12 to 31 Mar 13 recorded in Airline as subject to Metal Theft:

MAJOR x1 reported @ £35k

MID RANGE x 8 reported @ £11k

MINOR X 14 reported @ £6k

Total for 4 months period Dec 12 to Mar 13 circa 207k

Therefore Cost Estimate for Attacks on PRIMARIES for 12 month period: $3 \times 207k = £621k$.

The average cost of an installation of security system at a primary substation is £32k and this is the cost of repair for major range attack.

3) Distribution Substation Lock Upgrade Installation: Due to increased theft and unauthorised entry to our substation and loss of copy right, it was decided to adopt a new locking system to distribution substations. This programme of work will start in 2013 and is due for completion at the second year of the ED1 period.

UK Power Network’s strategy document *Secondary Substation Locking Replacement Strategy* details the company’s approach for the installation of the intelligent locking at secondary substations after the successful completion at Grid and primary substations.

4)

7.2.3 Substation Flood Protection

Substation flood protection is forecasted on a planned basis according to its risk of flooding and subsequent loss of supplies due to impact on critical plant and equipment. There is an ongoing work programme of substation flood protection works based on environmental risk assessments. This programme will provide flood protection in the period 2015 to 2023 for 16 sites in SPN prioritised based on customer number, load and flood depth. The flood protection works will include protection against 1:100, 1:200 and 1:1000 fluvial and tidal flood events as well as protection against surface water flooding. . Information and guidance on the extent and degree of pluvial flooding is currently being gathered in conjunction with the Environment Agency. All flood risk scenario protection schemes will be developed to produce a site specific solution taking into account vulnerable critical equipment, customer numbers and vulnerability and, where appropriate but not exclusively, existing flood protection schemes with a proven record of operational reliability and adequate long term maintenance.

All these costs are CAPEX.

Investment Type	DPCR5 pro rata to 8 years (£k)	ED1 proposed expenditure (£k)	Variance (£k)	Total ED1 Volume	NAMP Line	RIG Table	RIG Row
Substation Flooding (Grid)	1,660	1,590	-70	10	1.47.61	CV11	11
Substation Flooding (Primary)	2,246	2,225	-21	6	1.47.62	CV11	17

Total	3,906	3,815	-91	16			
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Table 9 Substation flood protection expenditure

Planning, feasibility studies and design of flood protection works of the most critical sites have been completed for delivery over the DPCR5 period.

Following on from the work being carried out in DPCR5, a second phase of flood protection works are currently being planned to be carried out over the RIIO ED1 regulatory period from 2015 to 2023. The flood protection programme of works will be extended further in ED1 to address the issues of surface water (pluvial) flooding in addition to the sites already identified as a risk from fluvial and tidal flooding.

Publication of the Environment Agency reservoir flooding inundation maps is highlighting growing concern about the possibility of failure of existing water retaining structures such as dams or reservoirs and the consequent flooding event and potential for destabilisation of overhead line assets associated.

The table below shows the list of sites for flood protection in ED1

SPN Grid Sites	SPN Primary Sites
Croydon Energy Switching Station	Deal Primary 33/11kV
Purley Grid 132kV	Dymchurch 33/11kV
Northfleet East Grid	Ebbsfleet 33/11kV
Purley Grid	Gatwick Airport 33/11kV
Ridham Dock Grid	Hythe Main
Kingston Grid 132 kV	Pulborough 33kV
4No Medium risk sites to be confirmed subject to feasibility studies	

Table 10 List of sites for flood protection in ED1

7.2.4 Oil containment / Bunding

This programme will provide full bunding of 20 Grid transformers and 20 primary transformers in the ED1 period in SPN based on current works

The plan budgets cleaning of oil contamination from 80 Grid and Primary substation sites.

Investment Type	DPCR5 pro rata to 8 years	ED1 proposed expenditure (£k)	Variance (£k)	Total ED1 Transformer Volume	NAMP Line	RIG Table	R R
Oil Containment at grid substations	1,164	1190	26	20	1.30.01	CV12	
Oil Containment at primary substations	1,088	1020	-68	20	1.30.02	CV12	
Cleanup oil contaminated site to prevent external pollution	1,244	509	-735	1360	1.30.05	CV12	
Total	3,496	2,719	-777				

Table 11 Oil containment expenditure

The increased expenditure of oil containment in ED1 is due to the increased number of bunds from oil filled circuit breakers as well as transformers.

The DPCR5 expenditure for cleanup of oil contaminated site to prevent external pollution includes the project for investigating the pollution potential of our sites. The scope of the project is to carry out initial site investigations at 100 sites over the next 4 years in order to have a clearer indication of the issue. The ED1 expenditure is for small scale site by site clean up as part of oil bunding programme and is now intended to include Secondary substations as well as Grid and Primary sites.

7.2.5 Cable Tunnel

The programme allows for the refurbishment of 1 cable tunnel every other year.

Cable tunnels are inspected annually. Following inspections refurbishment works are identified and put into works plan.

Investment Type	DPCR5 pro-rata to	Total ED1 proposed expenditure	Variance (£k)	Total ED1 Volume	NAMP Line	Volume Unit	RIG Table	RIG Row
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	8 years (£k)	(£k)						
SPN Cable Tunnel refurbishment	838	825	-13	4	1.47.02	Site	CV6	18
Cable Tunnel Inspections	41	66	25		2.30.14	Site	CV13	78
Cable Tunnel Maintenance	120	159	39	30	2.32.17	Site	CV13	79
Total	999	1,050	51					

Table 12 Cable tunnel expenditure

7.2.6 Cable Bridge

The programme allows for the refurbishment of 1 Cable Bridge every other year in ED1. Cable bridges are inspected at six monthly intervals by UK Power Networks inspectors. Following inspections refurbishment work are identified and put into works plan.

Investment Type	DPCR5 pro rata to 8 years (£k)	ED1 proposed expenditure (£k)	Variance (£k)	Total ED1 Volume	Volume Unit	NAMP Line	RIG Table	RIG Row
SPN Cable bridge refurbishment	469	530	61	4	Site	1.47.03	CV6	19
Cable Bridge Inspections	96	136	40	544	Site	2.30.13	CV6	80
Cable Bridge Maintenance - SPN	298	576	278	272	Site	2.32.18	CV6	81
Total	863	1,242	379					

Table 13 Cable bridge expenditure

Following the Dartford incident in 2009 steps were taken to identify all cable bridges, assess the relative importance of the circuits being carried (in terms of load and customer numbers) and assess the need to carry out mitigation measures to reduce the risk of third party damage and consequential supply failures.

The increased expenditure of cable bridges in ED1 is due to the increased inspection, maintenance and refurbishment works. Recent surveys have highlighted

an increase in deterioration of cable bridges. There has also been a slight increase in contractor rates following a contractual review.

7.2.7 Safety

These costs are all CAPEX.

Investment Type	DPCR5 pro rata to 8 years (£k)	ED1 proposed expenditure (£k)	Variance	ED1 Volume	Unit	Comment	RIG Table	RIG Row
Removal of Asbestos	615	733	118	1064	Task	Justification 1	CV8	9
Asbestos Survey - Remedial Works	2	45	43	121	Task		CV8	9
Sheerness Grid 132kV asbestos removal	67	0	-67	0	£k		CV8	9
Asbestos Survey Distribution Sites - Outdoor	2,175	1,085	-1090	6564	Site	Justification 2	CV8	9
Grid Substation FRA Review	69	0	-69	0	FRA	Justification 3	CV8	12
Primary Substation FRA Review	28	0	-28	0	FRA		CV8	12
Tunnel Fire Risk Assessments	47	0	-47	0	Units		CV13	78
TOTAL	3,003	1,863	-1,140					

Table 14 Safety expenditure

1) Asbestos Removal

Asbestos removal volumes are expected to increase through ED1 as unstable asbestos within substations is identified during specific asbestos inspections and

monitoring. The removal programme is currently underway and is expected to continue at a reduced rate in ED1.

2) Asbestos Survey Distribution Sites - Outdoor

Asbestos survey of all indoor and outdoor sites will be completed in DPCR5. The funding on the asbestos survey distribution sites – outdoor is to cover the Asbestos Monitoring reviews as required by law for all asbestos found in operational substations.

3) Grid, Primary and Tunnel Fire Risk Assessments

Grid and Primary Fire Risk Assessment review and Tunnel Fire Risk Assessments will be completed during the DPCR5 period.

7.2.8 Inspection and Maintenance

This programme covers major and minor grid, primary and secondary site inspections and maintenance, defect repairs identified during inspection and maintenance activities and other operational responsibilities, including demolishing abandoned/unsafe buildings.

The table below details the actual and predicted pro-rata expenditure in DPCR5 and the predicted expenditure in ED1 for civil inspection and maintenance. Explanations have been provided for the variances between DPCR5 and ED1 in the paragraphs following the table.

				CV13: I&M				
SPN				Total				
				DPCR5	DPCR 5 pro rata to 8 years	RIIO-ED1	DPCR5/ED1 Variance	ED1/ DPCR5 variance justification
Asset category	Activity	RIGs Table	RIGs Row	£m	£m	£m	£m	
Substations - GM Indoor & Outdoor	Repair & Maintenance (Civil Works)	CV13	25	6.71	10.73	11.14	0.40	
Substation	Repair & Maintenance (Civil Works)	CV13	45	2.73	4.36	3.06	-1.30	Justification 1
Substation	Repair & Maintenance (Civil Works)	CV13	73	3.86	6.17	10.97	4.80	Justification 2
Substation	Inspections	CV13	72	3.33	5.33	3.58	-1.76	Justification 3
Substation	Inspections	CV13	44	3.59	5.74	5.65	-0.09	

Table 15 inspection and maintenance

ED1/DPCR5 variance explanation

Justification 1

The reduction shown in ED1 expenditure is due to:

- Reduction in vegetation clearance expenditure due to operational site tree trimming expenditure being allocated to a specific expenditure line – this allows improved budgetary control and correct allocation of expenditure.
- It is expected that as maintenance and asset replacement (e.g. doors, roofs, surrounds) works are undertaken in ED1, the volume consequentially expenditure of defect rectification will reduce.

Justification 2

The increase shown in ED1 expenditure is due to:

- Increase in electrical wiring defects

The increase in reported electrical wiring defects is due to an ageing asset base and a greater number and improved, more targeted inspections leading to a better understanding of asset risk and is allowing more efficient interventions which are more closely focused on the building components and structures which are becoming unserviceable. Although there is a requirement to increase expenditure in ED1 the total increase will be tempered by the continuing LV wiring replacement works.

- Increase in tree trimming expenditure

The expenditure for tree trimming was originally allocated to the vegetation clearance line - because tree trimming is low volume high value activity and was distorting reporting of vegetation clearance expenditure this new line has been created to allow more accurate reporting and works programming.

Justification 3

The majority of the expenditure is non Civil. Only few Civil lines have been mapped to this table. The total expenditure for the civil lines equates to £0.9m.

This expenditure is for the lines;

- Water Quality Testing at Grid & Primary Substations and Water Testing - Remedial Works

The decrease in expenditure in ED1 for water quality testing at grid and primary substations is due to the work being carried out by internal staff as part of direct cost savings and initiative.

- PAT Testing at Grid & Primary Substations

The requirement for PAT testing is to be greatly reduced as UK Power Networks are planning to remove portable electrical appliances from operational substation buildings, as part of the Welfare Removal programme of works.

7.2.9 Civil Works Driven By Plant Asset Replacement

The forecast volumes for civil works driven by plant asset replacement have been review since the 2013 submission and changed accordingly. The volumes and costs are outlined below.

Civil Works Driven By Plant Asset Replacement	RIGs Table	RIGs Row	DPCR5 volume	RIIO-ED1 Volume	DPCR5 (£m)	RIIO-ED1 (£m)
Plinths and Groundworks	CV6	27	375	1,635	4	2
Building		28	3	12	1	1
Enclosures and Surrounds		29	-	40	0	0
Plinths and Groundworks		30	106	181	1	2
Building		31	13	30	3	9
Enclosures and Surrounds		32	22	42	1	3
Plinths and Groundworks		33	120	84	1	1
Building		34	74	2	0	4
Enclosures and Surrounds		35	17	24	0	1
Cable Tunnel		36	-	-	0	-
Cable Bridge		37	-	-	-	-
Total						11

Table 16 Civil works driven by plant asset replacement

HV Costs and Volumes

On the three HV lines the volumes have been based on the number of Distribution switchgear and transformer replacements in CV3. The volumes are less than those seen in CV3 as not all replacements require a plinth, building or enclosure. In SPN the majority of sites are outdoors, so will require a new plinth to be installed where the existing plinth is unsuitable. Very few replacements will require new buildings to be built in any of the areas.

The costs on the HV lines have been based on a standard unit cost associated with each of the individual activities such as installing a plinth or shingle.

132kV and EHV Costs and Volumes

The volumes on the 132kV and EHV lines are based on the volumes from individual major projects. These include mainly grid and primary switchgear and transformer

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

replacements from CV3. Since the 2013 submission the activities included on the table have been reviewed and remove where they were considered to follow the guidance. This has seen a drop in the number of buildings. EHV building volumes consist of works on 11kV and 33kV switchgear replacements. At 33kV a number of new buildings are required where outdoor switchgear is being replaced with indoor equipment.

Costs are based on Compatible Units selected in individual projects.

7.3 Additional Considerations

Not applicable.

7.4 Expenditure Graphs

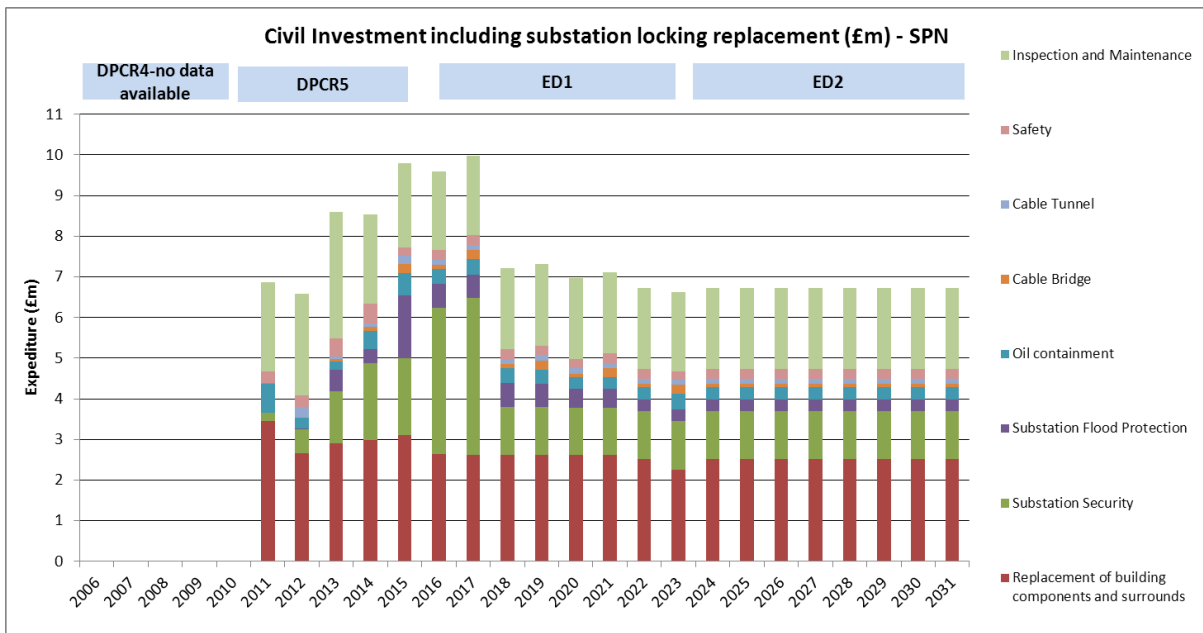


Figure 15 DPCR5 and ED1 expenditures (including locking replacement programme at distribution substation. See commentary below)

The increase in expenditure at the start of the ED1 period is due to high volume of locking replacement at distribution substations.

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Due to the increased theft and unauthorised entry to our substation and the loss of copy right of our locking system, it was decided to adopt a new locking system which is programmable electronic locking system.

Work started on this programme in 2013 and is due for completion at the second year of the ED1 period. The estimated total value of this programme in ED1 is £5.1 million.

The peak from 2015 represents the expenditure for the planning and installation of this system. This is just for the supply and installation of the padlocks.

Whilst there is an increase in expenditure for the first two years of ED1, the expenditure on the remaining periods of ED1 are comparable to the last two years DPCR5 NAMP.

The following chart shows the expenditure without distribution substation locking replacement investment.

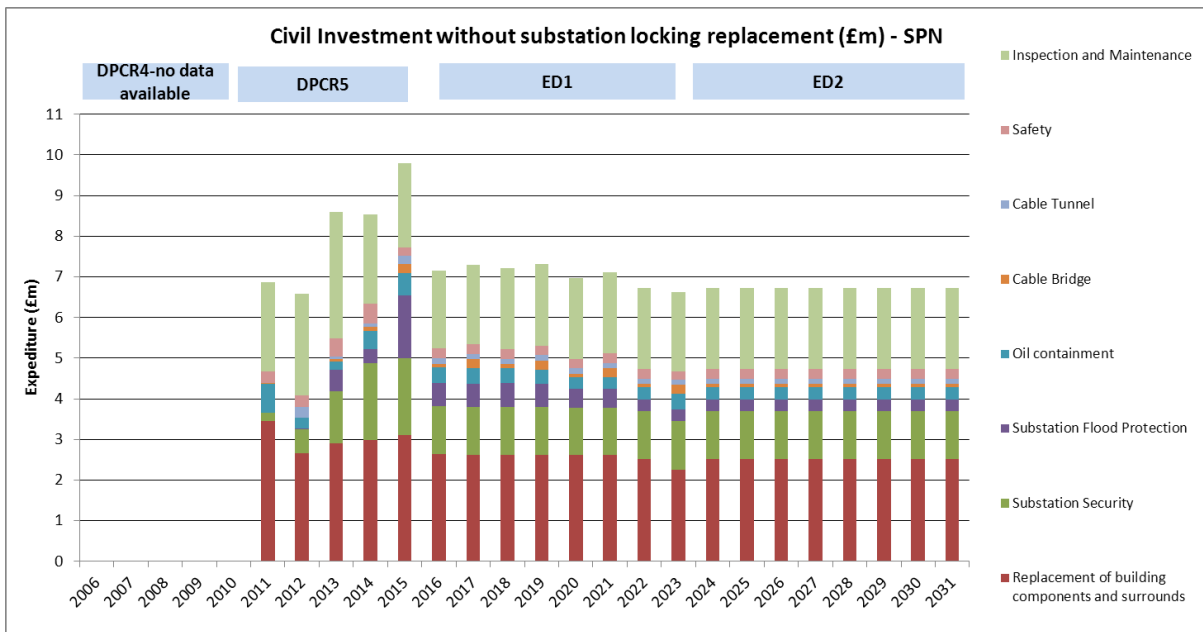


Figure 16 DPCR5 and ED1 expenditures without distribution substation locking replacement programme.

7.5 Commentary

The proposed expenditure for some of the civil asset groups in ED1 is greater than in DPCR5 for the following reasons:

- Better quality and completeness of data in recent years has led to identification of greater number of condition 3 and 4 assets requiring replacement or refurbishment. There is now more historical information and better asset information.
- Where a new driver of investment or replacement has been identified a new programme of work has been drawn up since the submission of DPCR5 plan. For example installation of security systems on substations, substation major structures (e.g. external support structure) replacement.
- If we continue to replace/repair assets at the same rate as DPCR5, the network will deteriorate. The number of condition 4s are not reducing and will fail to do so unless funding is increased.
- Analysis of the DPCR5 expenditure shows only small proportions of civil will have been replaced during this time. During ED1 it is proposed to replace assets such as substation doors and roofs which are demonstrating increasing condition 4 rating as shown in the graphs in figure 7. Accordingly the increase in civil investment expenditure in the DPCR5 period is the start of a sustained need for replacement funding which will grow throughout ED1 period and into the ED2 regulatory period. Notwithstanding this our ED1 proposals presume we are able to contain investment at levels very close to those completed during DPCR5.
- Historical achievements show that we have been spending more than the proposed DPCR5 plan for the past few years of the DPCR5 period.

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7.6 RIGS vs. ASR Volumes and Expenditures

The tables below details the variances between the volumes and expenditure recorded in this ASR and PIMS and what is reported in the submitted RIGS tables.

Outputs	NAMP Line	Asset Stewardship Report		RIG Table			Variance	Variance explanation
		Total volume	Group total volume	RIG Table	RIG Row	RIG volume		
Civil Enabling Work at Grid & Primary Substations	1.47.08.6699							
Replacement of Dist S/S Brick Surround	1.47.29.6166	208	3,344	CV6	11	4,066	722	Explanation 1
Replacement of Dist S/stn Surround (Non Brick)	1.47.30.6167	3,000						
Replacement of Dist S/S Gates	1.47.31	136						
Dist s/stn building - minor asset replacement	1.47.32.6170	736	2,136	CV6	8	2,136		
Dist s/stn building - rewire	1.47.36.6190	1,200						
Dist S/Stn Building - Install New LV Service	1.47.38.6188	200						
Dist s/stn building - replace roof	1.47.33.6171	280	280	CV6	7	280		
Dist s/stn building - replace door	1.47.34.6172	403	403	CV6	6	403		

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Dist S/Stn - Replace Trench Covers	1.47.39.6173	2	2					
Grid/Primary - Replace roof	1.47.50.6184	66	581	CV6	16 and 17	581	0	
Grid/Primary - Replace heating	1.47.52.6183	40						
Grid/Primary - Rewire	1.47.53.8412	55						
Grid/Primary - Replace compound floodlighting	1.47.54.6177	18						
Grid/Primary - Replace doors	1.47.55.6176	125						
Grid/Primary - Replace compound trench covers	1.47.58.6174	96						
Grid/Primary - internal refurbishment	1.47.59.6202	8						
Enhance grid and primary fencing	1.47.63.6162	128						
Substation Major Structure Replacement (NEW***)	1.47.64.6296	44						16
Substation Pressure Relief - Explosion Vents	1.47.65.6289	1						17
Installation of Security System at Primary Substation	1.08.01.6125	120	525	CV8	8	544	19	Explanation 2
Grid & Primary Substation Security Access System Installation	1.08.01.6524	133						
Installation of Security System at Grid Substation	1.08.01.8432	40						
Improve Grid and Primary Security	1.08.05.6124	232						
Improve Distribution Security	1.08.02.6123	240	7,748	CV8	6	7,750	2	

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Distribution Substation Lock Upgrade Installation	1.08.04.6523	7,508						
Removal of Asbestos	1.20.09.6133	1,064	7,749	CV8	9	7,750	1	
Asbestos Survey - Remedial Works	1.20.09.8191	121						
Asbestos Survey Distribution Sites - Outdoor	1.20.18.6718	6,564						
Oil Containment at grid substations	1.30.01.6676	21	57	CV12	9	40	-17	
Oil Containment at primary substations	1.30.02.6677	36						
Cleanup oil contaminated site to prevent external pollution	1.30.02.6142	80	1360	CV6	12	1360	0	
SPN Cable Tunnel Refurbishment	1.47.02.6164	4	4	CV6	18	4	0	
SPN Cable bridge refurbishment	1.47.03.6165	4	4	CV6	19	4	0	
Substation Flooding (Grid)	1.47.61.8413	8	10	CV11	11	10		
Substation Flooding (Primary)	1.47.61.8414	14	6	CV11	17	6		

Table 17 ASR and RIG volume comparison

Asset Name	NAMP Line	Asset Stewardship Report		RIG Table		
		Total investment (£m)	RIGs Table	RIGs Row	Total Investment (£m)	Variance
Replacement of Dist S/S Brick	1.47.29.6166	9.21	CV6	11	9.53	0.32

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Surround						
Replacement of Dist S/stn Surround (Non Brick)	1.47.30.6167					
Replacement of dist s/stn gates	1.47.31					
Dist s/stn building - minor asset replacement	1.47.32.6170					
Dist s/stn building - rewire	1.47.36.6190	1.51	CV6	8	1.50	-0.01
Dist S/Stn Building - Install New LV Service	1.47.38.6188					
Dist s/stn building - replace roof	1.47.33.6171	1.23	CV6	7	1.23	0.00
Dist s/stn building - replace door	1.47.34.6172	1.02	CV6	6	1.01	0.00
Grid/Primary - Replace roof	1.47.50.6184					
Grid/Primary - Replace heating	1.47.52.6183					
Grid/Primary - Rewire	1.47.53.8412					
Grid/Primary - Replace compound floodlighting	1.47.54.6177	7.62	CV6	16 and 17	7.62	0.00
Grid/Primary - Replace doors	1.47.55.6176					
Grid/Primary - Replace compound trench covers	1.47.58.6174					

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Grid/Primary - internal refurbishment	1.47.59.6202					
Enhance grid and primary fencing	1.47.63.6162					
Substation Pressure Relief - Explosion Vents	1.47.65.6289			16		
Civil Enabling Work at Grid & Primary Substations	1.47.08.6699			17		
Substation Major Structure Replacement (NEW***)	1.47.64.6296			17		
Installation of Security System at Primary Substation	1.08.01.6125					
Grid & Primary Substation Security Access System Installation	1.08.01.6524	8.99	CV8	8	9.74	0.75
Installation of Security System at Grid Substation	1.08.01.8432					
Improve Grid and Primary Security	1.08.05.6124					
Improve Distribution Security	1.08.02.6123					
Distribution Substation Lock Upgrade Installation	1.08.04.6523	5.56	CV8	6	5.60	0.04
Removal of Asbestos	1.20.09.6133					
Asbestos Survey - Remedial Works	1.20.09.8191	1.87	CV8	9	1.86	-0.01

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

Asbestos Survey Distribution Sites - Outdoor	1.20.18.6718					
Oil Containment at grid substations	1.30.01.6676	2.21	CV12	9	2.21	0.00
Oil Containment at primary substations	1.30.02.6677					
Cleanup oil contaminated site to prevent external pollution	1.30.02.6142	0.51	CV12	13	0.51	0.00
SPN Cable Tunnel Refurbishment	1.47.02.6164	0.83	CV6	18	0.82	0.00
SPN Cable bridge refurbishment17	1.47.03.6165	0.53	CV6	19	0.53	0.00
Substation Flooding (Grid)	1.47.61.8413	1.59	CV11	11	1.59	0.00
Substation Flooding (Primary)	1.47.61.8414	2.23	CV11	17	2.23	0.00

Table 18 ASR and RIG Expenditure comparison

RIGS/ASR variance in volumes expenditure explanation

Tables 17 and 18 above show the link of the Civil costs and volumes within this Asset Stewardship Report and the RIG tables. The variance in volumes and expenditure on the tables above is because the RIGS tables contain civil works driven by other asset replacement such as switchgear replacement, transformer replacement, general substation reinforcement etc. as well as steel kiosk replacement, switchgear cover replacement and project specific works with some element of Civil work. The volume and expenditure detailed in Section 7.2 of this report do not include these additional other works.

Explanation 1

720 volumes of Switchgear Weather Cover Installation have been mapped to RIG table CV6 row 11. Other 2 project specific works has also been mapped to this line.

This equates to £0.32m of expenditure.

Explanation 2

19 project specific security related lines have been mapped to CV8 row 7 which equates to £0.75m expenditure. These works are driven by other asset replacement such as transformer replacement, general substation reinforcement etc. These projects have a Security works element which has been mapped to this line but the works are not Security risk driven.

8 Deliverability

There are no significant issues with regards to outages and network access during civil asset replacement, inspection and maintenance works. Oil containment and substation surrounds replacement works may require outages but it is anticipated that these will be planned and agreed prior to works being carried out.

Proposed replacement volumes in RIIO-ED1 are similar to historical delivery levels. Volumes are continually reviewed to ensure that they are deliverable. Progress will be monitored via the works volumes shown in appendix 5. Contractors record the work through closed work orders and photographs and the works are independently monitored and reviewed by UK Power Networks project managers or staff. Increase in volumes will be managed by engaging with existing frame work contractors to increase their staff and subcontractors where appropriate.

The civil replacement work program will be prioritised and lists of assets for replacement and site specific projects/programmes determined using the condition data and risk assessment. These lists are planned by the asset management team before being issued to the delivery teams, these are discussed 3-4 months before the annual delivery period begins to ensure understanding and resource availability; for major project works (including bunding and flood protection) the delivery teams are engaged in the feasibility and preliminary design works. Security, flooding protection and oil containment works are converted into approved projects by producing scope of work and high level costing and passed onto programme delivery team.

Inspection and maintenance of civil assets is carried out by internal inspectors or external specialist contractors. Inspection and maintenance programmes are converted into approved projects by generating work orders on ellipse and passed onto contractor/inspector.

9 Appendices

Appendix 1 - Age profiles

The age analysis of all civil assets within Ellipse were undertaken as shown below

Of all the UK Power Networks civil assets being considered under civil assets replacements 2,279 out of 332,468 assets have build year data.

In order to generate a proxy age for the remaining assets it was assumed the build year of an asset to be the same as of its parent asset. As not all parent assets have build year information, remaining assets with still missing build year data were assumed to be the same as of its child asset's build year.

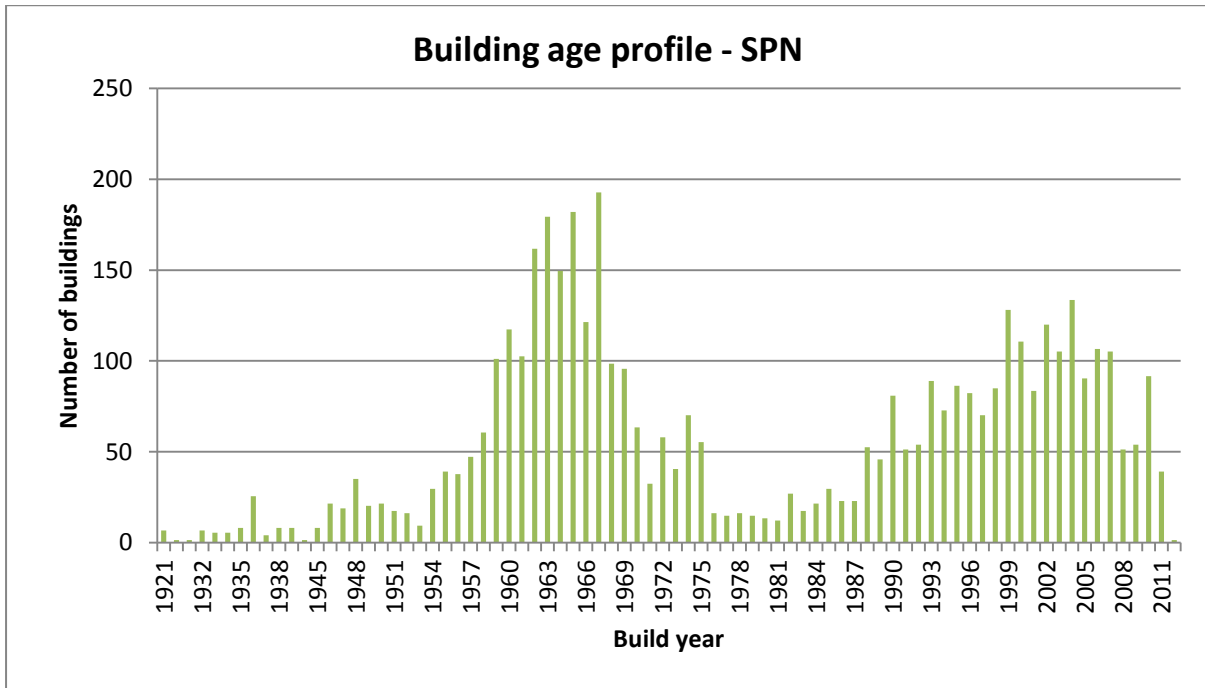
For the remaining assets without a build year, this was estimated as follows. An average build year was determined for each group of assets and then assigned to each asset without a built year.

For example, only 67 out of the 32,447 building assets records contained the actual built year information. The build year information of an additional 24,418 building assets was determined using either the parent or child assets such as rooms and roofs. The remaining 8,023 building assets were distributed proportionally throughout the known build years.

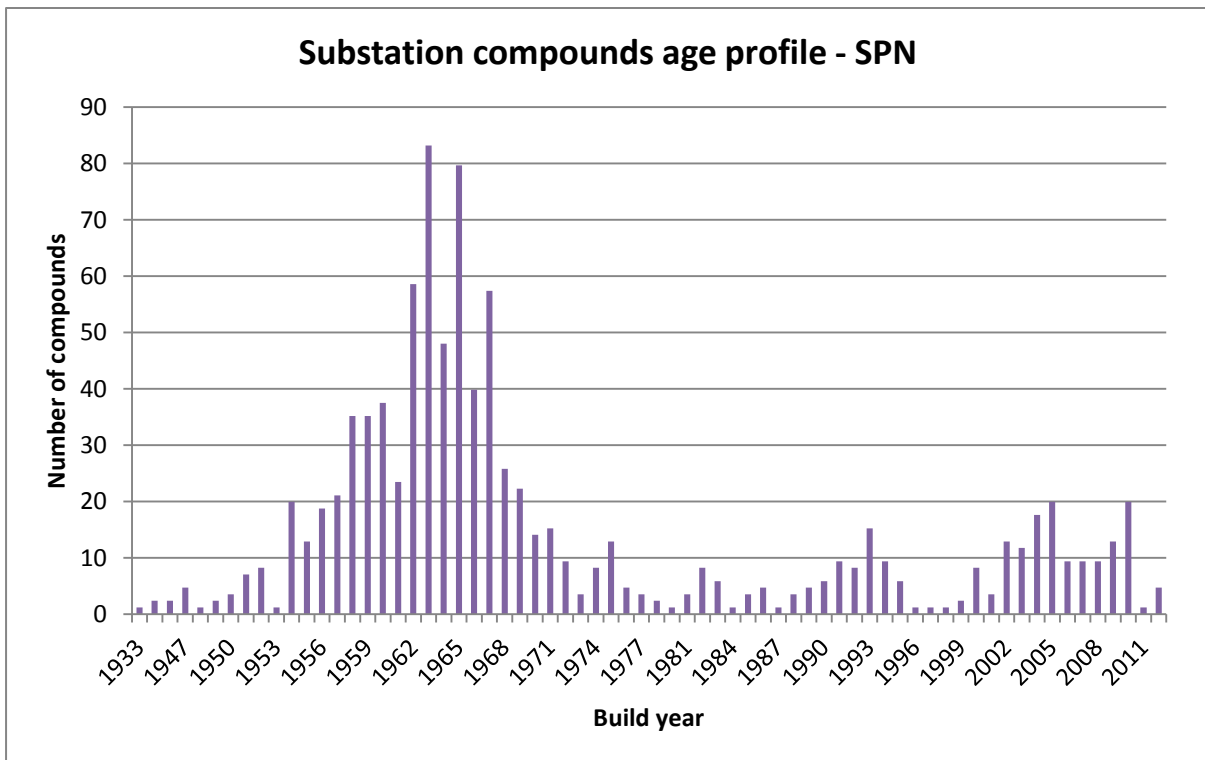
Using this methodology we have determined a reasonable and effective asset age for 99.9% of our assets recorded within in the Ellipse system. There have only been 148 assets where it was not possible to assign the average asset group built year. For these assets, an overall average built year of 1980 was assumed. The overall average was determined by taking the average built year of all other assets with known built year determined as described previously.

The age analysis showed that a substantial number of assets were older than the design life proposed, yet still in good condition. The analysis also showed that a significant number of assets were in poor condition but had not exceeded the proposed asset life. Therefore age alone could not be used as an indicator for replacement strategy. History and current work rates have also been used to forecast the volumes for some civil assets.

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.



Due to most of the buildings being installed during the 1960s, the age profile of the buildings and building components is now at a point where a large replacement work is required.



All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

The above chart shows that most of the substation compounds are aged 50 or above, exceeding the design life (30 years)

Appendix 2 - HI profiles

Not available at time of preparing narrative.

Appendix 3 - Fault data

Not applicable.

Appendix 4 - WLC case studies - risk, cost, performance, condition profiles for various options

Not applicable.



S&R - Baseline_Final ED1 Re-submission_19th February 2014_15:15																
GWP	Namp Reference	Project ID	DNO	Op Unit	Description	UCI	Project Type	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024
1.47	1.47.50	8779	SPN	CP Hub 2 - South	Primary - Replace Roof	14,094	GWP	5	5	5	5	5	5	5	6	7
1.47	1.47.52	6183	SPN	CP Hub 2 - South	Grid - Replace Heating	5,299	GWP	2	2	2	2	2	2	2	2	2
1.47	1.47.52	8792	SPN	CP Hub 2 - South	Primary - Replace Heating	5,299	GWP	3	3	3	3	3	3	3	3	2
1.47	1.47.53	8412	SPN	CP Hub 2 - South	Grid - Rewire	46,855	GWP	3	3	3	3	3	3	3	0	0
1.47	1.47.53	8778	SPN	CP Hub 2 - South	Primary - Rewire	46,855	GWP	5	5	5	5	5	5	4	0	0
1.47	1.47.54	6177	SPN	CP Hub 2 - South	Grid - Replace Compound Floodlighting	5,299	GWP	1	1	1	1	1	1	1	1	1
1.47	1.47.54	8791	SPN	CP Hub 2 - South	Primary - Replace Compound Floodlighting	5,299	GWP	1	1	1	1	1	1	2	2	2
1.47	1.47.55	6176	SPN	CP Hub 2 - South	Grid - Replace Doors	2,511	GWP	7	7	7	7	7	6	6	6	5
1.47	1.47.55	8786	SPN	CP Hub 2 - South	Primary - Replace Doors	2,511	GWP	9	9	9	9	9	9	9	9	6
1.47	1.47.58	6174	SPN	CP Hub 2 - South	Grid - Replace Compound Trench Covers	1,145	GWP	5	5	5	5	5	5	5	5	4
1.47	1.47.58	8785	SPN	CP Hub 2 - South	Primary - Replace Compound Trench Covers	1,145	GWP	7	7	7	7	7	7	7	7	5
1.47	1.47.59	6202	SPN	PD Hub 2 - South	Primary - Internal Refurbishment	1,562	GWP	1	1	1	1	1	1	1	1	1
1.47	1.47.61	8413	SPN	PD Hub 2 - South	Substation Flooding (Grid)	264,921	GWP	1	1	1	1	1	1	1	1	2
1.47	1.47.61	8414	SPN	PD Hub 2 - South	Substation Flooding (Primary)	158,953	GWP	2	2	2	2	2	2	1	1	3
1.47	1.47.62	8372	SPN	PD Hub 2 - South	Chertsey Primary Flood Mitigation - Raise Switchroom Extension, Transformer Bund & Base	1	Major	0	0	0	0	0	0	0	0	0
1.47	1.47.63	6162	SPN	CP Hub 2 - South	Enhance Grid Fencing	11,487	GWP	7	7	7	7	7	7	7	7	6
1.47	1.47.64	6296	SPN	PD Hub 2 - South	Substation Major Structure Replacement (NEW)	7,569	GWP	6	5	5	5	5	5	5	8	15
1.47	1.47.65	6289	SPN	PD Hub 2 - South	Substation Pressure Relief - Explosion Vents	12,716	GWP	1	0	0	0	0	0	0	0	1
2.30	2.30.13	6314	SPN	CO Hub 2 - South	Cable Bridge Inspections	116	GWP	68	68	68	68	68	68	68	68	68
2.30	2.30.14	6320	SPN	CO Hub 2 - South	Cable Tunnel Inspections	111	GWP	840	840	840	840	840	840	840	630	0
2.30	2.30.21	6322	SPN	CO Hub 2 - South	Building, Tunnel and Bridge Survey	111	GWP	15	15	15	15	15	15	15	15	15
2.30	2.30.22	6842	SPN	CO Hub 2 - South	PAT Testing at Grid & Primary Substations	156	GWP	25	4	4	4	4	4	4	4	4
2.30	2.30.23	8182	SPN	CO Hub 2 - South	Water Quality Testing at Grid Substations	295	GWP	350	350	350	350	350	350	350	350	848
2.30	2.30.23	8985	SPN	CO Hub 2 - South	Water Quality Testing at Primary Substations	295	GWP	105	105	105	105	105	105	105	105	848
2.34	2.34.07	6471	SPN	CO Hub 2 - South	Abandoned/Unidentified Cable Location	19	GWP	8	8	8	8	8	8	8	8	8
2.34	2.34.08	6472	SPN	CO Hub 2 - South	Noise Complaint Investigations by Operations	295	GWP	0	0	0	0	0	0	0	0	0
2.32	2.32.02	8184	SPN	CO Hub 2 - South	Graffiti Removal (Was Veg Clearance)	1,650	GWP	122	122	122	122	122	122	122	122	92
2.32	2.32.03	6713	SPN	CO Hub 2 - South	Maintain Grid Sites & Building - 132kV	1,650	GWP	184	184	184	184	184	184	183	173	145
2.32	2.32.04	6714	SPN	CO Hub 2 - South	Maintain Primary Sites & Building - 33kV	650	GWP	151	151	151	151	151	151	151	151	151
2.32	2.32.05	6715	SPN	CO Hub 2 - South	Maintain Distribution Sites & Building - 11kV	70	GWP	333	333	333	333	333	333	332	357	435
2.32	2.32.06	6454	SPN	CO Hub 2 - South	Vegetation Clearance - 132kV	1,650	GWP	66	66	66	66	66	66	66	66	66
2.32	2.32.06	6455	SPN	CO Hub 2 - South	Vegetation Clearance - 33kV	1,650	GWP	330	330	330	330	330	330	330	330	330



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GWP	Namp Reference	Project ID	DNO	Op Unit	Description	UCI	Project Type	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024
2.32	2.32.08	6456	SPN	CO Hub 2 - South	Vegetation Clearance - 11kV	70	GWP	17,142	17,142	17,142	17,142	17,142	17,142	17,142	14,252	8,150
2.32	2.32.15	8185	SPN	CO Hub 2 - South	Tree Trimming (Distribution Sites)	70	GWP	698	698	698	698	698	698	698	698	524
2.32	2.32.15	8685	SPN	CO Hub 2 - South	Tree Trimming (Primary Sites)	650	GWP	10	10	10	10	10	10	10	10	8
2.32	2.32.15	8686	SPN	CO Hub 2 - South	Tree Trimming (Grid Sites)	1,650	GWP	5	5	5	5	5	5	5	5	4
2.32	2.32.17	8186	SPN	CO Hub 2 - South	Cable Tunnel Maintenance	5,299	GWP	4	4	4	4	3	3	3	5	6
2.32	2.32.18	8187	SPN	CO Hub 2 - South	Cable Bridge Maintenance - SPN	2,119	GWP	34	34	34	34	34	34	34	34	34
2.33	2.33.02	8188	SPN	CO Hub 2 - South	Defect Repair - Secondary Substation Civils	70	GWP	1,005	1,100	1,381	1,381	1,381	1,381	1,381	1,381	1,381
2.33	2.33.03	8189	SPN	CO Hub 2 - South	Defect Repair - Grid Substation Civils	317	GWP	118	71	71	71	71	71	71	123	298
2.33	2.33.06	8190	SPN	CO Hub 2 - South	132&33kV Fly Tipping Site Clearance	2,031	GWP	26	26	26	26	26	26	26	26	20
2.33	2.33.17	8420	SPN	CO Hub 2 - South	Pumping Out Flooded Substations	650	GWP	6	6	6	6	6	6	6	6	5
2.33	2.33.18	6854	SPN	CO Hub 2 - South	Asbestos Survey - Remedial Works	390	GWP	0	0	0	0	0	0	0	0	0
2.33	2.33.19	8192	SPN	CO Hub 2 - South	Water Testing - Remedial Works	295	GWP	42	42	42	42	42	42	42	42	42
2.33	2.33.20	8193	SPN	CO Hub 2 - South	Fire Risk Assessment - Remedial Work	145	GWP	0	154	154	154	154	154	154	154	154
2.33	2.33.22	8194	SPN	CO Hub 2 - South	Electrical Wiring - Defect Repair at Grids	1,650	GWP	79	79	79	79	79	79	79	67	37
2.33	2.33.24	7090	SPN	CO Hub 2 - South	Electrical Wiring - Defect Repair at Secondary Substation	70	GWP	78	78	78	78	78	78	78	78	78
2.33	2.33.25	8458	SPN	CO Hub 2 - South	Drainage Inspection & Maintenance	156	GWP	5	4	4	4	4	4	4	4	3
2.34	2.34.16	7012	SPN	CO Hub 2 - South	Demolish Abandoned/Unsafe Buildings	70	GWP	0	0	0	0	0	0	0	0	1

All of the cost numbers displayed in this document are before the application of on-going efficiencies and real price effects.

ED1 Expenditure (£k)

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SR Table J	GWPID	Namp Line	Project ID	Operational Unit	DNO	Description	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
	1.08	1.08.01	6125	CP Hub 2 - South	SPN	Installation of Security System at Primary Substation	476,857	476,857	476,857	476,857	476,857	476,857	476,857	476,857
	1.08	1.08.01	6524	CP Hub 2 - South	SPN	Grid & Primary Substation Security Access System Installation	142,677	142,677	142,677	134,285	134,285	134,285	134,285	151,070
	1.08	1.08.01	8432	CP Hub 2 - South	SPN	Installation of Security System at Grid Substation	341,830	341,830	341,830	341,830	341,830	341,830	341,830	341,830
	1.08	1.08.01	8526	CP Hub 2 - South	SPN	Newhaven Town Security Upgrade	0	0	0	0	0	0	0	0
	1.08	1.08.02	6123	CP Hub 2 - South	SPN	Improve Distribution Security	56,908	56,908	56,908	56,908	56,908	56,908	56,908	56,908
	1.08	1.08.04	6523	CP Hub 2 - South	SPN	Distribution Substation Lock Upgrade Installation	2,423,405	2,678,929	0	0	0	0	0	0
	1.08	1.08.05	6124	CP Hub 2 - South	SPN	Improve Grid and Primary Security	166,571	166,571	166,571	166,571	166,571	166,571	166,571	166,571
	1.08	1.08.08	6821	PD Hub 2 - South	SPN	Cable Bridge Security Enhancement	0	0	0	0	0	0	0	0
	1.08	1.08.09	6918	CP Hub 2 - South	SPN	Replace Locking at Grid Substation	0	0	0	0	0	0	0	0
	1.08	1.08.10	6919	CP Hub 2 - South	SPN	Replace Locking at Primary Substation	0	0	0	0	0	0	0	0
	1.20	1.20.09	6133	CP Hub 2 - South	SPN	Removal of Asbestos	91,606	91,606	91,606	91,606	91,606	91,606	91,606	91,606
	1.20	1.20.09	8191	CP Hub 2 - South	SPN	Asbestos Survey - Remedial Works	5,608	5,608	5,608	5,608	5,608	5,608	5,608	5,608
	1.20	1.20.09	8545	CP Hub 2 - South	SPN	Sheerness Grid 132kV Asbestos Removal	0	0	0	0	0	0	0	0
	1.20	1.20.18	6718	CP Hub 2 - South	SPN	Asbestos Survey Distribution Sites - Outdoor	140,001	140,001	140,001	140,001	140,001	140,001	140,001	104,959
	1.20	1.20.46	9443	Asset Optimisation	SPN	Grid Substation FRA Review	0	0	0	0	0	0	0	0
	1.20	1.20.47	9445	CP Hub 2 - South	SPN	Primary Substation FRA Review	0	0	0	0	0	0	0	0
	1.20	1.20.49	6823	CP Hub 2 - South	SPN	Tunnel Fire Risk Assessments	0	0	0	0	0	0	0	0
	1.30	1.30.01	6676	PD Hub 2 - South	SPN	Oil Containment at Grid Substations	170,013	170,013	170,013	170,013	113,342	113,342	113,342	170,013
	1.30	1.30.01	6677	PD Hub 2 - South	SPN	Oil Containment at Primary Substations	141,678	141,678	141,678	113,342	113,342	113,342	113,342	141,678
	1.30	1.30.05	8991	PD Hub 2 - South	SPN	Cleanup oil contaminated site to prevent external pollution	63,581	63,581	63,581	63,581	63,581	63,581	63,581	63,581
	1.47	1.47.02	6164	CP Hub 2 - South	SPN	SPN Cable Tunnel Refurbishment	0	204,000	0	204,000	0	204,000	0	204,000
	1.47	1.47.02	6987	CP Hub 2 - South	SPN	Cable Tunnel Refurbishment	9,000	0	0	0	0	0	0	0
	1.47	1.47.03	4188	PD Hub 2 - South	SPN	Cable Bridge Refurbishment - SPN	0	0	0	0	0	0	0	0
	1.47	1.47.03	6165	PD Hub 2 - South	SPN	SPN Cable Bridge Refurbishment	0	132,461	0	132,461	0	132,461	0	132,461
	1.47	1.47.08	6699	CP Hub 2 - South	SPN	Civil Enabling Work at Grid & Primary Substations	200,000	200,000	200,000	200,000	200,000	200,000	200,000	150,000
	1.47	1.47.21	8780	CP Hub 2 - South	SPN	Enhance Primary Fencing	103,380	103,380	103,380	103,380	103,380	103,380	103,380	103,380
	1.47	1.47.29	6166	CP Hub 2 - South	SPN	Replacement of Dist S/S Brick Surround	82,934	82,934	82,934	82,934	82,934	82,934	82,934	82,934
	1.47	1.47.30	6167	CP Hub 2 - South	SPN	Replacement of Dist S/S Surround (Non Brick)	1,029,330	1,029,330	1,029,330	1,029,330	1,029,330	1,029,330	1,029,330	1,029,330
	1.47	1.47.31	6168	CP Hub 2 - South	SPN	Replacement of Dist S/S Gates	31,866	31,866	31,866	31,866	31,866	31,866	31,866	31,866
	1.47	1.47.32	6170	CP Hub 2 - South	SPN	Dist S/S Building - Minor Asset Replacement	57,546	57,546	57,546	57,546	57,546	57,546	57,546	57,546
	1.47	1.47.33	6171	CP Hub 2 - South	SPN	Dist S/S Building - Replace Roof	153,927	153,927	153,927	153,927	153,927	153,927	153,927	153,927
	1.47	1.47.34	6172	CP Hub 2 - South	SPN	Dist S/S Building - Replace Door	125,560	125,560	125,560	125,560	125,560	125,560	123,049	135,605
	1.47	1.47.36	6190	CP Hub 2 - South	SPN	Dist S/S Building - Rewire	109,744	109,744	109,744	109,744	109,744	109,744	109,744	109,744
	1.47	1.47.38	6188	CP Hub 2 - South	SPN	Dist S/S Building - Install New LV Service	20,816	20,816	20,816	20,816	20,816	20,816	20,816	20,816
	1.47	1.47.39	6173	CP Hub 2 - South	SPN	Dist S/S - Replace Trench Covers	70	0	0	0	0	0	0	70
	1.47	1.47.50	6184	CP Hub 2 - South	SPN	Grid - Replace Roof	42,281	42,281	42,281	42,281	42,281	42,281	42,281	56,375
	1.47	1.47.50	8779	CP Hub 2 - South	SPN	Primary - Replace Roof	70,469	70,469	70,469	70,469	70,469	70,469	70,469	84,563
	1.47	1.47.52	6183	CP Hub 2 - South	SPN	Grid - Replace Heating	10,598	10,598	10,598	10,598	10,598	10,598	10,598	10,598
	1.47	1.47.52	8792	CP Hub 2 - South	SPN	Primary - Replace Heating	15,897	15,897	15,897	15,897	15,897	15,897	15,897	15,897
	1.47	1.47.53	8412	CP Hub 2 - South	SPN	Grid - Rewire	140,564	140,564	140,564	140,564	140,564	140,564	140,564	0
	1.47	1.47.53	8778	CP Hub 2 - South	SPN	Primary - Rewire	234,274	234,274	234,274	234,274	234,274	234,274	187,419	0
	1.47	1.47.54	6177	CP Hub 2 - South	SPN	Grid - Replace Compound Floodlighting	5,299	5,299	5,299	5,299	5,299	5,299	5,299	5,299
	1.47	1.47.54	8791	CP Hub 2 - South	SPN	Primary - Replace Compound Floodlighting	5,299	5,299	5,299	5,299	5,299	5,299	10,598	10,598
	1.47	1.47.55	6176	CP Hub 2 - South	SPN	Grid - Replace Doors	17,578	17,578	17,578	17,578	17,578	15,067	15,067	15,067



SR Table J	S&R - Baseline Final ED1 Re-submission_19th February 2014_15:15					2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
GWPID	Namp Line	Project ID	Operational Unit	DNO	Description	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
1.47	1.47.55	8786	CP Hub 2 - South	SPN	Primary - Replace Doors	22,601	22,601	22,601	22,601	22,601	22,601	22,601	22,601
1.47	1.47.58	6174	CP Hub 2 - South	SPN	Grid - Replace Compound Trench Covers	5,724	5,724	5,724	5,724	5,724	5,724	5,724	5,724
1.47	1.47.58	8785	CP Hub 2 - South	SPN	Primary - Replace Compound Trench Covers	8,014	8,014	8,014	8,014	8,014	8,014	8,014	8,014
1.47	1.47.59	6202	PD Hub 2 - South	SPN	Primary - Internal Refurbishment	1,562	1,562	1,562	1,562	1,562	1,562	1,562	1,562
1.47	1.47.61	5165	PD Hub 2 - South	SPN	Newhaven Grid Flood Defence	0	0	0	0	0	0	0	0
1.47	1.47.61	8413	PD Hub 2 - South	SPN	Substation Flooding (Grid)	264,921	264,921	264,921	264,921	132,461	132,461	132,461	132,461
1.47	1.47.61	8414	PD Hub 2 - South	SPN	Substation Flooding (Primary)	317,906	317,906	317,906	317,906	317,906	317,906	158,953	158,953
1.47	1.47.62	5224	PD Hub 2 - South	SPN	Newhaven Town Flood Defence	0	0	0	0	0	0	0	0
1.47	1.47.62	8372	PD Hub 2 - South	SPN	Chertsey Primary Flood Mitigation - Raise Switchroom Extension, Transformer Bund & Base	0	0	0	0	0	0	0	0
1.47	1.47.63	6162	CP Hub 2 - South	SPN	Enhance Grid Fencing	80,406	80,406	80,406	80,406	80,406	80,406	80,406	80,406
1.47	1.47.64	6296	PD Hub 2 - South	SPN	Substation Major Structure Replacement (NEW)	45,416	37,847	37,847	37,847	37,847	37,847	37,847	60,555
1.47	1.47.65	6289	PD Hub 2 - South	SPN	Substation Pressure Relief - Explosion Vents	9,537	0	0	0	0	0	0	3,179
1.47	1.47.67	6976	CP Hub 2 - South	SPN	Welfare Facility Installation at Primary Substation	0	0	0	0	0	0	0	0
2.36	2.36.04	6968	CO Hub 2 - South	SPN	Welfare Facility Removal at Primary Substation	0	0	0	0	0	0	0	0
2.30	2.30.13	6314	CO Hub 2 - South	SPN	Cable Bridge Inspections	7,908	7,908	7,908	7,908	7,908	7,908	7,908	7,908
2.30	2.30.14	6320	CO Hub 2 - South	SPN	Cable Tunnel Inspections	92,845	92,845	92,845	92,845	92,845	92,845	92,845	69,634
2.30	2.30.21	6322	CO Hub 2 - South	SPN	Building, Tunnel and Bridge Survey	1,658	1,658	1,658	1,658	1,658	1,658	1,658	1,658
2.30	2.30.22	6842	CO Hub 2 - South	SPN	PAT Testing at Grid & Primary Substations	3,897	623	623	623	623	623	623	623
2.30	2.30.23	8182	CO Hub 2 - South	SPN	Water Quality Testing at Grid Substations	103,289	103,289	103,289	103,289	103,289	103,289	103,289	103,289
2.30	2.30.23	8985	CO Hub 2 - South	SPN	Water Quality Testing at Primary Substations	30,987	30,987	30,987	30,987	30,987	30,987	30,987	30,987
2.32	2.32.02	8184	CO Hub 2 - South	SPN	Graffiti Removal (Was Veg Clearance)	201,300	201,300	201,300	201,300	201,300	201,300	201,300	201,300
2.32	2.32.03	6713	CO Hub 2 - South	SPN	Maintain Grid Sites & Building - 132kV	303,600	303,600	303,600	303,600	303,600	303,600	301,950	285,450
2.32	2.32.04	6714	CO Hub 2 - South	SPN	Maintain Primary Sites & Building - 33kV	98,150	98,150	98,150	98,150	98,150	98,150	98,150	98,150
2.32	2.32.05	6715	CO Hub 2 - South	SPN	Maintain Distribution Sites & Building - 11kV	23,310	23,310	23,310	23,310	23,310	23,310	23,240	24,990
2.32	2.32.06	6454	CO Hub 2 - South	SPN	Vegetation Clearance - 132kV	108,900	108,900	108,900	108,900	108,900	108,900	108,900	108,900
2.32	2.32.06	6455	CO Hub 2 - South	SPN	Vegetation Clearance - 33kV	544,500	544,500	544,500	544,500	544,500	544,500	544,500	544,500
2.32	2.32.08	6456	CO Hub 2 - South	SPN	Vegetation Clearance - 11kV	1,199,940	1,199,940	1,199,940	1,199,940	1,199,940	1,199,940	1,199,940	997,640
2.32	2.32.15	8185	CO Hub 2 - South	SPN	Tree Trimming (Distribution Sites)	48,860	48,860	48,860	48,860	48,860	48,860	48,860	48,860
2.32	2.32.15	8685	CO Hub 2 - South	SPN	Tree Trimming (Primary Sites)	6,500	6,500	6,500	6,500	6,500	6,500	6,500	6,500
2.32	2.32.15	8686	CO Hub 2 - South	SPN	Tree Trimming (Grid Sites)	8,250	8,250	8,250	8,250	8,250	8,250	8,250	8,250
2.32	2.32.17	8186	CO Hub 2 - South	SPN	Cable Tunnel Maintenance	21,196	21,196	21,196	21,196	15,897	15,897	15,897	26,495
2.32	2.32.18	8187	CO Hub 2 - South	SPN	Cable Bridge Maintenance - SPN	72,059	72,059	72,059	72,059	72,059	72,059	72,059	72,059
2.33	2.33.02	8188	CO Hub 2 - South	SPN	Defect Repair - Secondary Substation Civils	70,350	77,000	96,670	96,670	96,670	96,670	96,670	96,670
2.33	2.33.03	8189	CO Hub 2 - South	SPN	Defect Repair - Grid Substation Civils	37,406	22,507	22,507	22,507	22,507	22,507	22,507	38,991
2.33	2.33.06	8190	CO Hub 2 - South	SPN	132&33kV Fly Tipping Site Clearance	52,814	52,814	52,814	52,814	52,814	52,814	52,814	52,814
2.33	2.33.17	8420	CO Hub 2 - South	SPN	Pumping Out Flooded Substations	3,900	3,900	3,900	3,900	3,900	3,900	3,900	3,900
2.33	2.33.18	6854	CO Hub 2 - South	SPN	Asbestos Survey - Remedial Works	0	0	0	0	0	0	0	0
2.33	2.33.19	8192	CO Hub 2 - South	SPN	Water Testing - Remedial Works	12,395	12,395	12,395	12,395	12,395	12,395	12,395	12,395
2.33	2.33.20	8193	CO Hub 2 - South	SPN	Fire Risk Assessment - Remedial Work	0	22,282	22,282	22,282	22,282	22,282	22,282	22,282
2.33	2.33.22	8194	CO Hub 2 - South	SPN	Electrical Wiring - Defect Repair at Grids	130,350	130,350	130,350	130,350	130,350	130,350	130,350	110,550
2.33	2.33.24	7090	CO Hub 2 - South	SPN	Electrical Wiring - Defect Repair at Secondary Substation	5,483	5,483	5,483	5,483	5,483	5,483	5,483	5,483
2.33	2.33.25	8458	CO Hub 2 - South	SPN	Drainage Inspection & Maintenance	779	623	623	623	623	623	623	623
2.34	2.34.16	7012	CO Hub 2 - South	SPN	Demolish Abandoned/Unsafe Buildings	28	28	21	23	21	21	21	24

Appendix 6- Sensitivity Analysis

Not applicable.

Appendix 7- Named Schemes

Not applicable.