



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

Asset Stewardship Report
2014

Helen Amare

Document History

Version	Date	Details	Originator	Revision Class	Section Update
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1.1	17/02/2014	Minor changes to volumes in table 6 to align with PIMS/RIGS	H. Amare	Minor	7.2.1
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	26/02/2014	Appendix 5 updated to ensure alignment with the latest NAMP (dated 19 th February 2014))	H. Amare	Major	Appendix 5
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 have 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, essential cable bridge refurbishment, cable tunnel refurbishment and inspection and maintenance of these assets across the Eastern Power Networks (EPN). 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 NAMP line number.

Investment type	ED1 (£k)	NAMP line		RIGs Table
Replacement of building components and surrounds	29,615	1.47	CAPEX	CV6
Substation Security (including the expenditure for distribution substation locking replacement detailed in section 2.2. This is a one off programme with a total value of £5.1m)	16,734	1.08	CAPEX	CV8
Substation Flood Protection	7,524	1.61 & 1.62	CAPEX	CV11
Oil Containment	9,900	1.30	CAPEX	CV12
Cable Refurbishment	1,060	1.47	CAPEX	CV6

Bridge	Inspection and maintenance	456	2.30 & 2.32	OPEX	CV13
Cable Tunnel	Refurbishment	478	1.47	CAPEX	CV6
	Inspection and maintenance	165	2.30 & 2.32	OPEX	CV13
Safety		2,665	1.20	CAPEX	CV8
Inspection and maintenance		34,535	2.30, 2.32, 2.33, 2.34	OPEX	CV13
Total Expenditure (Condition driven works)		103,132			
Project specific lines mapped to Civil asset replacement lines (CV6) as explained in section 7.6		2,670			CV6
Civil Expenditure associated with other asset replacement projects		50,543			CV6
Total Expenditure (Including civil works driven by other asset replacement and project specific lines mapped to CV6)		156,345			

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 the deteriorated condition of 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 also shows assets are now at a point where a large replacement work is required. Forecast expenditure required for Civil assets in the EPN Licence area in ED1 is £156m

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 2% as shown in Table 2. Given that the £5.1m of the investment required in ED1 is driven by Company specific need to replace “patent expired” locks then our ED1 proposal represents a 7% 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. An in-house Health Indices model is being developed for civil assets which will contribute to the achievement of continual improvement of data quality and works programming.

The table below shows the civil expenditure for the EPN 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)	ED1 (including civil works driven by other asset replacement projects and project specific lines mapped to CV6)
EPN	105,374	103,132	156,345

Table 2 Forecast Expenditure

1.4 Innovation

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

UK Power Networks 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 trail of this product has been carried out and delivered at Warren Heath Primary Initial cost estimates indicate a saving of 20% 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
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 1 % 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 increased height of flood protection design levels (5% of sites)	Potentially 0.5% increase of ED1 investment

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:

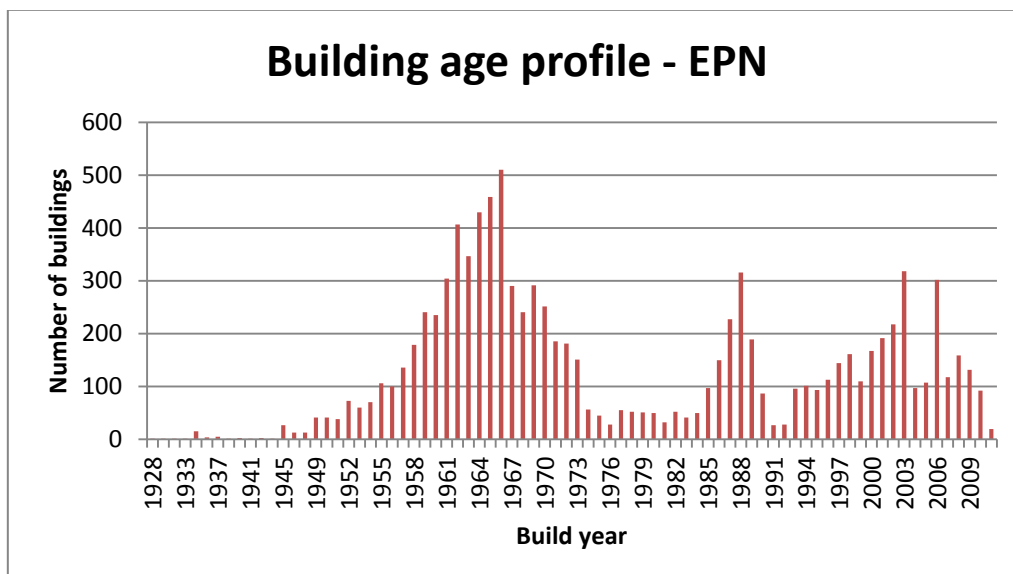
- Substation Building Components and Surrounds.
- Substation security.
- Substation Flood protection.
- Oil Containment.
- Cable Tunnels.
- Cable Bridges.

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

2.1 Substation Building Components and Surrounds

There are 36,176 Distribution substation sites and 761 operational Grid and Primary sites in the EPN network.

There are 13,800 secondary buildings of which 5,467 are GRP buildings, 703 primary building and 328 grid substation buildings in EPN 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).



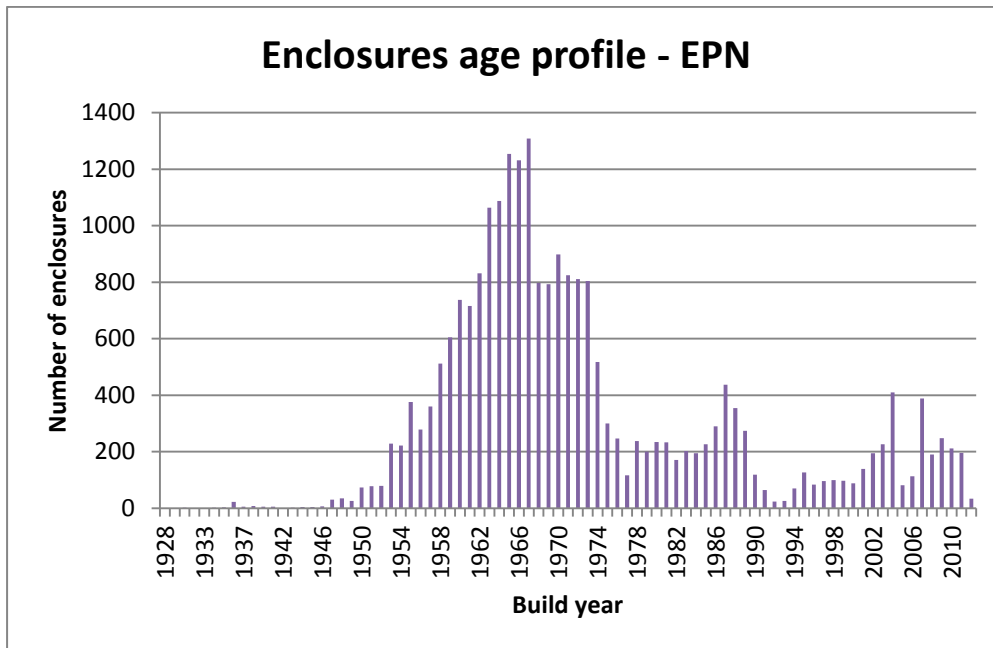


Figure 1 Typical civil asset age profiles

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 £5.0m.

2.3 Substation Flood Protection

A total of 96 Grid and Primary substation sites have been identified in EPN as being in potential flood risk areas as highlighted by existing Environment Agency flood maps.

The Flood defences are 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 substation in 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 sites 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 EPN 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 4 cable tunnels in listed in the Table below their total length is approximately 600m total. Refer to sections 3.5 and 7.2.5 for more detail.

Tunnel Name	Tunnel Length (m)
Haven Tunnel	250
Great Yarmouth -Power Station	170
Lowestoft - Lake Lothing	130
Ipswich	50

2.6 Cable Bridges

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 31 cable bridges in EPN listed on the Table below.

List of Cable Bridges EPN	
Peterborough Central - North 1	West Hall Farm
Mill Hill - Hendon No1	Green Lane
Mill Hill - Finchley No1	MFI Carpark A110
Tottenham Grid - Palmers Green 1	Mathews Car Park
Broxbourne Lido - Near Pole 224	Lower Hall Lane 1
Broxbourne Lido - Near Pole 223	Lower Hall Lane 2
Broxbourne Lido - Near Pole 222	Lea Navigation Canal
River Stort North Harlow	West End Pk
Lowside Cable Bridge	Brimsdown Gantry River Lee Navigation
Twenty Foot Sidings	Welwyn Primary Railway Bridge 66
Rear Of 69 Lampits	Foot Bridge Apsley
Lords Bridge	River Lee
Thorntons Bridge	Tottenham Grid - Palmers Green 2
Hartham River Lee Crossing	Tottenham Grid - Palmers Green 3
Footbridge Nr Edf Depot	Foulden Water Mill
West Hall Farm	

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 and refurbishment 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 *“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 conditions 4 of building components raised by year are increasing.

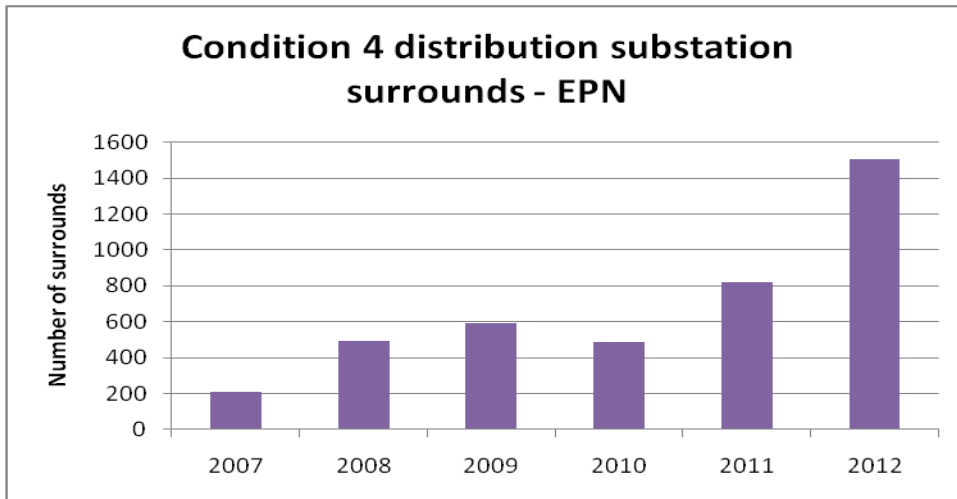


Figure 3 Condition 4 distribution substation surrounds raised by year

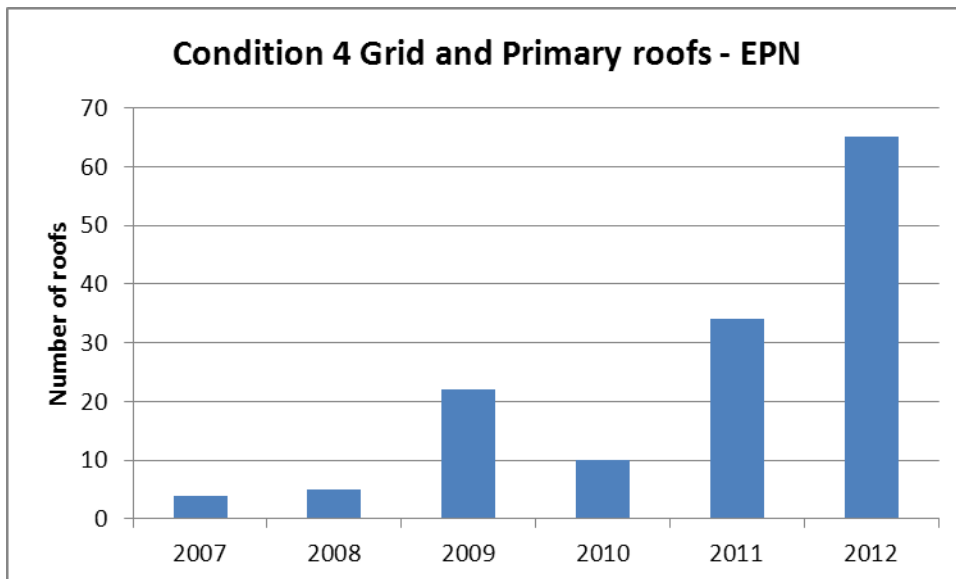


Figure 4 Condition 4 grid and primary substation roofs raised by year

The increase in reported Condition 4 assets is primarily due to more detailed and targeted inspections being undertaken. This has been carried out by an external framework contractor (Freedom) and internal inspectors. 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 substation security.

Metal Theft Report (volume)				
Year	2009	2010	2011	2012
EPN	320	519	819	1112

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.
- 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.

Security enhancement 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.

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 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 subsequent replacement and repair costs. The cost of replacing the plant/equipment on a grid site would be £2.5m. 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 oils storage facilities 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 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 Grid and Primary 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.

The requirements of Asbestos containing materials are:

- Good condition: The material is monitored at regular interval and labelled where practical.
- Poor condition/ Disturbed: It is removed by a specialist contractor.

- Minor damage: The material is repaired or encapsulated and labelled and monitored at regular intervals.
- Major project works are expected to carry out demolition and refurbishment surveys and assessments prior to any works being carried out on assets suspected of containing asbestos containing materials.

This is discussed further in section 7.2.7.

4 Asset Assessment

4.1 Condition

Inspections of civil assets (Grid and Primary) are carried out every six month 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 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 environments 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.

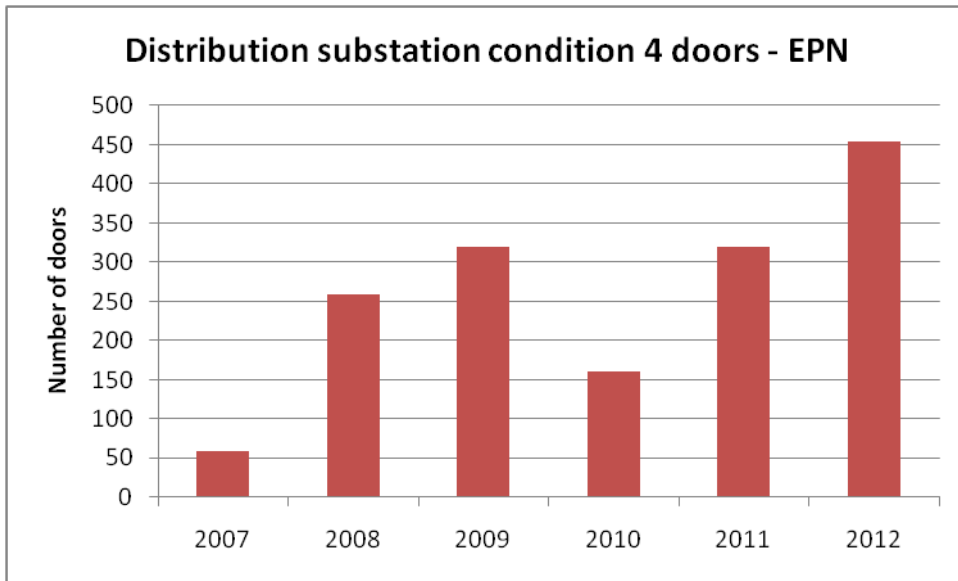


Figure 5 Distribution substation condition 4 doors

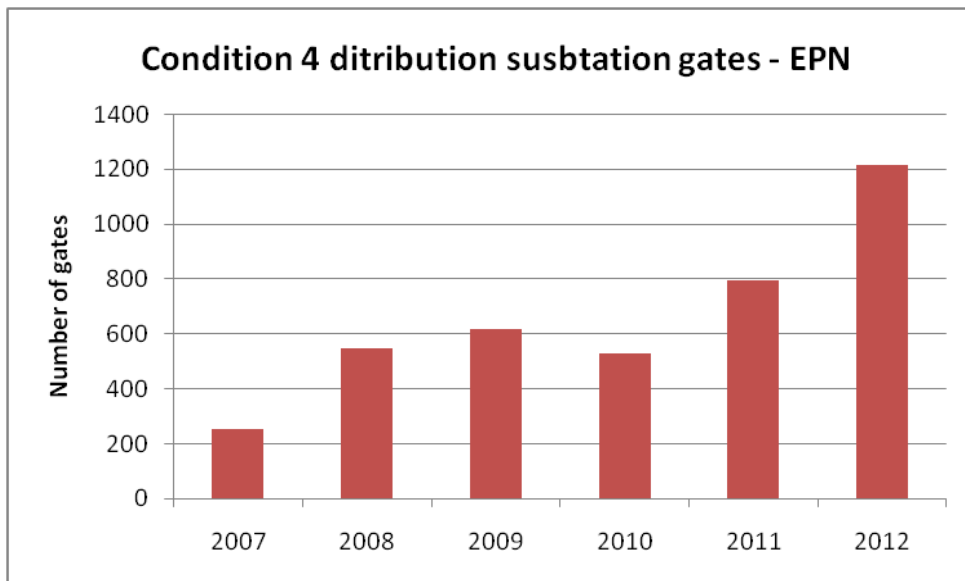


Figure 6 Condition 4 distribution gates



Figure 7 Epping Grid transformer housing representing a Condition 4 building.

Serious structural failure leads to 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.

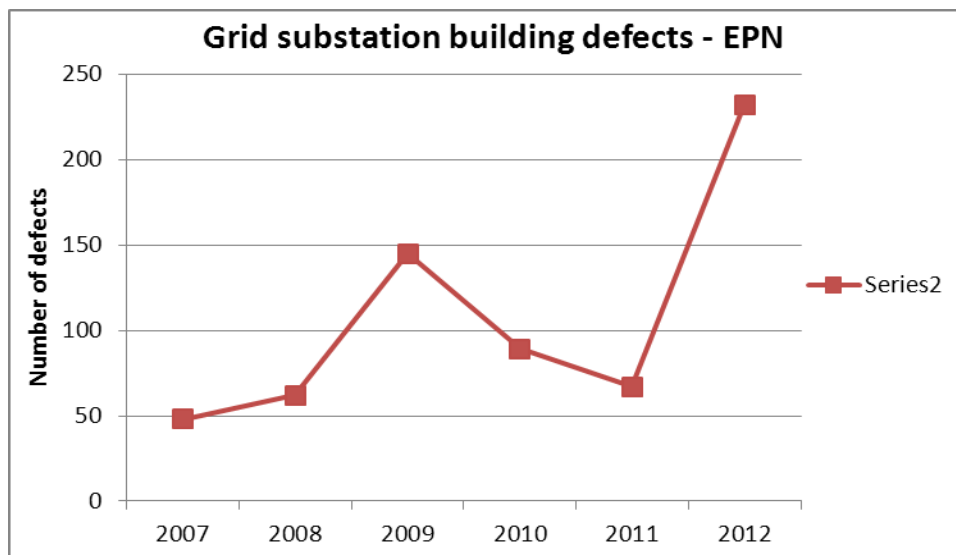
The main source of condition data and defects for civil assets is from substation inspectors. Inspections are carried out as per UK Power Networks inspection and maintenance policy (EMS 10-0002 Inspection and Maintenance Frequency Schedule). During inspection, defects and condition data on civil assets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



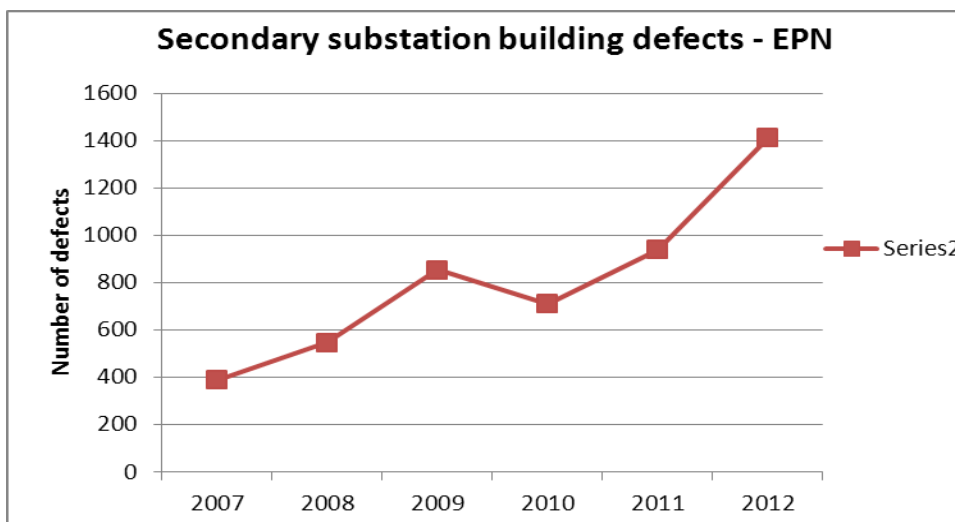
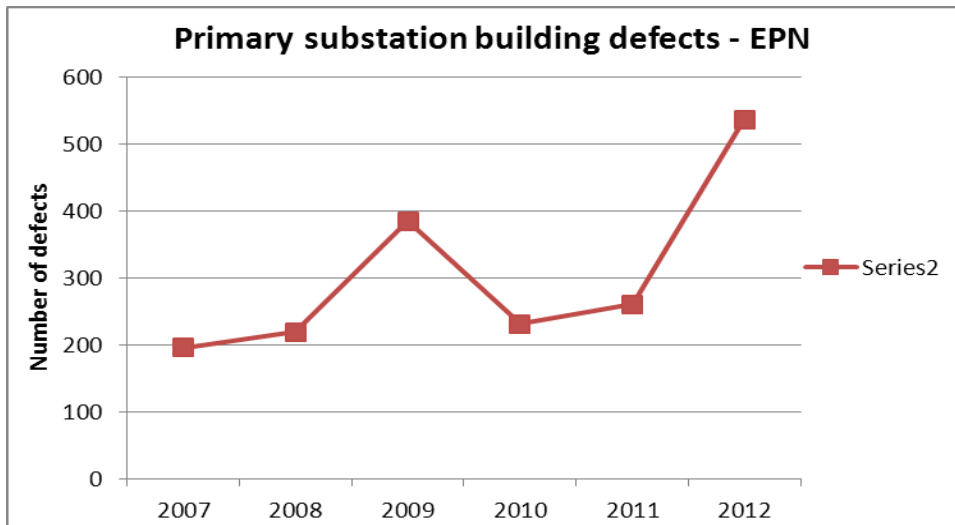


Figure 8 Volumes of building defects raised by year

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	£500-1000/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.



Flood alleviation wall constructed of concrete/steel around relay room



Fitment of Steel/Aluminium flood barriers to the grid transformer building and a protective membrane painted onto the outer walls.

Figure 9 Flood defence works at Hendon Grid



Figure 10 Central Tottenham- completed transformer oil bund



Figure 11 Farcet primary – completed transformer oil bund





Typical Roof repair



Door handle replacement

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 Hatch End and Hendon and 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 9,000 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 Warren Heath Primary. 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.

This approach has been applied to forecast volumes and expenditure of inspection and maintenance of civil assets.

- 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, asbestos survey.

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 12 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.

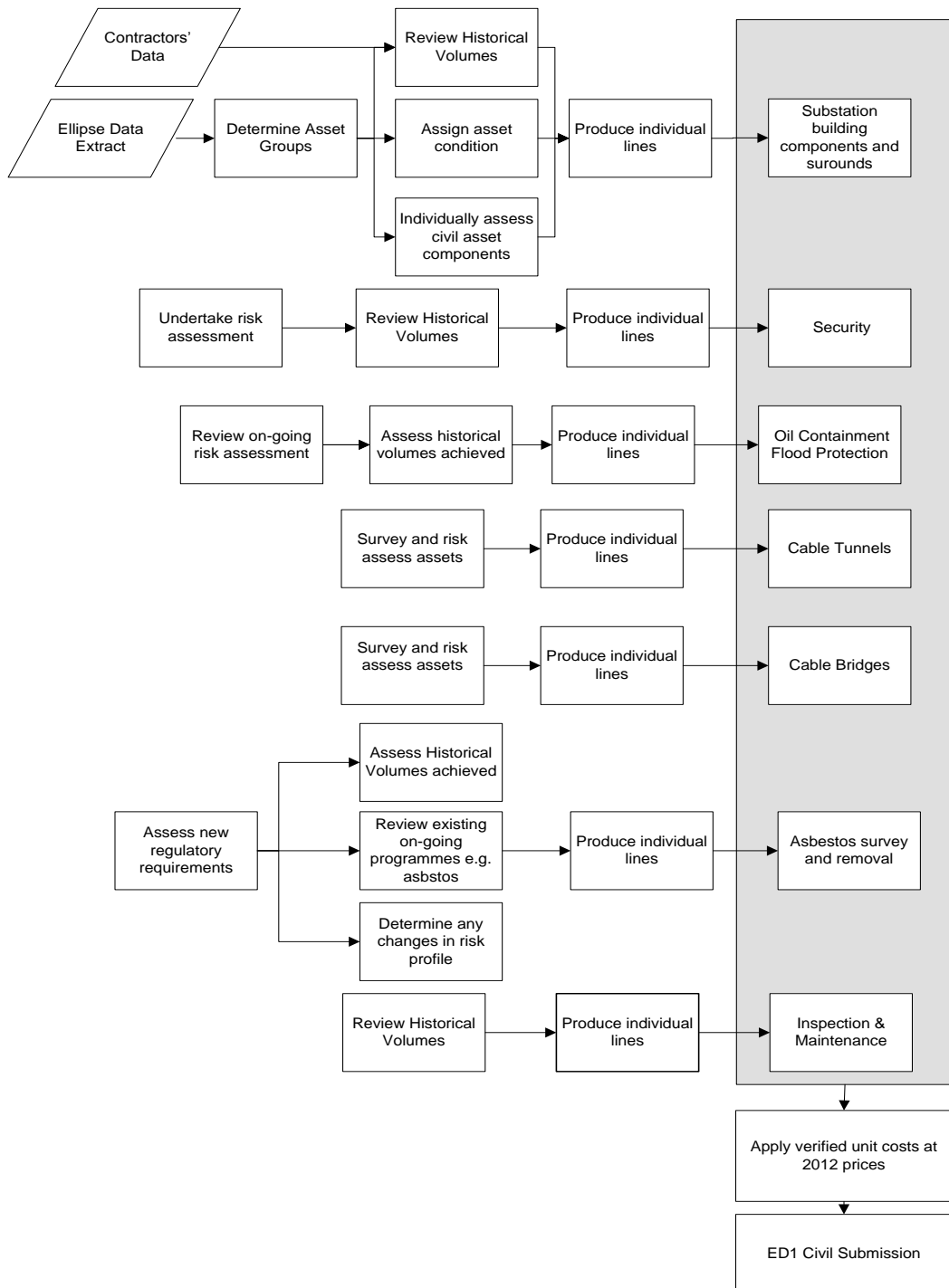


Figure 12 Process diagram showing inputs and outputs of ED1 plan of civil assets

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 .All these costs are CAPEX. The most significant investment is in:

- Replacement of distribution substation surround.
- Replacement of grid and primary substation roofs.
- Distribution Substation Building – Rewire (replacement of the existing building internal LV).
- Grid and primary fencing enhancement.

Investment Type	DPCR5 total pro rata to 8 years expenditure (£k)	ED1 Total Expenditure (£k)	Variance (£k)	Total ED1 volume	Volume Unit	RIG Table	RIG Row	COMMENT
Civil Enabling work at Grid and Primary sites	460	395	-65	n/a	£k	CV6 17	17	Justification 1
Replacement of Distribution Substation	1,815	2,467	652	488	Site	CV6 11	11	Justification 2

Investment Type	DPCR5 total pro rata to 8 years expenditure (£k)	ED1 Total Expenditure (£k)	Variance (£k)	Total ED1 volume	Volume Unit	RIG Table	RIG Row	COMMENT
Brick Surround								
Replacement of Distribution Substation Surround (Non Brick)	9,307	9,472	165	1960	Site	CV6 11	11	Justification 2
Replacement of Distribution Substation gates	440	420	-20	288	Units	CV6 11	11	Justification 3
Distribution Substation Building - minor asset replacement	18	29	11	63	Task	CV6 8	8	Justification 4
Distribution Substation building - replace roof	2,417	2,447	30	592	Roof	CV6 7	7	Justification 5
Distribution Substation building - replace door	1,570	1,679	109	680	Door	CV6 6	6	Justification 6
Distribution Substation Building - Rewire	2676	2,496	-180	3020	Task	CV6 8	8	Justification 7
Distribution Substation Building - Install New LV Service	1,362	908	-454	1091	Site	CV6 8	8	Justification 8
Distribution Substation - replace trench covers	2	3	1	2	Site			
Grid/Primary - Replace roof	1,492	1,917	425	136	Roof	CV6	16 and 17	Justification 9

Investment Type	DPCR5 total pro rata to 8 years expenditure (£k)	ED1 Total Expenditure (£k)	Variance (£k)	Total ED1 volume	Volume Unit	RIG Table	RIG Row	COMMENT
Grid/Primary - Replace heating	357	355	-7	67	SS	CV6	16 and 17	
Grid/Primary - Rewire	1,518	1,499	-19	32	Site	CV6	16 and 17	Justification 10
Grid/Primary - Replace compound floodlighting	185	190	0	36	SS	CV6	16 and 17	
Grid/Primary - Replace doors	612	652	40	264	Door	CV6	16 and 17	Justification 11
Grid/Primary - Replace compound trench covers	141	161	20	208	Site	CV6	16 and 17	
Grid/Primary - internal refurbishment	5	12	7	8	Site	CV6	16 and 17	Justification 12
Enhance grid and primary fencing	3,639	3,716	49	260	Site	CV6	16 and 17	
Substation Major Structure Replacement	85	325	240	43	task	CV6	16	Justification 14
Substation Pressure Relief - Explosion Vents	767	292	-475	40	Site	CV6	17	Justification 15
Welfare Facility Installation at Primary Substation	305	0	-305	0	Site	CV6	17	Justification 16
Welfare Facility Removal at Primary Substation	933	180	-753	34	Site	CV6	17	Justification 17

Investment Type	DPCR5 total pro rata to 8 years expenditure (£k)	ED1 Total Expenditure (£k)	Variance (£k)	Total ED1 volume	Volume Unit	RIG Table	RIG Row	COMMENT
TOTAL	30,109	29,615	-494					

Table 6 Civil asset replacement expenditure

Justifications for the for high increase or reduction of expenditure in ED1

1) Civil Enabling works at Grid and Primary sites

This Investment type represents any works not covered by a specific line or works necessary to refurbish asset to support related development works. This investment type represents civil replacement expenditure at grid and primary sites which can be more efficiently delivered if it is completed in conjunction with another project.

- 2) **Replacement of Distribution Substation Surround:** A replacement of a fence or 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. 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 35,930 secondary sites across in EPN which have some form of enclosure around the site. The proposed ED1 volumes and expenditure represent the replacement of 7% of the total number of brick and non-brick distribution substation surrounds.

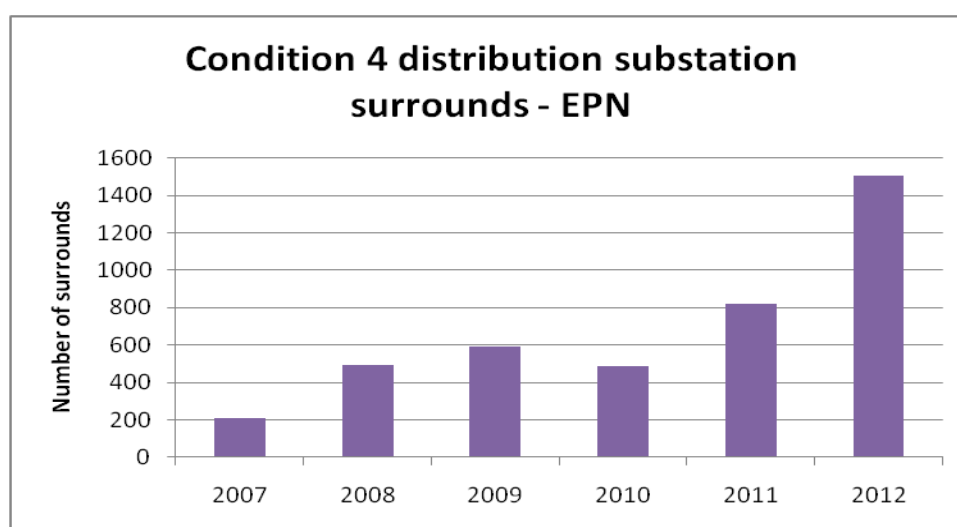


Figure 13 Condition 4 distribution substation surrounds raised by year

3) Replacement of Distribution Substation gates

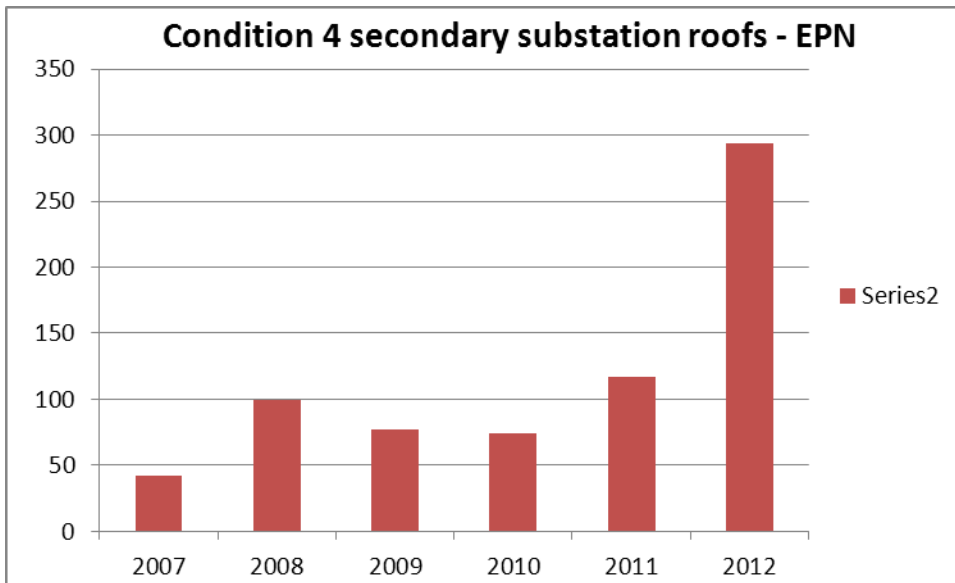
Expenditure is reducing in ED1 by 5% as increased numbers are being undertaken in DR5 to address existing issues.

4) Distribution Substation Building - minor asset replacement

Distribution substation minor asset replacement covers the replacement of ancillary assets without a specific expenditure line in the plan, for example louvers, door stays and cable support structures. The increase in expenditure on this investment type reflects the increase in Condition 4 rectification on other distribution substation assets described in this section

5) Distribution Substation building - replace roof

The ED1 expenditure represents the replacement of 4% (592) of secondary substation roofs. The tables below shows an increase of condition 4 secondary substation roof over the previous year's, which in addition to showing a deteriorating asset base, shows 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.



6) Distribution Substation building - replace door

Replacement of distribution substation doors shows a 7% growth in expenditure. This is due to the increase in condition 4s being reported year on year as shown in the chart below brought about by an increasingly targeted and detailed inspections. In ED1 replacement volumes for assets can be seen to only represent a small proportion of the total number of assets; there are 13,800 distribution substation buildings in EPN and assuming each building to have one door, only 5% (81/year) of distribution doors will be replaced during ED1.

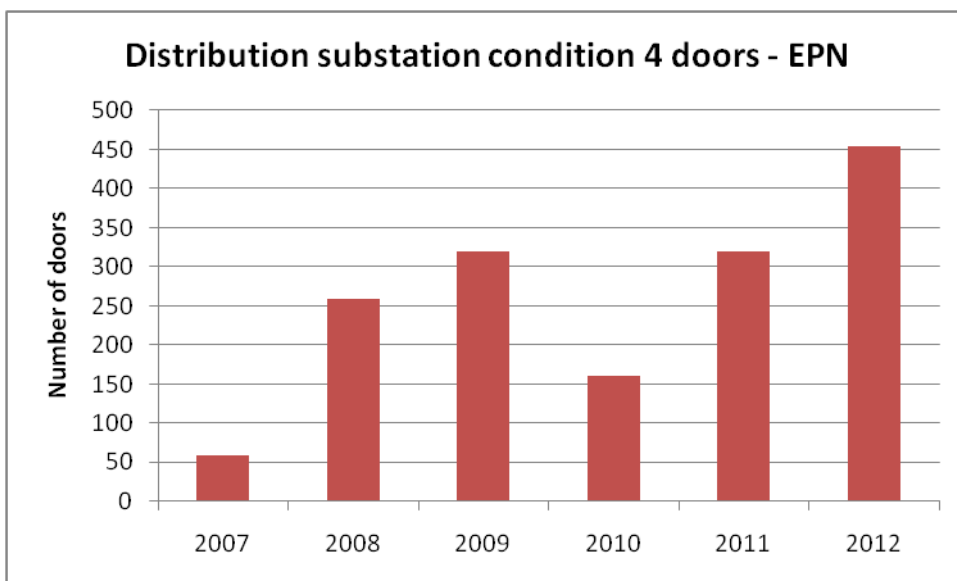


Figure 14 Distribution substation condition 4 doors

7) Distribution substation building rewire

Table 6 shows a 7% reduction of 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 the UCI (unit cost indicator).

8) 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.

9) Grid/Primary - Replace roof

The ED1 expenditure represents the replacement of 12% (136) of Grid/Primary roofs. The tables below shows an increase of condition 4 grid and primary roof conditions over the previous year's indicating a deteriorating asset base and supporting the increase in proposed expenditure.

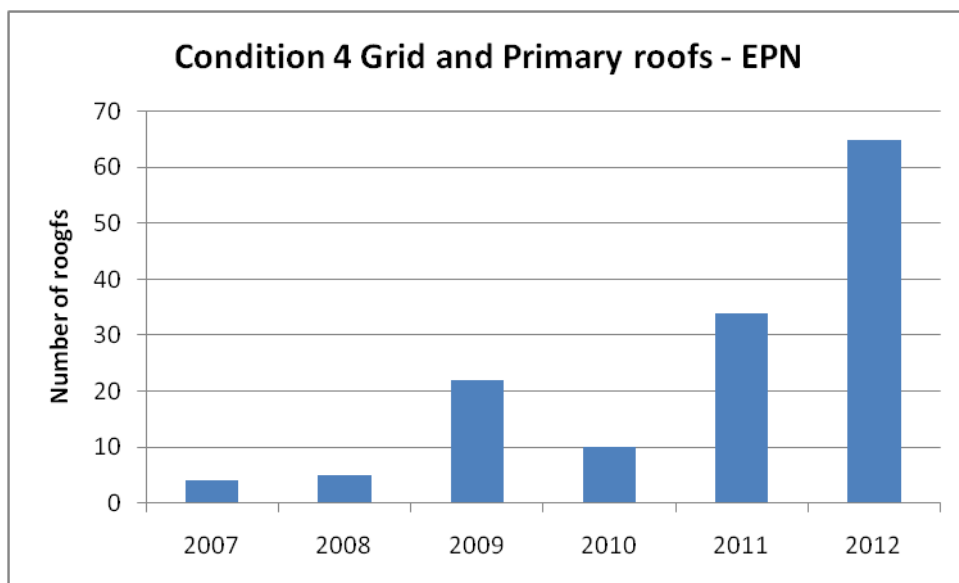


Figure 15 grid and primary condition 4 roofs

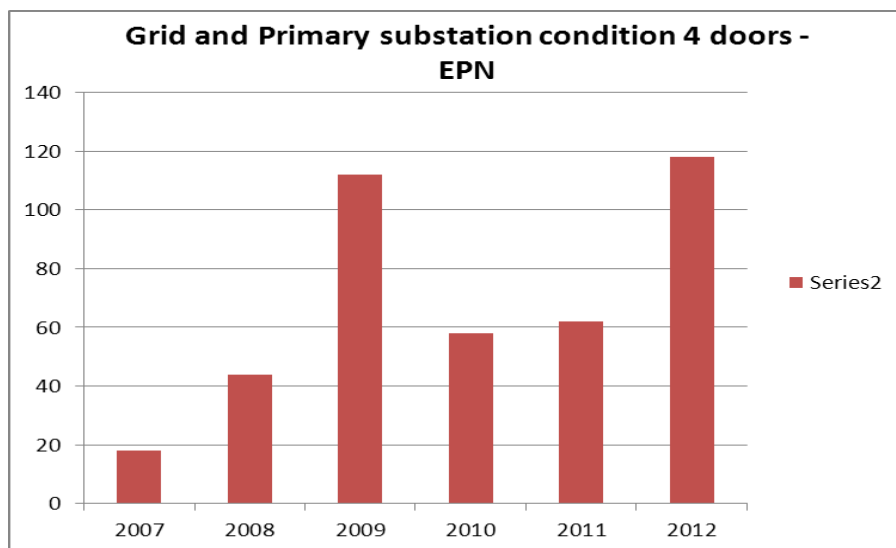
As can be seen from the graph above, the total number of condition 4 defects identified has grown three fold between the first 3 years and the second 3 years of the period 2007-2012. In ED1, it is assumed this rate of growth of condition 4 defect will only continue at a 10th of this rate in total.

10) Grid/Primary – Rewire

Current level of expenditure will be continuing throughout ED1.

11) Grid/Primary - Replace doors

Increase in expenditure during ED1 due to increased reporting of condition 4's as shown in Figure below. There are 712 Grid and Primary substations in EPN and if an assumption is made that every site has 5 external doors the replacement volume through ED1 will be 7%.



12) 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.

13) Enhance grid and primary fencing

The work is an on-going replacement programme based on condition of existing fences.

14) 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 the preliminary results from a new improved inspection regime introduced in 2013.

15) Substation Pressure Relief - Explosion Vents

Explosion vents are being installed at high risk sites throughout DPCR5 as they are identified. The programme will continue through ED1 addressing the issues at medium risk sites, which through lower predicted volumes, expenditure will be reduced compared to that in DPCR5.

16) Welfare Facility Installation

The Programme of work is due for completion in early ED1 therefore expenditure will not be required throughout the whole of the 2015-2023 period.

17) Welfare Facility Removal at Primary Substation

Expenditure is showing reduction as the programme of work is due for completion in early ED1. Welfare facility removal at grid and primary substation will be carried out in accordance with UK Power Networks strategy document '*Strategy for Provision and Management Welfare Facilities at UK Power Networks Operational Sites*' and specification document '*Welfare facilities at Grid and Primary sites*'.

7.2.2 Substation Security

All these costs are CAPEX.

Investment Type	DPCR5 total pro rata to 8 years expenditure (£k)	ED1 Total (£k)	Variance (£k)	Total ED1 volume	Volume Unit	RIG Table	RIG Row	Comments
Improve Grid and Primary Security	2,055	1,809	-246	376	Site	CV8	7	See Justification 1
Installation of security system at Grid Substation	1,094	2,735	1,641	40	Site	CV8	8	Justification 2
Improve Distribution Security	483	725	242	321	Site	CV8	6	Justification 1
Distribution Substation Lock Upgrade Installation	1,432	5,102	3,670	7,463	Site	CV8	6	Justification 3
Grid & Primary Substation Security Access System Installation	970	1,595	625	190	Site	CV8	8	Justification 4
Installation of Security System at Primary Substation	966	4,769	3,803	150	Site	CV8	8	Justification 2
Cable Bridge Security Enhancement (Due for completion in DR5)	1,204	0	-1,204					Projects completed in DPCR5
Replace Locking at Grid Substation (Due for completion in DR5)	678	0	-678					
Replace Locking at Primary Substation (Due for completion in DR5)	2,039	0	-2,039					
Total	10,920	16,734	5,814					

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 spends and scope of works of substation security is 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 - H&SAWA) 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 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 x 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 less than the cost of repair for major.

It is predicted that a security intervention will be triggered at 40 grid sites and 150 primary sites during the ED1 period.

3) Distribution Substation Lock Upgrade Installation: Due to increased theft and unauthorised entry to our substation and loss of copy right, it has been 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 in EPN.

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 34 sites in EPN prioritised based on customer number, load and flood depth. Volumes of protection in EPN are higher

than in other UK Power Networks licensed areas, primarily because the EPN region represents the largest UK Power Networks operated DNO by area with a greater number of low lying areas vulnerable to flooding, this links directly to the number of Grid and Primary substation sites considered to be at risk.

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 (pluvial) 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 total pro rata to 8 years expenditure (£k)	ED1 proposed expenditure (£k)	Variance (£k)	Total ED1 Vol	NAMP Line	RIG Table	RIG Row
Substation Flooding (Grid)	4,198	3,709	-489	14	1.47.61	CV11	17
Substation Flooding (Primary)	4,264	3,815	-449	20	1.47.62	CV11	11
Total	8,462	7,524	-938	34			

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.

EPN Grid Sites	EPN Primary Sites
BR Manningtree	Manganese Bronze Primary
Brimsdown South Grid	Selwyn Rd Primary
Chequers Primary	East Bay
Coryton Grid	Feltwell Primary
Histon Grid	Central Edmonton Primary
Thorpe Grid	Exchange Street Primary
Tilbury 132kv Tee Point	Canvey Primary
Tilbury Compact Grid	Godmanchester Primary
Tottenham Grid	Melton Primary
West March 132	Waltham Abbey Primary
Fleethall Grid	Prebend St Primary
Shell Grid	Caister Primary
Histon Grid	Littleport Primary
Tilbury Local	Kings Lynn Grid & Primary
	Leverington Primary
	Aylsham Primary
	Barclay Way Primary
	Gaywood Bridge Primary
	Great Yarmouth Power Stn

	Fornham Primary
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Table 10 list of sites for flood protection in ED1

7.2.4 Oil containment / Bunding

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	Volume Unit	RIG table	RIG Row
Oil Containment at grid substations	2,396	2,742	346	40	1.30.01	Transformer	CV12	9
Oil Containment at primary substations	6,860	6,649	-211	120	1.30.02	Transformer	CV12	9
Clean up oil contaminated site to prevent external pollution	4048	509	-3,539	1080	1.30.05	Site	CV12	13
Total	13,304	9,900	-3,404					

Table 11

Oil containment expenditure

This programme will provide full bunding of 40 Grid transformers and 120 primary transformers in the ED1 period in EPN based on current works.

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

The increased expenditure of oil containment in ED1 is due to the identification of oil filled circuit breakers not due for removal / replacement in the ED1 period requiring bunding in addition to the transformers already programmed for oil containment works. 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 sample 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. Following inspections refurbishment works are identified and put into works plan.

These costs are a mixture of CAPEX and OPEX as detailed below.

Investment Type	DPCR5 pro-rata to 8 years (£k)	ED1 proposed expenditure (£k)	Variance (£k)	Total ED1 Volume	NAMP Line	Volume Unit	RIG Table	RIG Row
EPN Cable Tunnel refurbishment (CAPEX)	163	478	315	3	1.47.02	Site	CV6	18
Cable Tunnel Inspections (OPEX)	51	38	-13	43	2.30.14	Task	CV13	78
Cable Tunnel Maintenance (OPEX)	127	127	0	24	2.32.17	Site	CV13	79
Total	341	643	302					

Table 12 Cable tunnel expenditure

The increase expenditure of cable tunnels in ED1 is due to the increased refurbishment requirements identified during the improved inspection regime commenced in 2013. Recent surveys have highlighted an increase in deterioration of ancillary assets (ladders, cable supports). There has also been an increase in contractor rates following a contractual review.



7.2.6 Cable Bridge

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

These costs are a mixture of CAPEX and OPEX as detailed below.

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
Cable bridge refurbishment (CAPEX)	1,335*	1060	-275	8	Site	1.47.03	CV6	19
Cable Bridge Inspections (OPEX)	64	124	60	496	Task	2.30.13	CV13	80
Cable Bridge Maintenance (OPEX)	187	332	145	272	Site		CV13	81
Total	1,586	1,516	-70					

Table 13 Cable bridge expenditure

* This expenditure includes cable bridge refurbishment works in security point of view. 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 (£k)	ED1 proposed expenditure (£k)	Variance (£k)	ED1 Vol	Unit	Justification	RIG Table	RIG Row
Asbestos removal	1,604	1,299	-305	1767	Task	Justification 1	CV8	9
Asbestos Survey Distribution Sites -	6,048	1,356	-4,692	8218	Site	Justification 2	CV8	9
Grid Sub-station Fire Risk	438	11	-427	15	Site		CV8	9
Primary Sub-station Fire Risk Assessment	489	0	-489	0	Site			
Grid Substation	121	0	-121	0	FRA			
Primary Substation FRA	383	0	-383	0	FRA			
Tunnel Fire Risk Assessment	45	0	-45	0	Unit			
Total	9,127	2,665	-6,462					

Table 14 – Safety expenditure

1) Asbestos Removal

Asbestos removal volumes are expected to reduce overall through ED1 as unstable asbestos within substations is removed and fewer ACM's (Asbestos Containment Material) remain. 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 and reviews that are to follow up on the completed survey work as required by law for all asbestos found in operational substations. The Monitoring is

less detailed requiring less time and expenditure to undertake Inspection and Maintenance.

7.2.8 Inspection and Maintenance (I&M)

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								
EPN				Total				
				DPCR5	DPCR5 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	6.78	10.85	6.39	-4.46	Justification 1
Substation	Repair & Maintenance (Civil Works)	CV13	45	3.51	5.62	9.02	3.4	Justification 2
Substation	Repair & Maintenance (Civil Works)	CV13	73	7.20	11.52	18.22	6.7	Justification 3
Substation	Inspections	CV13	72	8.15	13.05	12.11	-0.94	Justification 4
Substation	Inspections	CV13	44	7.87	12.60	10.52	-2.08	Justification 5

Table 15 Inspection and Maintenance Expenditure

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.

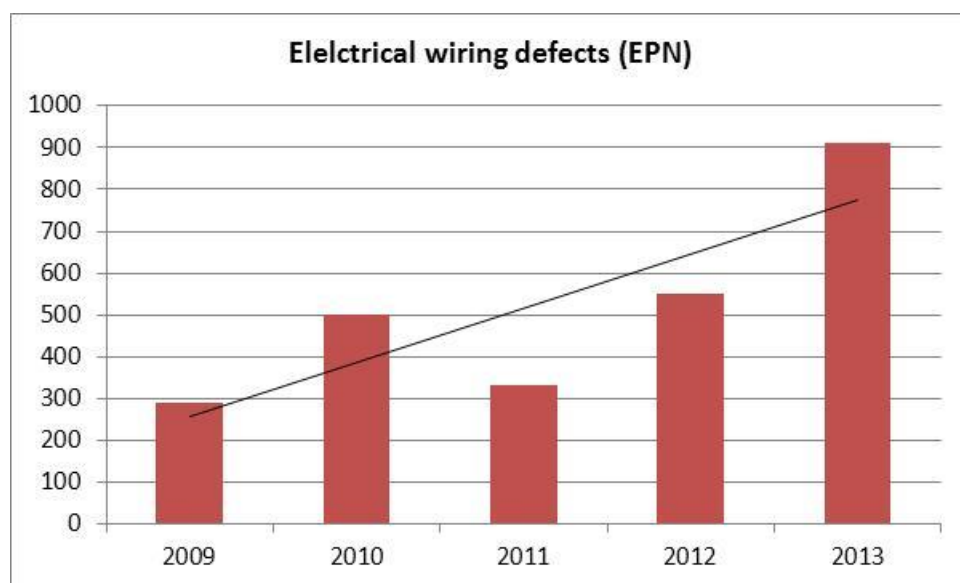


Figure 16 Electrical wiring defects raised by year

- Increase in Primary Substation 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 increase shown in ED1 expenditure is due to:

- Increase in fire risk assessment expenditures – Fire risk assessment programme is now intended to include secondary substations as well as Grid and Primary sites.
- Increase in Grid Substation 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 4

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 £1.5m.

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.

Justification 5

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 £2.3m

7.2.9 Civil Works Driven By Plant Asset Replacement

The forecast volumes for civil works driven by plant asset replacement have been reviewed 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	526	2,062	2	2
Building		28	50	86	3	4
Enclosures and Surrounds		29	30	52	1	0
Plinths and Groundworks		30	216	414	2	2
Building		31	47	83	7	27
Enclosures and Surrounds		32	49	104	2	3
Plinths and Groundworks		33	245	153	3	2
Building		34	17	7	2	8
Enclosures and Surrounds		35	32	65	0	2
Cable Tunnel		36	-	-	0	-
Cable Bridge		37	-	-	-	-
Total						23

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 EPN 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 replacements from CV3. Since the 2013 submission the activities included on the table have been reviewed and removed 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. At 132kV the volume of buildings is higher in EPN due to the larger number of GIS switchgear replacements compared to SPN and LPN.

Costs are based on Compatible Units selected in individual projects.

7.3 Additional Considerations

Not applicable.

7.4 Expenditure Graphs

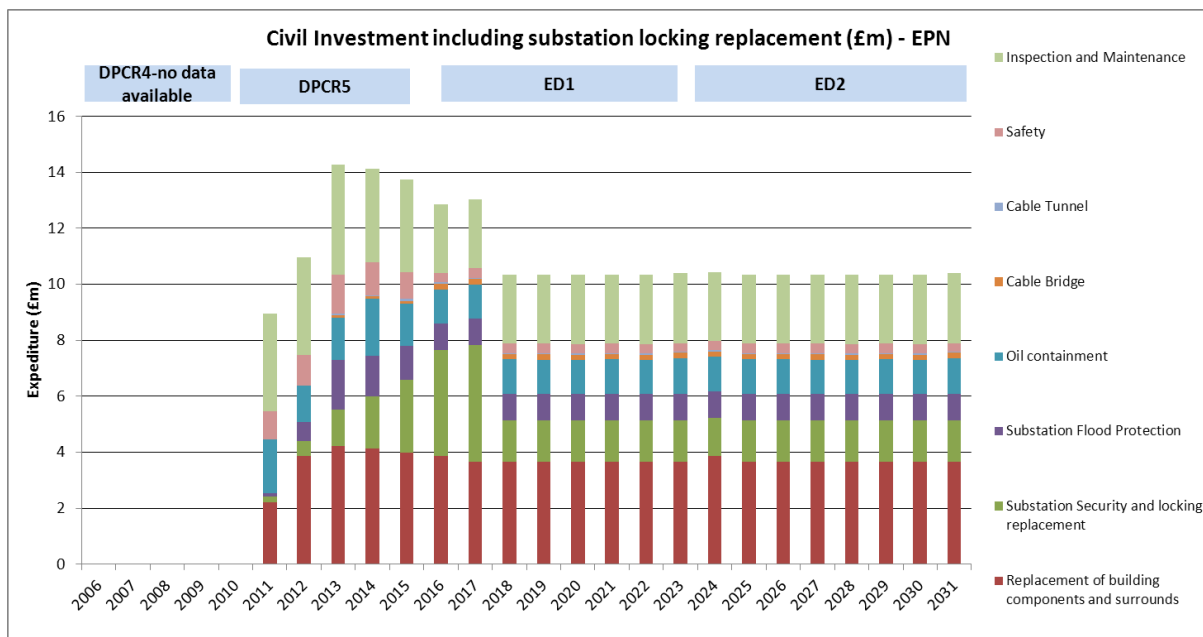


Figure 17 DPCR5 and ED1 expenditures (including locking replacement programme at distribution substation. See commentary below)

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

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 is £5.997m, of which £5.0m is the expenditure in ED1 and £0.997m in DPCR5.

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

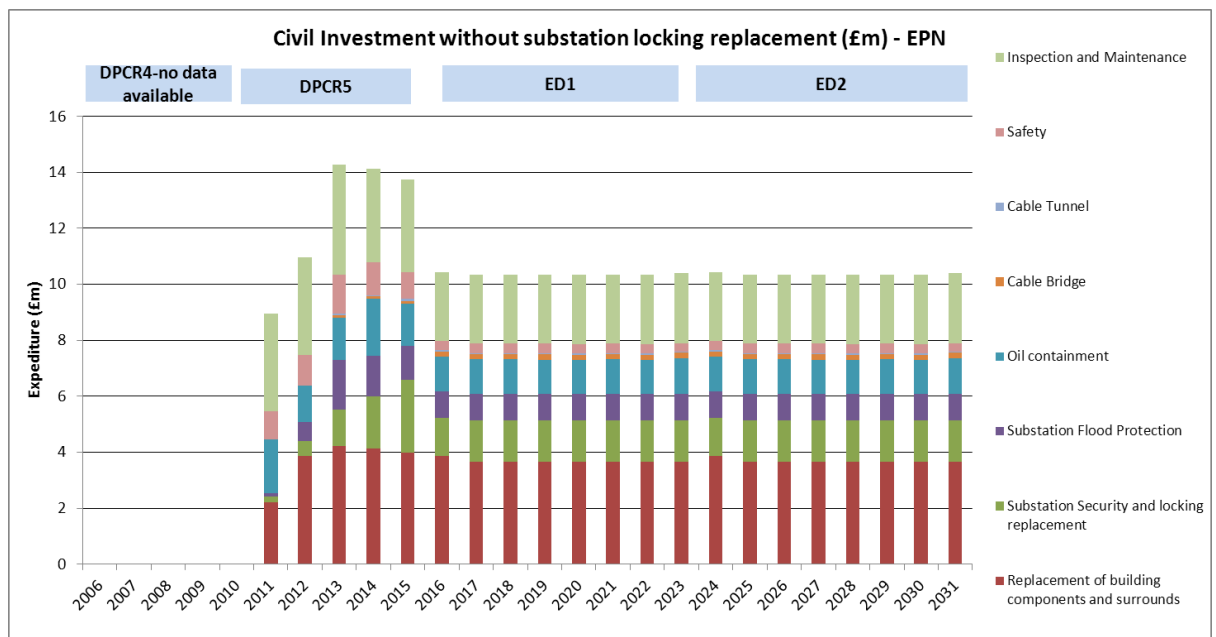


Figure 18 DPCR5 and ED1 expenditures without distribution substation locking replacement programme.

The increased expenditure at the end of DPCR5 is due to the completion of the following work programmes:

- Asbestos survey at distribution substation sites.
- Replace locking at grid and primary substations.
- Clean-up of oil contaminated sites to prevent external pollution.

7.5 Commentary

The proposed expenditure for some of the civil asset groups in ED1 are 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.

- Historical achievements show that we have been spending more than the original DPCR5 submission for the past few years of the DPCR5 period.

7.6 RIGS vs. ASR Volumes and Expenditure

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.

Output	NAMP Line	Asset Stewardship report		RIG table			Variance	Variance Explanation
		Total volume	Group total Volume	RIG Table	RIG Row	RIGS Volume		
Civil Enabling work at Grid and Primary sites	1.47.08					0	0	
Replacement of Distribution Substation Brick Surround	1.47.29.8020	488	2,736	CV6	11	4,352	1,616	Explanation 1
Replacement of Distribution Substation Surround (Non Brick)	1.47.30.8021	1,960						
Replacement of Dist S/S Gates	1.47.31.8022	288						
Distribution Substation Building - minor asset replacement	1.47.32.8331	63	4,174	CV6	8	4,174	0	
Distribution Substation Building - Rewire	1.47.36.8025	3,020						
Distribution Substation Building - Install New LV Service	1.47.38.8026	1,091						
Distribution Substation building - replace roof	1.47.33.8023	592	592	CV6	7	592	0	
Distribution Substation building - replace door	1.47.34.8024	680	680	CV6	6	680	0	
Grid/Primary - Replace roof	1.47.50.8027	136	1,128	CV6		1,100		Explanation

Grid/Primary - Replace heating	1.47.52.8028	67						2
Grid/Primary - Rewire	1.47.53.8029	32						
Grid/Primary - Replace compound floodlighting	1.47.54.8030	36						
Grid/Primary - Replace doors	1.47.55.8031	264			16		28	
Grid/Primary - Replace compound trench covers	1.47.58.8032	208			17			
Grid/Primary - internal refurbishment	1.47.59.6238	8						
Enhance grid and primary fencing	1.47.63.8034	260						
Substation Major Structure Replacement	1.47.64.8334	43			16			
Substation Pressure Relief - Explosion Vents	1.47.65.8336	40			17			
Welfare Facility Removal at Primary Substation	1.47.66	34			17			
Improve Grid and Primary Security	1.08.01.8005	376	376	CV8	7	551	175	Explanation
Installation of security system at Grid Substation	1.08.01	40						Explanation 4
Grid & Primary Substation Security Access System Installation	1.08.05.6207	190	380	CV8	8	406	26	
Installation of Security System at Primary Substation	1.08.05.8006	150						
Improve Distribution Security	1.08.02.8007	321						
Distribution Substation Lock Upgrade Installation	1.08.04.6498	7,463	7,784	CV8	6	7,798	14	Explanation 5
Removal of Asbestos	1.20.09.8012	1,767						
Asbestos Survey Distribution Sites - Outdoor	1.20.18	8,218	10,144	CV8	9	10,144	0	

Asbestos Survey - Remedial Work	2.33.18	160						
Grid Sub-station Fire Risk Assessment	1.20.43.6777	15	15	CV8	12	15	0	
Oil Containment at grid substations	1.30.01	40	304	CV12	9	160	144	
Oil Containment at primary substations	1.30.02	264						
Cleanup oil contaminated site to prevent external pollution	1.30.05.8016	80						
ED1 Cable tunnel refurbishment provision - EPN	1.47.02.5096	1	1	CV6	18	0		
EPN Cable Bridge Refurbishment	1.47.03.8329	8	8	CV6	19	8	0	
Substation Flooding (Grid)	1.47.61.8033	14	14	CV11	17	16	2	
Substation Flooding (Primary)	1.47.62.8035	24	24	CV11	11	20	-4	

Table 17 ASR and RIG volume comparison

Asset Name	NAMP Line	Asset Stewardship Report	RIG Table			Variance (£m)
		Total investment (£m)	RIGs Table	RIGs Row	Total Investment (£m)	
Replacement of Distribution Substation Brick Surround	1.47.29.8020	12.36	CV6	11	14.75	2.39
Replacement of Distribution Substation Surround (Non Brick)	1.47.30.8021					
Replacement of Distribution Substation gates	1.47.31.8022					
Distribution Substation Building - minor asset replacement	1.47.32.8331	3.43	CV6	8	3.43	0.00
Distribution Substation Building - Rewire	1.47.36.8025					
Distribution Substation Building - Install New LV Service	1.47.38.8026					
Distribution Substation building - replace roof	1.47.33.8023	2.45	CV6	7	2.45	0.00

Distribution Substation building - replace door	1.47.34.8024	1.68	CV6	6	1.68	0.00
Grid/Primary - Replace roof	1.47.50.8027	9.694	CV6	16 and 17	9.98	0.28
Grid/Primary - Replace heating	1.47.52.8028					
Grid/Primary - Rewire	1.47.53.8029					
Grid/Primary - Replace compound floodlighting	1.47.54.8030					
Grid/Primary - Replace doors	1.47.55.8031					
Grid/Primary - Replace compound trench covers	1.47.58.8032					
Grid/Primary - internal refurbishment	1.47.59.6238					
Enhance grid and primary fencing	1.47.63.8034					
Substation Major Structure Replacement	1.47.64.8334					
Substation Pressure Relief - Explosion Vents	1.47.65.8336					
Civil Enabling work at Grid and Primary sites	1.47.08					
Welfare Facility Removal at Primary Substation	1.47.66					
Improve Grid and Primary Security	1.08.01.8005	1.81	CV8	7	8.94	7.13
Installation of security system at Grid Substation	1.08.01	9.10	CV8	8	10.16	1.06
Grid & Primary Substation Security Access System Installation	1.08.05.6207					
Installation of Security System at Primary Substation	1.08.05.8006					
Improve Distribution Security	1.08.02.8007	5.83	CV8	6	6.27	0.44
Distribution Substation Lock Upgrade Installation	1.08.04.6498					
Removal of Asbestos	1.20.09.8012	2.72	CV8	9	2.72	0.00
Asbestos Survey Distribution Sites - Outdoor	1.20.18					
Asbestos Survey - Remedial Work	2.33.18					
Grid Sub-station Fire Risk Assessment	1.20.43.6777	0.01	CV8	12	0.01	0.00
Oil Containment at grid substations	1.30.01	9.39	CV12	9	9.39	0.00
Oil Containment at primary substations	1.30.02					
Cleanup oil contaminated site to prevent external pollution	1.30.05.8016	0.51	CV12	13	0.51	0.00

ED1 Cable tunnel refurbishment provision - EPN	1.47.02.5096	0.48	CV6	18	0.48	0.00
EPN Cable Bridge Refurbishment	1.47.03.8329	1.06	CV6	19	1.06	0.00
Substation Flooding (Grid)	1.47.61.8033	3.71	CV11	17	3.71	0.00
Substation Flooding (Primary)	1.47.62.8035	3.82	CV11	11	3.81	0

Table 18 ASR and RIG Expenditure comparison

The 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

1,616 volumes of Switchgear Weather Cover Installation and Replace Steel Kiosk S/S in Poor Condition have been mapped to RIG table CV6 row 11. This equates to £2.39m expenditure.

Explanation 2

8 project specific lines have been mapped RIG table CV6 row 16 which equates to £0.28m expenditure. These projects have a Civil works element which has been mapped to this line but the works are not Civil asset condition driven.

Explanation 3

175 project specific security related lines have been mapped to CV8 row 7 which equates to £7.15m. These works are driven by other asset replacement such as switchgear replacement, 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.

Explanation 4

26 project specific security related line have been mapped to CV8 row 8. This equates to an expenditure of £1.06m. These projects have a Security works element which has been mapped to this line but the works are not Security risk driven.

Explanation 5

14 project specific security related lines have been mapped to CV8 row 6. This equates to an expenditure of £0.44m. 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 civil assets across the entire network being considered under the substation building components and surrounds 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, the assets were distributed proportionally throughout the known build years.

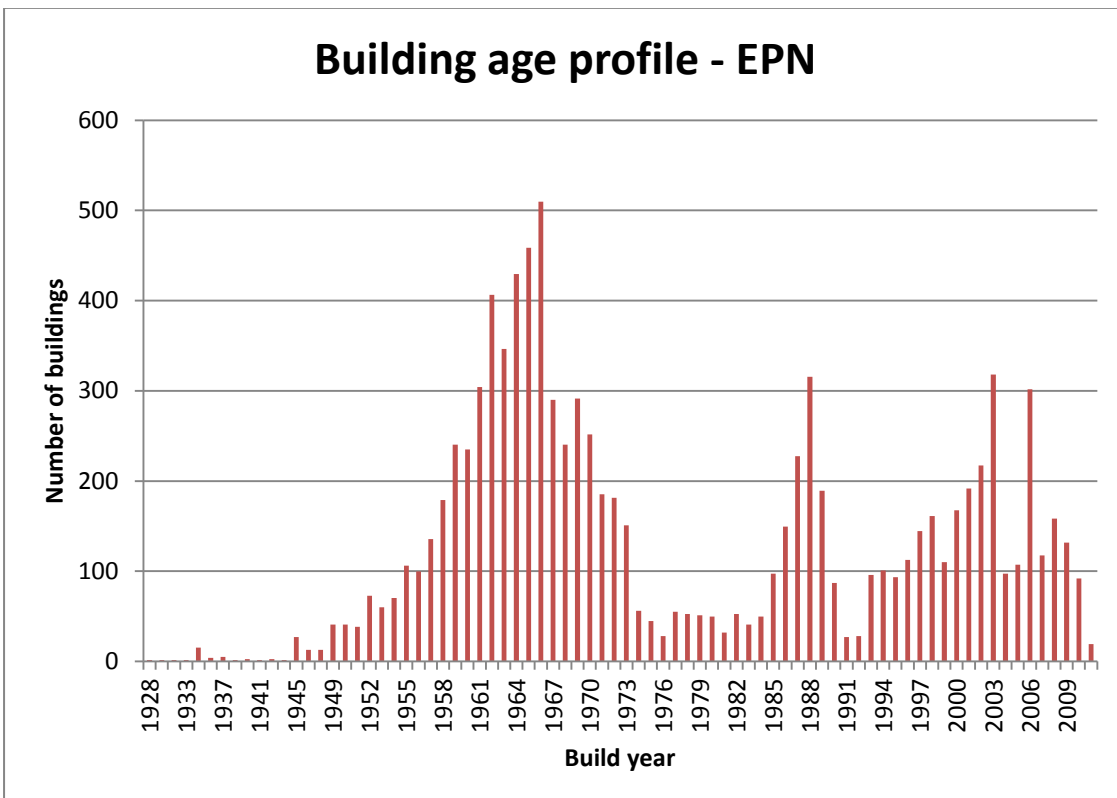
For example, only 67 out of the 32,447 building assets records contained the actual built year information. The build year information of an additional 24,418 building

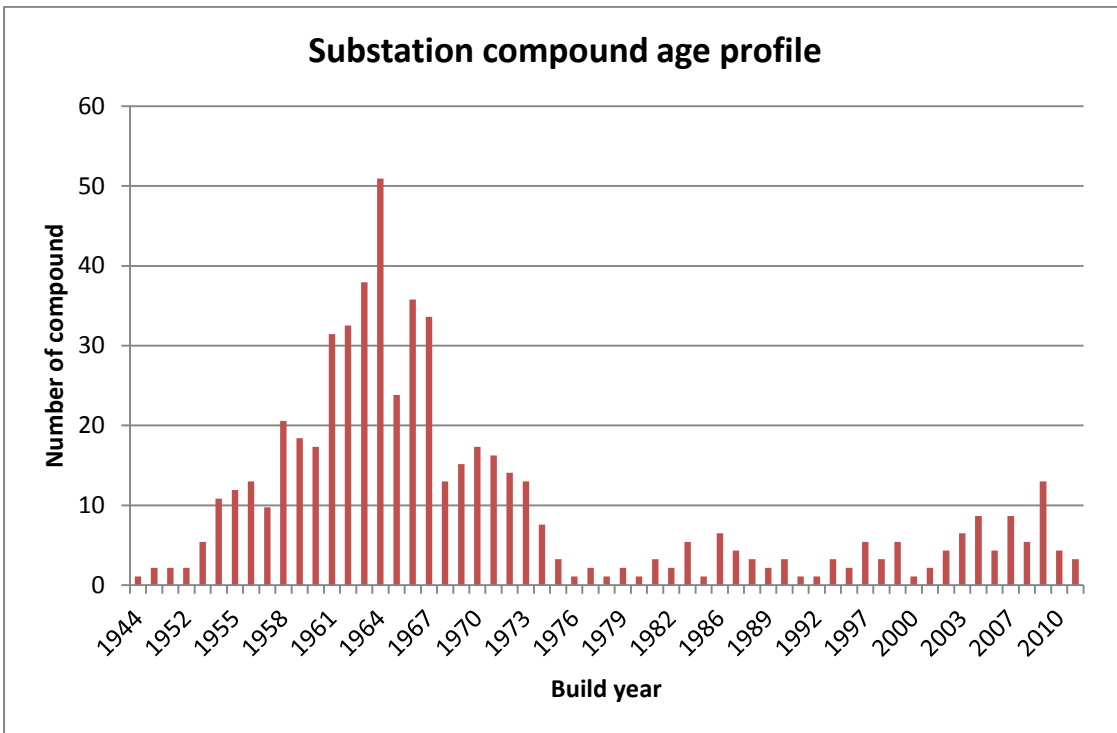
assets was determined using either the parent or child assets such as rooms and roofs. The remaining 8,023 building assets were distributed proportionally throughout the known build years.

Using this methodology we have determined a reasonable and effective asset age for 99.9% of our assets recorded in Ellipse.

The age analysis showed that a substantial number of assets were older than the design life proposed. 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 intervention strategy. Condition assessment and historic and current work rates have also been used to forecast the ED1 expenditures and volumes of civil assets.

For the purpose of this plan, the age profiles of buildings and enclosures are presented as shown in the graphs below.





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.

Appendix 5 Expenditure Plan

ED1 Volumes

S&R Table O- 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
1.08	1.08.01	8005	EPN	CP Hub 3 - East	Improve Grid and Primary Security	4,811	GWP	42	48	48	48	48	48	47	47
1.08	1.08.01	8433	EPN	CP Hub 3 - East	Installation of Security System at Grid Substation	68,366	GWP	5	5	5	5	5	5	5	5
1.08	1.08.02	8007	EPN	CP Hub 3 - East	Improve Distribution Security	2,257	GWP	34	41	41	41	41	41	41	41
1.08	1.08.04	6498	EPN	CP Hub 3 - East	Distribution Substation Lock Upgrade Installation	684	GWP	3,545	3,918	0	0	0	0	0	0
1.08	1.08.05	6207	EPN	CP Hub 3 - East	Grid & Primary Substation Security Access System Installation	8,397	GWP	24	24	24	24	23	24	23	24
1.08	1.08.05	8006	EPN	CP Hub 3 - East	Installation of Security System at Primary Substation	31,791	GWP	17	19	19	19	19	19	19	19
1.20	1.20.09	6566	EPN	CP Hub 3 - East	Removal of Asbestos	1,000	GWP	62	62	62	62	62	62	62	48
1.20	1.20.09	8012	EPN	CP Hub 3 - East	Removal of Asbestos	636	GWP	161	161	161	161	161	161	161	161
1.20	1.20.09	8462	EPN	CP Hub 3 - East	Manns Rd 33/11kV Primary - 11kV Switchboard Replacement (Asbestos Removal)	1	Major	0	0	0	0	0	0	0	0
1.20	1.20.18	6567	EPN	CP Hub 3 - East	Asbestos Survey Distribution Sites - Outdoor	165	GWP	1,060	1,061	1,061	1,061	1,060	1,060	1,060	795
1.20	1.20.43	6777	EPN	Asset Optimisation	Grid Substation Fire Risk Assessment	750	GWP	15	0	0	0	0	0	0	0
1.20	1.20.46	7087	EPN	Asset Optimisation	Grid Substation FRA Review EPN	122	GWP	0	0	0	0	0	0	0	0
1.20	1.20.47	9440	EPN	CP Hub 3 - East	Primary Substation FRA Review	122	GWP	0	0	0	0	0	0	0	0
1.20	1.20.49	6839	EPN	CP Hub 3 - East	Tunnel Fire Risk Assessment	107	GWP	0	0	0	0	0	0	0	0
1.30	1.30.01	9083	EPN	PD Hub 3 - East	Oil Containment at Grid Substations	66,871	GWP	5	5	5	5	5	5	5	6
1.30	1.30.02	9084	EPN	PD Hub 3 - East	Oil Containment at Primary Substations	25,186	GWP	33	33	33	33	33	33	33	33
1.30	1.30.05	8016	EPN	CP Hub 3 - East	Cleanup Oil Contaminated Site to Prevent External Pollution	6,358	GWP	10	10	10	10	10	10	10	10
1.47	1.47.02	5096	EPN	CP Hub 3 - East	ED1 Cable Tunnel Refurbishment Provision - EPN	159,183	GWP	1	0	1	0	1	0	0	0
1.47	1.47.03	8329	EPN	PD Hub 3 - East	EPN Cable Bridge Refurbishment	132,461	GWP	1	1	1	1	1	1	1	1
1.47	1.47.08	9141	EPN	CP Hub 3 - East	Civil Enabling Work at Grid and Primary Sites	1	Major	51,000	51,000	51,000	51,000	51,000	51,000	51,000	38,000
1.47	1.47.21	8783	EPN	CP Hub 3 - East	Enhance Primary Fencing	14,295	GWP	22	22	22	22	22	22	22	23
1.47	1.47.29	8020	EPN	CP Hub 3 - East	Replacement of Dist S/S Brick Surround	5,055	GWP	61	61	61	61	61	61	61	61
1.47	1.47.30	8021	EPN	CP Hub 3 - East	Replacement of Dist S/S Surround (Non Brick)	4,833	GWP	245	245	245	245	245	245	245	245
1.47	1.47.31	8022	EPN	CP Hub 3 - East	Replacement of Dist S/S Gates	1,458	GWP	36	36	36	36	36	36	36	36
1.47	1.47.32	8331	EPN	CP Hub 3 - East	Dist S/S Building - Minor Asset Replacement	456	GWP	5	5	5	5	5	5	5	28
1.47	1.47.33	8023	EPN	CP Hub 3 - East	Dist S/S Building - Replace Roof	4,133	GWP	74	74	74	74	74	74	74	74
1.47	1.47.34	8024	EPN	CP Hub 3 - East	Dist S/S Building - Replace Door	2,469	GWP	85	85	85	85	85	85	85	85
1.47	1.47.36	8025	EPN	CP Hub 3 - East	Dist S/stn Building - Rewire	827	GWP	380	379	379	379	379	379	379	366
1.47	1.47.38	8026	EPN	CP Hub 3 - East	Dist S/stn Building - Install New LV Service	833	GWP	140	140	140	140	140	140	140	111
1.47	1.47.39	8333	EPN	CP Hub 3 - East	Dist S/S - Replace Trench Covers	78	GWP	1	0	0	0	0	0	0	1
1.47	1.47.50	8027	EPN	CP Hub 3 - East	Grid - Replace Roof	14,094	GWP	5	5	5	5	5	5	5	5
1.47	1.47.50	8774	EPN	CP Hub 3 - East	Primary - Replace Roof	14,094	GWP	12	12	12	12	12	12	12	12
1.47	1.47.52	8028	EPN	CP Hub 3 - East	Grid - Replace Heating	5,299	GWP	3	3	3	3	3	3	3	3
1.47	1.47.52	8775	EPN	CP Hub 3 - East	Primary - Replace Heating	5,299	GWP	6	6	6	5	5	5	5	5
1.47	1.47.53	8029	EPN	CP Hub 3 - East	Grid - Rewire	46,855	GWP	1	1	1	1	1	1	1	1
1.47	1.47.53	8776	EPN	CP Hub 3 - East	Primary - Rewire	46,855	GWP	3	3	3	3	3	3	3	3
1.47	1.47.54	8030	EPN	CP Hub 3 - East	Grid - Replace Compound Floodlighting	5,299	GWP	1	1	1	1	1	2	2	2
1.47	1.47.54	8777	EPN	CP Hub 3 - East	Primary - Replace Compound Floodlighting	5,299	GWP	3	3	3	3	3	3	3	4
1.47	1.47.55	8031	EPN	CP Hub 3 - East	Grid - Replace Doors	2,469	GWP	11	11	11	11	11	11	11	11
1.47	1.47.55	8781	EPN	CP Hub 3 - East	Primary - Replace Doors	2,469	GWP	22	22	22	22	22	22	22	22
1.47	1.47.58	8032	EPN	CP Hub 3 - East	Grid - Replace Compound Trench Covers	773	GWP	8	8	8	8	8	8	8	8
1.47	1.47.58	8782	EPN	CP Hub 3 - East	Primary - Replace Compound Trench Covers	773	GWP	18	18	18	18	18	18	18	18

S&R Table O- 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
1.47	1.47.59	6238	EPN	PD Hub 3 - East	Primary - Internal Refurbishment	1,562	GWP	1	1	1	1	1	1	1	1
1.47	1.47.61	7082	EPN	PD Hub 3 - East	Rye House Grid - Flood Protection Work	1	Major	0	0	0	0	0	0	0	0
1.47	1.47.61	7083	EPN	PD Hub 3 - East	Hendon Grid - Flood Protection Work	1	Major	0	0	0	0	0	0	0	0
1.47	1.47.61	7107	EPN	PD Hub 3 - East	Peterborough Power Station Flooding	1	Major	0	0	0	0	0	0	0	0
1.47	1.47.61	8033	EPN	PD Hub 3 - East	Substation Flooding (Grid)	264,921	GWP	0	2	2	2	2	2	2	2
1.47	1.47.62	8035	EPN	PD Hub 3 - East	Substation Flooding (Primary)	158,953	GWP	3	3	3	3	3	3	3	3
1.47	1.47.63	8034	EPN	CP Hub 3 - East	Enhance Grid Fencing	14,295	GWP	11	11	10	10	10	10	10	11
1.47	1.47.64	8334	EPN	PD Hub 3 - East	Substation Major Structure Replacement	7,569	GWP	5	5	5	5	5	5	5	8
1.47	1.47.65	8336	EPN	PD Hub 3 - East	Substation Pressure Relief - Explosion Vents	7,289	GWP	5	5	5	5	5	5	5	5
1.47	1.47.67	6978	EPN	CO Hub 3 - East	Welfare Facility Installation at Primary Substation	21,194	GWP	0	0	0	0	0	0	0	0
2.36	2.36.04	6252	EPN	CO Hub 3 - East	Welfare Facility Removal at Primary Substation	5,299	GWP	34	0	0	0	0	0	0	0
2.30	2.30.13	6441	EPN	CO Hub 3 - East	Cable Bridge Inspections	135	GWP	62	62	62	62	62	62	62	62
2.30	2.30.14	6444	EPN	CO Hub 3 - East	Cable Tunnel Inspections	107	GWP	8	5	5	5	5	5	5	5
2.30	2.30.21	8040	EPN	CO Hub 3 - East	Building, Tunnel and Bridge Survey	107	GWP	12	12	12	11	11	11	11	13
2.30	2.30.22	6827	EPN	CO Hub 3 - East	PAT Testing at Grid & Primary Substations	286	GWP	7	4	4	4	4	4	7	4
2.30	2.30.23	8042	EPN	CO Hub 3 - East	Water Quality Testing at Grid & Primary Substations	286	GWP	565	565	565	565	565	565	565	565
2.30	2.30.23	8984	EPN	CO Hub 3 - East	Water Quality Testing (Primary Sites)	286	GWP	1,025	1,025	1,025	1,025	1,025	1,025	1,025	1,025
2.34	2.34.07	9341	EPN	CO Hub 3 - East	Abandoned/Unidentified Cable Location	19	GWP	18	18	18	18	18	18	18	18
2.34	2.34.08	9699	EPN	CO Hub 3 - East	Noise Complaint Investigations by Operations	286	GWP	2	2	2	2	2	2	2	2
2.32	2.32.02	8043	EPN	CO Hub 3 - East	Graffiti Removal (was Veg Clearance)	1,650	GWP	86	86	86	86	86	86	86	86
2.32	2.32.03	9328	EPN	CO Hub 3 - East	Maintain Grid Sites & Building - 132kV	1,650	GWP	304	304	304	304	304	304	304	304
2.32	2.32.04	9329	EPN	CO Hub 3 - East	Maintain Primary Sites & Building - 33kV	450	GWP	221	221	221	220	220	220	220	205
2.32	2.32.05	9330	EPN	CO Hub 3 - East	Maintain Distribution Sites & Building - 11kV	78	GWP	604	620	620	620	620	620	620	620
2.32	2.32.06	9331	EPN	CO Hub 3 - East	Vegetation Clearance - 132kV	1,650	GWP	107	107	107	107	106	106	106	114
2.32	2.32.07	9332	EPN	CO Hub 3 - East	Vegetation Clearance - 33kV	650	GWP	450	450	450	450	450	450	450	450
2.32	2.32.08	9333	EPN	CO Hub 3 - East	Vegetation Clearance - 11kV	15	GWP	36,138	36,138	36,138	36,138	36,138	36,138	36,138	36,137
2.32	2.32.12	6926	EPN	CO Hub 3 - East	Maintain Fixed Fire Protection Equipment	650	GWP	5	5	5	5	5	5	5	5
2.32	2.32.15	6250	EPN	CO Hub 3 - East	Tree Trimming (Distribution Sites)	78	GWP	1,346	1,346	1,346	1,346	1,346	1,346	1,346	1,346
2.32	2.32.15	8683	EPN	PD Hub 3 - East	Tree Trimming (Primary Sites)	650	GWP	489	489	489	489	489	489	489	489
2.32	2.32.15	8684	EPN	PD Hub 3 - East	Tree trimming (Grid Sites)	1,650	GWP	165	165	165	165	165	165	165	165
2.32	2.32.16	6924	EPN	CO Hub 3 - East	Maintain Portable Fire Protection Equipment	650	GWP	68	68	68	68	68	68	68	68
2.32	2.32.17	8044	EPN	CO Hub 3 - East	Cable Tunnel Maintenance	5,299	GWP	3	3	3	3	3	3	3	3
2.32	2.32.18	8045	EPN	CO Hub 3 - East	Cable Bridge Maintenance - EPN	1,220	GWP	34	34	34	34	34	34	34	34
2.33	2.33.02	8046	EPN	CO Hub 3 - East	Defect Repair - Secondary Substation Civils	78	GWP	1,000	1,008	1,020	1,028	1,040	1,048	1,060	1,072
2.33	2.33.03	6251	EPN	CO Hub 3 - East	Defect Repair - Grid Substation Civils	1,650	GWP	92	94	95	96	96	97	98	99
2.33	2.33.06	8047	EPN	CO Hub 3 - East	132&33kV Fly Tipping Site Clearance	1,650	GWP	13	13	13	13	13	13	13	13
2.33	2.33.17	8048	EPN	CO Hub 3 - East	Pumping Out Flooded Substations	650	GWP	13	13	13	13	13	13	13	13
2.33	2.33.18	6877	EPN	CO Hub 3 - East	Asbestos Survey - Remedial Work	394	GWP	20	20	20	20	20	20	20	20
2.33	2.33.19	6843	EPN	CO Hub 3 - East	Water Testing - Remedial Works	286	GWP	98	84	84	84	84	84	84	84
2.33	2.33.20	6878	EPN	CO Hub 3 - East	Fire Risk Assessment - Remedial Work	1,650	GWP	404	420	420	420	420	420	420	420
2.33	2.33.21	6844	EPN	CO Hub 3 - East	Portable Appliance Removal	1,650	GWP	0	0	0	0	0	0	0	0
2.33	2.33.22	8049	EPN	CO Hub 3 - East	Electrical Wiring - Defect Repair at Grids	1,650	GWP	184	187	187	185	191	192	195	196
2.33	2.33.24	7076	EPN	CO Hub 3 - East	Electrical Wiring - Defect Repair at Secondary Substations	78	GWP	133	134	136	137	138	132	119	142
2.33	2.33.25	8456	EPN	CO Hub 3 - East	Drainage Inspection & Maintenance	151	GWP	4	4	4	4	4	4	4	4
2.34	2.34.16	8159	EPN	CO Hub 3 - East	Demolish Abandoned/Unsafe Buildings	78	GWP	1	1	1	0	0	0	0	1

ED1 Expenditure

SR Table J S&R - Baseline Final ED1 Re-submission_19th February 2014_15:15															
GWPID	NAMP Line	Project ID	Operational Unit	DNO	Description	Project Type	Budget Type	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
1.08	1.08.01	8005	CP Hub 3 - East	EPN	Improve Grid and Primary Security	GWP	Capex	202,070	230,937	230,937	230,937	230,937	230,937	226,125	226,125
1.08	1.08.01	8433	CP Hub 3 - East	EPN	Installation of Security System at Grid Substation	GWP	Capex	341,830	341,830	341,830	341,830	341,830	341,830	341,830	341,830
1.08	1.08.02	8007	CP Hub 3 - East	EPN	Improve Distribution Security	GWP	Capex	76,742	92,542	92,542	92,542	92,542	92,542	92,542	92,542
1.08	1.08.04	6498	CP Hub 3 - East	EPN	Distribution Substation Lock Upgrade Installation	GWP	Capex	2,423,603	2,678,611	0	0	0	0	0	0
1.08	1.08.05	6207	CP Hub 3 - East	EPN	Grid & Primary Substation Security Access System Installation	GWP	Capex	201,527	201,527	201,527	201,527	193,130	201,527	193,130	201,527
1.08	1.08.05	8006	CP Hub 3 - East	EPN	Installation of Security System at Primary Substation	GWP	Capex	540,440	604,021	604,021	604,021	604,021	604,021	604,021	604,021
1.20	1.20.09	6566	CP Hub 3 - East	EPN	Removal of Asbestos	GWP	Capex	62,016	62,016	62,016	62,016	62,016	62,016	62,016	48,013
1.20	1.20.09	8012	CP Hub 3 - East	EPN	Removal of Asbestos	GWP	Capex	102,349	102,031	102,031	102,031	102,031	102,031	102,031	102,031
1.20	1.20.18	6567	CP Hub 3 - East	EPN	Asbestos Survey Distribution Sites - Outdoor	GWP	Capex	174,900	175,065	175,065	175,065	174,900	174,900	174,900	131,175
1.20	1.20.43	6777	Asset Optimisation	EPN	Grid Substation Fire Risk Assessment	GWP	Capex	11,250	0	0	0	0	0	0	0
1.20	1.20.46	7087	Asset Optimisation	EPN	Grid Substation FRA Review EPN	GWP	Capex	0	0	0	0	0	0	0	0
1.20	1.20.47	9440	CP Hub 3 - East	EPN	Primary Substation FRA Review	GWP	Capex	0	0	0	0	0	0	0	0
1.20	1.20.49	6839	CP Hub 3 - East	EPN	Tunnel Fire Risk Assessment	GWP	Capex	0	0	0	0	0	0	0	0
1.30	1.30.01	9083	PD Hub 3 - East	EPN	Oil Containment at Grid Substations	GWP	Capex	334,354	334,354	334,354	334,354	334,354	334,354	334,354	401,225
1.30	1.30.02	9084	PD Hub 3 - East	EPN	Oil Containment at Primary Substations	GWP	Capex	831,137	831,137	831,137	831,137	831,137	831,137	831,137	831,137
1.30	1.30.05	8016	CP Hub 3 - East	EPN	Cleanup Oil Contaminated Site to Prevent External Pollution	GWP	Capex	63,581	63,581	63,581	63,581	63,581	63,581	63,581	63,581
1.47	1.47.02	5096	CP Hub 3 - East	EPN	ED1 Cable Tunnel Refurbishment Provision - EPN	GWP	Capex	159,183	0	159,183	0	159,183	0	0	0
1.47	1.47.03	8329	PD Hub 3 - East	EPN	EPN Cable Bridge Refurbishment	GWP	Capex	132,461	132,461	132,461	132,461	132,461	132,461	132,461	132,461
1.47	1.47.08	9141	CP Hub 3 - East	EPN	Civil Enabling Work at Grid and Primary Sites	Major	Capex	51,000	51,000	51,000	51,000	51,000	51,000	51,000	38,000
1.47	1.47.21	8783	CP Hub 3 - East	EPN	Enhance Primary Fencing	GWP	Capex	314,485	314,485	314,485	314,485	314,485	314,485	314,485	328,780
1.47	1.47.29	8020	CP Hub 3 - East	EPN	Replacement of Dist S/S Brick Surround	GWP	Capex	308,359	308,359	308,359	308,359	308,359	308,359	308,359	308,359
1.47	1.47.30	8021	CP Hub 3 - East	EPN	Replacement of Dist S/S Surround (Non Brick)	GWP	Capex	1,183,989	1,183,989	1,183,989	1,183,989	1,183,989	1,183,989	1,183,989	1,183,989
1.47	1.47.31	8022	CP Hub 3 - East	EPN	Replacement of Dist S/S Gates	GWP	Capex	52,493	52,493	52,493	52,493	52,493	52,493	52,493	52,493
1.47	1.47.32	8331	CP Hub 3 - East	EPN	Dist S/S Building - Minor Asset Replacement	GWP	Capex	2,281	2,281	2,281	2,281	2,281	2,281	2,281	12,771
1.47	1.47.33	8023	CP Hub 3 - East	EPN	Dist S/S Building - Replace Roof	GWP	Capex	305,814	305,814	305,814	305,814	305,814	305,814	305,814	305,814
1.47	1.47.34	8024	CP Hub 3 - East	EPN	Dist S/S Building - Replace Door	GWP	Capex	209,896	209,896	209,896	209,896	209,896	209,896	209,896	209,896
1.47	1.47.36	8025	CP Hub 3 - East	EPN	Dist S/stn Building - Rewire	GWP	Capex	314,078	313,251	313,251	313,251	313,251	313,251	313,251	302,506
1.47	1.47.38	8026	CP Hub 3 - East	EPN	Dist S/stn Building - Install New LV Service	GWP	Capex	116,571	116,571	116,571	116,571	116,571	116,571	116,571	92,424
1.47	1.47.39	8333	CP Hub 3 - East	EPN	Dist S/S - Replace Trench Covers	GWP	Capex	78	0	0	0	0	0	0	78
1.47	1.47.50	8027	CP Hub 3 - East	EPN	Grid - Replace Roof	GWP	Capex	70,469	70,469	70,469	70,469	70,469	70,469	70,469	70,469
1.47	1.47.50	8774	CP Hub 3 - East	EPN	Primary - Replace Roof	GWP	Capex	169,125	169,125	169,125	169,125	169,125	169,125	169,125	169,125
1.47	1.47.52	8028	CP Hub 3 - East	EPN	Grid - Replace Heating	GWP	Capex	15,897	15,897	15,897	15,897	15,897	15,897	15,897	15,897
1.47	1.47.52	8775	CP Hub 3 - East	EPN	Primary - Replace Heating	GWP	Capex	31,794	31,794	31,794	26,495	26,495	26,495	26,495	26,495
1.47	1.47.53	8029	CP Hub 3 - East	EPN	Grid - Rewire	GWP	Capex	46,855	46,855	46,855	46,855	46,855	46,855	46,855	46,855
1.47	1.47.53	8776	CP Hub 3 - East	EPN	Primary - Rewire	GWP	Capex	140,564	140,564	140,564	140,564	140,564	140,564	140,564	140,564
1.47	1.47.54	8030	CP Hub 3 - East	EPN	Grid - Replace Compound Floodlighting	GWP	Capex	5,299	5,299	5,299	5,299	5,299	10,598	10,598	10,598
1.47	1.47.54	8777	CP Hub 3 - East	EPN	Primary - Replace Compound Floodlighting	GWP	Capex	15,897	15,897	15,897	15,897	15,897	15,897	15,897	21,196
1.47	1.47.55	8031	CP Hub 3 - East	EPN	Grid - Replace Doors	GWP	Capex	27,163	27,163	27,163	27,163	27,163	27,163	27,163	27,163
1.47	1.47.55	8781	CP Hub 3 - East	EPN	Primary - Replace Doors	GWP	Capex	54,326	54,326	54,326	54,326	54,326	54,326	54,326	54,326
1.47	1.47.58	8032	CP Hub 3 - East	EPN	Grid - Replace Compound Trench Covers	GWP	Capex	6,188	6,188	6,188	6,188	6,188	6,188	6,188	6,188

SR Table J															
S&R - Baseline Final ED1 Re-submission_19th February 2014_15:15															
GWPID	NAMP Line	Project ID	Operational Unit	DNO	Description	Project Type	Budget Type	2015/2016	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023
1.47	1.47.58	8782	CP Hub 3 - East	EPN	Primary - Replace Compound Trench Covers	GWP	Capex	13,922	13,922	13,922	13,922	13,922	13,922	13,922	13,922
1.47	1.47.59	6238	PD Hub 3 - East	EPN	Primary - Internal Refurbishment	GWP	Capex	1,562	1,562	1,562	1,562	1,562	1,562	1,562	1,562
1.47	1.47.61	8033	PD Hub 3 - East	EPN	Substation Flooding (Grid)	GWP	Capex	0	529,843	529,843	529,843	529,843	529,843	529,843	529,843
1.47	1.47.62	8035	PD Hub 3 - East	EPN	Substation Flooding (Primary)	GWP	Capex	476,858	476,858	476,858	476,858	476,858	476,858	476,858	476,858
1.47	1.47.63	8034	CP Hub 3 - East	EPN	Enhance Grid Fencing	GWP	Capex	157,243	157,243	142,948	142,948	142,948	142,948	142,948	157,243
1.47	1.47.64	8334	PD Hub 3 - East	EPN	Substation Major Structure Replacement	GWP	Capex	37,847	37,847	37,847	37,847	37,847	37,847	37,847	60,555
1.47	1.47.65	8336	PD Hub 3 - East	EPN	Substation Pressure Relief - Explosion Vents	GWP	Capex	36,444	36,444	36,444	36,444	36,444	36,444	36,444	36,444
1.47	1.47.67	6978	CO Hub 3 - East	EPN	Welfare Facility Installation at Primary Substation	GWP	Capex	0	0	0	0	0	0	0	0
2.36	2.36.04	6252	CO Hub 3 - East	EPN	Welfare Facility Removal at Primary Substation	GWP	Capex	180,164	0	0	0	0	0	0	0
2.30	2.30.11	9912	CO Hub 3 - East	EPN	Grid and Primary Earthing Inspection	GWP	Opex	193,559	193,559	193,559	193,559	193,559	193,559	193,559	193,559
2.30	2.30.13	6441	CO Hub 3 - East	EPN	Cable Bridge Inspections	GWP	Opex	8,400	8,400	8,400	8,400	8,400	8,400	8,400	8,400
2.30	2.30.14	6444	CO Hub 3 - East	EPN	Cable Tunnel Inspections	GWP	Opex	858	536	536	536	536	536	536	536
2.30	2.30.21	8040	CO Hub 3 - East	EPN	Building, Tunnel and Bridge Survey	GWP	Opex	1,287	1,287	1,287	1,180	1,180	1,180	1,180	1,394
2.30	2.30.22	6827	CO Hub 3 - East	EPN	PAT Testing at Grid & Primary Substations	GWP	Opex	2,004	1,145	1,145	1,145	1,145	1,145	2,004	1,145
2.30	2.30.23	8042	CO Hub 3 - East	EPN	Water Quality Testing at Grid & Primary Substations	GWP	Opex	161,776	161,776	161,776	161,776	161,776	161,776	161,776	161,776
2.30	2.30.23	8984	CO Hub 3 - East	EPN	Water Quality Testing (Primary Sites)	GWP	Opex	293,488	293,488	293,488	293,488	293,488	293,488	293,488	293,488
2.32	2.32.02	8043	CO Hub 3 - East	EPN	Graffiti Removal (was Veg Clearance)	GWP	Opex	141,900	141,900	141,900	141,900	141,900	141,900	141,900	141,900
2.32	2.32.03	9328	CO Hub 3 - East	EPN	Maintain Grid Sites & Building - 132kV	GWP	Opex	501,600	501,600	501,600	501,600	501,600	501,600	501,600	501,600
2.32	2.32.04	9329	CO Hub 3 - East	EPN	Maintain Primary Sites & Building - 33kV	GWP	Opex	99,450	99,450	99,450	99,000	99,000	99,000	99,000	92,250
2.32	2.32.05	9330	CO Hub 3 - East	EPN	Maintain Distribution Sites & Building - 11kV	GWP	Opex	47,040	48,286	48,286	48,286	48,286	48,286	48,286	48,286
2.32	2.32.06	9331	CO Hub 3 - East	EPN	Vegetation Clearance - 132kV	GWP	Opex	176,550	176,550	176,550	176,550	174,900	174,900	174,900	188,100
2.32	2.32.07	9332	CO Hub 3 - East	EPN	Vegetation Clearance - 33kV	GWP	Opex	292,500	292,500	292,500	292,500	292,500	292,500	292,500	292,500
2.32	2.32.08	9333	CO Hub 3 - East	EPN	Vegetation Clearance - 11kV	GWP	Opex	542,070	542,070	542,070	542,070	542,070	542,070	542,070	542,055
2.32	2.32.12	6926	CO Hub 3 - East	EPN	Maintain Fixed Fire Protection Equipment	GWP	Opex	3,250	3,250	3,250	3,250	3,250	3,250	3,250	3,250
2.32	2.32.15	6250	CO Hub 3 - East	EPN	Tree Trimming (Distribution Sites)	GWP	Opex	104,826	104,826	104,826	104,826	104,826	104,826	104,826	104,826
2.32	2.32.15	8683	PD Hub 3 - East	EPN	Tree Trimming (Primary Sites)	GWP	Opex	317,850	317,850	317,850	317,850	317,850	317,850	317,850	317,850
2.32	2.32.15	8684	PD Hub 3 - East	EPN	Tree trimming (Grid Sites)	GWP	Opex	272,250	272,250	272,250	272,250	272,250	272,250	272,250	272,250
2.32	2.32.16	6924	CO Hub 3 - East	EPN	Maintain Portable Fire Protection Equipment	GWP	Opex	44,200	44,200	44,200	44,200	44,200	44,200	44,200	44,200
2.32	2.32.17	8044	CO Hub 3 - East	EPN	Cable Tunnel Maintenance	GWP	Opex	15,897	15,897	15,897	15,897	15,897	15,897	15,897	15,897
2.32	2.32.18	8045	CO Hub 3 - East	EPN	Cable Bridge Maintenance - EPN	GWP	Opex	41,479	41,479	41,479	41,479	41,479	41,479	41,479	41,479
2.33	2.33.02	8046	CO Hub 3 - East	EPN	Defect Repair - Secondary Substation Civils	GWP	Opex	77,880	78,503	79,438	80,061	80,995	81,618	82,553	83,487
2.33	2.33.03	6251	CO Hub 3 - East	EPN	Defect Repair - Grid Substation Civils	GWP	Opex	151,800	155,100	156,750	158,400	158,400	160,050	161,700	163,350
2.33	2.33.06	8047	CO Hub 3 - East	EPN	132&33kV Fly Tipping Site Clearance	GWP	Opex	21,450	21,450	21,450	21,450	21,450	21,450	21,450	21,450
2.33	2.33.17	8048	CO Hub 3 - East	EPN	Pumping Out Flooded Substations	GWP	Opex	8,450	8,450	8,450	8,450	8,450	8,450	8,450	8,450
2.33	2.33.18	6877	CO Hub 3 - East	EPN	Asbestos Survey - Remedial Work	GWP	Opex	7,877	7,877	7,877	7,877	7,877	7,877	7,877	7,877
2.33	2.33.19	6843	CO Hub 3 - East	EPN	Water Testing - Remedial Works	GWP	Opex	28,060	24,052	24,052	24,052	24,052	24,052	24,052	24,052
2.33	2.33.20	6878	CO Hub 3 - East	EPN	Fire Risk Assessment - Remedial Work	GWP	Opex	666,600	693,000	693,000	693,000	693,000	693,000	693,000	693,000
2.33	2.33.21	6844	CO Hub 3 - East	EPN	Portable Appliance Removal	GWP	Opex	0	0	0	0	0	0	0	0
2.33	2.33.22	8049	CO Hub 3 - East	EPN	Electrical Wiring - Defect Repair at Grids	GWP	Opex	303,600	308,550	308,550	305,250	315,150	316,800	321,750	323,400
2.33	2.33.24	7076	CO Hub 3 - East	EPN	Electrical Wiring - Defect Repair at Secondary Substations	GWP	Opex	10,358	10,436	10,592	10,670	10,747	10,280	9,268	11,059
2.33	2.33.25	8456	CO Hub 3 - East	EPN	Drainage Inspection & Maintenance	GWP	Opex	605	605	605	605	609	605	605	605
2.34	2.34.16	8159	CO Hub 3 - East	EPN	Demolish Abandoned/Unsafe Buildings	GWP	Opex	40	40	40	38	37	37	37	44
2.34	2.34.17	7088	CO Hub 3 - East	EPN	Temporary Ballistic Screening	Major	Opex	0	0	0	0	0	0	0	0

Appendix 6- Sensitivity Analysis

Not applicable.

Appendix 7- Named Schemes

Not applicable.