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10 October 2014

Dear Chris

ED1 Link box strategy

Following the trilateral meeting between your team, the H.S.E and UKPN on the 6 October we would like to provide the additional information UKPN committed to provide with regards to the revision to our ED1 link box strategy. We believe this was a very helpful meeting that clarified the current situation and Ofgem's expectations.

The attached appendix provides the further information and CBA sensitivities raised in our meeting on 6 October, in particular:

- Explanation of our modelled fault rate, showing that the forecast we have used represents a prudent view of the likely increase if we were not to increase the number of interventions
- Explanation of the evidence supporting our modelled VSI and risk of injury/fatality
- A set of sensitivity studies that show that our proposed investment increase produces positive economic benefits when subject to significant changes.

Since the development of the asset replacement strategy (condition based) for link boxes contained within the March 2014 business plan resubmission we have seen a continued increase in the number of link box failures. This has included a number of high profile incidents that have been widely reported in the national media. In our ongoing discussions with the HSE on this issue we have been advised that they expect to see a reduction in the number of incidents on our network. We have developed a number of scenarios of replacement strategies based upon the latest data. In summary we have proposed to you that we need to move to aged based replacement strategy of all medium and low risk link boxes older than 70 years in ED1. We are also proposing to replace all very high and high risk link boxes older than 50 years in ED1. This amounts to the replacement of an additional 15,800 link boxes compared to our ED1 business plan, an increase in the level of inspections and installation of protective fire blankets. In combination this amounts to a further expenditure in ED1 of £95 million and is represented by "Scenario 5".

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Our analysis, supported by the HSE, shows that this scenario is the minimum investment required, and presents the scenario with the greatest residual risk. Scenario 5 does not include any allowance for condition driven replacements or replacements required due to a fault. The volumes being requested are purely derived from a risk based age replacement study. If we were to include an assessment for condition driven and faulted link boxes, the numbers would increase significantly. This scenario contains a significantly lower level of work than the HSE first advised they would expect to see in ED1.

We have assessed the CI and CML impact across UKPN and the impact is negligable. Using an aveage of 47 customers affected per failure and 250 minutes average restoration per failure, the impact of 800 failures across UKPN would cause less than 0.01CI CIs (Interruptions per 100 connected customers) and less than 0.03 CML (minutes lost per connected customer).

We welcome the flexibility and support of Ofgem in reviewing the revised scenarios, supporting information and cost benefit analysis in a very timely manner.

I hope this summary is helpful and we look forward to further meeting with your team early next to review our proposal further. If you have any further immediate questions please do not hesitate to contact me on 020 7397 7715

Yours sincerely

Keith Hutton
Head of Regulation, UK Power Networks

Cc
Barry Hatton, UKPN
Ben Wilson, UKPN
Richard Wakelen, UKPN
Paul Branston, Ofgem

Attachment: CBA sensitivity files

Appendix

Analysis has been carried out to assess the impact that different linkbox replacement rates during RIIO-ED1 will have on the failure rate. Six different scenarios have been considered in addition to the baseline RIIO-ED1 replacement plan. The variables in each of the scenarios are replacement age, and the risk rating of the linkbox, which is split into four categories, low, medium, high, and very high. Each of the 6 scenarios is described in table 1.

	Replacement age for each risk rating			
Scenario	Low	Medium	High	Very High
1	50	50	50	50
2	60	60	50	50
2a	65	65	50	50
3	65	65	55	55
4	70	70	60	60
5	70	70	50	50

Table 1 - Scenarios

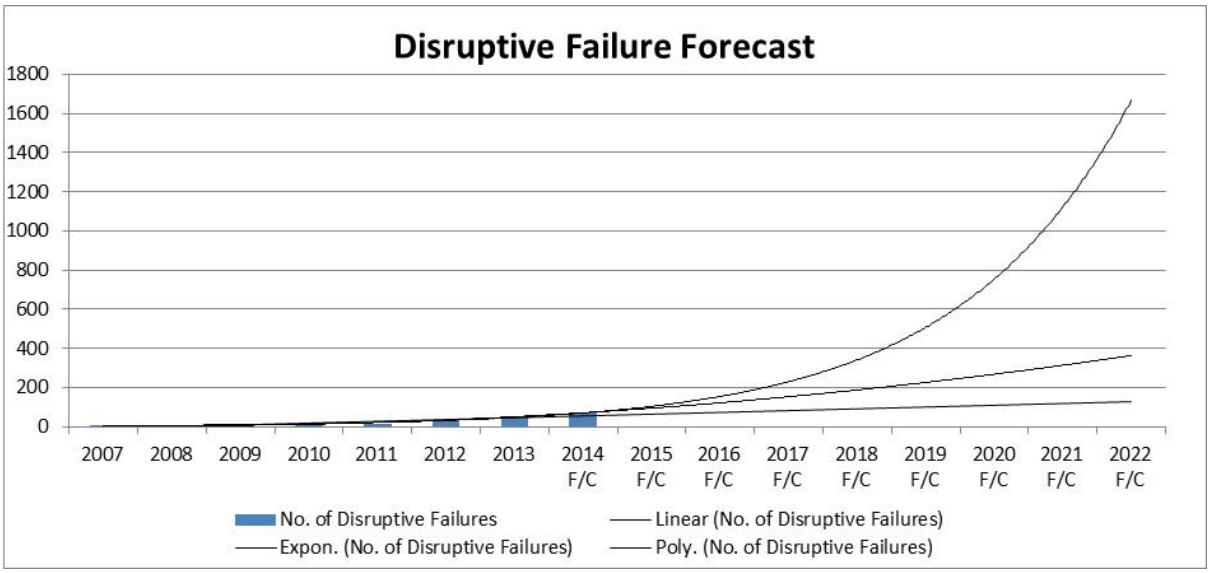
A CBA using the OFGEM model has then been done on each of the scenarios with the submitted RIIO-ED1 plan used as the baseline. The failure rate, as described below, has been used as a key input as well as the number of incidents per Very Serious Incident (VSI), probability of a injury following a VSI, and the probability of a fatality following a VSI. The reduction expected in CI and CMLs with each of scenarios has also been factored in using the average number of customer interrupted following a failure and the average duration they are off supply for. The analysis shows that the preferred option, scenario 5, has a positive NPV for customers after 45 years with the assumptions described below.

To verify that the scenario is still beneficial for customers if the expected number of failures is reduced, sensitivity analysis has been undertaken by varying the number of disruptive failures, the number of incidents per VSI, the probability of injury per VSI, and the probability of fatality per VSI, in the baseline and each of the six scenarios that have been considered. The full results are summarised in table 2.

From the sensitivity analysis it has been determined that a reduction of 37% in the volumes of disruptive failures is required to move the CBA of our preferred option (scenario 5) to become NPV neutral. Similarly an increase in the number of incidents per VSI from 20 to 33 or a reduction in the probability of a fatality to 18% also means that scenario 5 is also NPV neutral.
The failure rate used in our baseline CBA has been based on the 48 disruptive failures in that have occurred in 2014 (January – September). Two of these failures have been very serious incidents (VSI) (Caledonian Road in March 2014 and Piccadilly in July 2014). From this data it is can be derived that 20 failures = 1 VSI. The predicted failures for 2014 calendar year is 72 which equates to three VSI's.

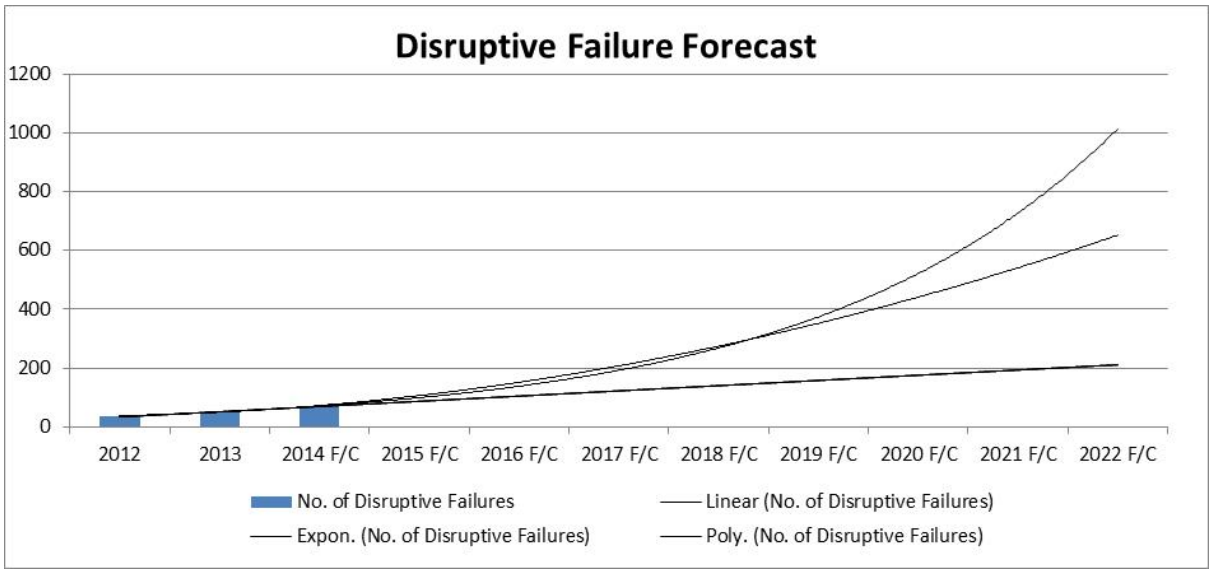
Using the actual disruptive failure rate data set for link boxes experienced during 2012 to 2014 we have created forecast using linear, polynomial and exponential growth rates. The results of which are indicated in the graph below.

The exponential growth forecast is supported by the curve experienced within the linkbox age profile which is indicated in the diagram below. Initially this analysis was undertaken using data from 2007 to 2014. This analysis produces the following results



Maximum exponential value of 1700
Maximum linear value of 120
Mid point value of (1700-120)/2+120 =910

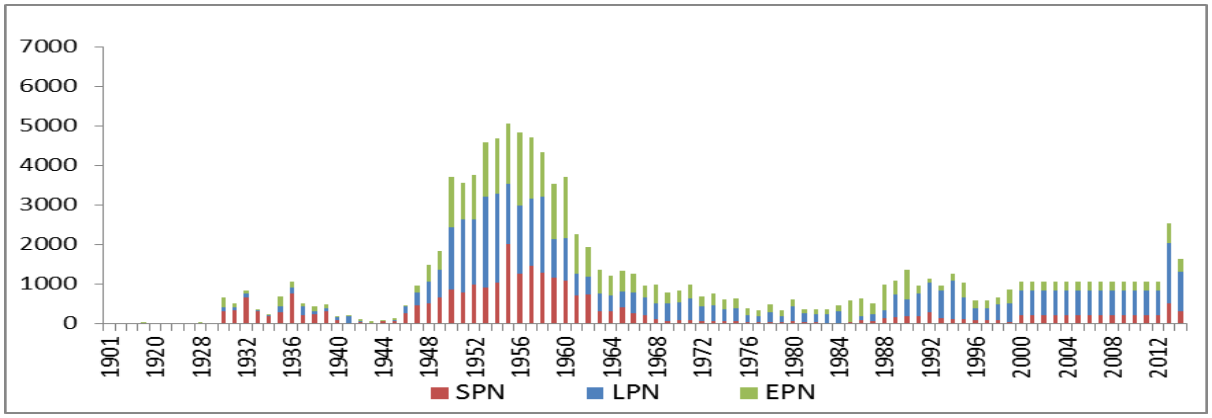
Similar analysis was then undertaken on the data set from 2012 to 2014, and is represented in the graph below.



This analysis produces the following results
Maximum exponential value of 1000
Maximum linear value of 200
Mid point value of (1000-200)/2+200 =600

The mid point of the two graphs is 755, which we have rounded up to 800 and undertaken sensitivity analysis around this base value.

Linkbox age profile



Analysis of disruptive failures indicates the probability of failure increases significantly between 50 and 60 years of age, which corresponds to Link boxes installed between 1964 and 1954. The increased probability of failure rate correlates to an increasing age profile and coincides with the peak of installations during the 50's and 60's. The increasing probability of failure relates to the well-established asset management technique for predicting asset failure known as the "P – F" curve which forecast the future timing of when an asset has potential to fail and the increasing probability to fail as the asset deteriorates.

The three elements listed below supports the use of an exponential forecast in disruptive failures.

- The forecast of existing disruptive failures using an exponential function.
- The significant of Link boxes installed in the 50's and 60's and significant associated probability of failure
- The well-established asset management approach of the P-F curve and the "bath tub" deterioration curve, both widely used approaches in asset management.

The exponential forecast indicates a figure of 1600 disruptive failures; however we have taken a conservative approach of 800, as an initial sensitivity to our analysis.

			Group 1				Group 2		Group 3		Group 4				Group 5		
	Description	45 year base NPV	Sensitivity 1	Sensitivity 2	Sensitivity 3	Sensitivity 4	Sensitivity 5	Sensitivity 6	Sensitivity 7	Sensitivity 8	Sensitivity 9	Sensitivity 10	Sensitivity 11	Sensitivity 12	Sensitivity 13	Sensitivity 14	Sensitivity 15
Factors	Number of Failures Sensitivity	100%	**150%**	**50%**	**120%**	**80%**	100%	100%	100%	100%	100%	100%	100%	100%	**63%**	100%	100%
	Incidents/VSI	20	20	20	20	20	**22**	**18**	20	20	20	20	20	20	20	**32.85**	20
	Probability of injury per VSI	75%	75%	75%	75%	75%	75%	75%	**82.5%**	**67.5%**	75%	75%	75%	75%	75%	75%	75%
	Probability of fatality per VSI	30%	30%	30%	30%	30%	30%	30%	30%	30%	**27%**	**33%**	**24%**	**36%**	30%	30%	**17.81%**
Scenario 1	Replace all Link boxes older than 50 years old.	-£121.43	-£34.75	-£208.12	-£86.76	-£156.10	-£136.10	-£103.50	-£120.83	-£122.03	-£136.96	-£105.90	-£152.50	-£90.36	-£184.79	-£184.55	-£184.55
Scenario 2	Replace VH & H over 50; M & L over 60	-£83.62	£2.01	-£169.26	-£49.37	-£117.88	-£98.11	-£65.91	-£83.03	-£84.22	-£98.97	-£68.28	-£114.32	-£52.93	-£146.22	-£145.99	-£145.99
Scenario 2a	Replace VH & H over 50; M & L over 65	-£26.50	£56.66	-£109.66	£6.76	-£59.76	-£40.57	-£9.30	-£25.92	-£27.07	-£41.40	-£11.60	-£56.30	£3.31	-£87.28	-£87.06	-£87.06
Scenario 3	Replace VH & H 55; L & M over 65	-£22.26	£60.80	-£105.33	£10.96	-£55.49	-£36.32	-£5.09	-£21.69	-£22.84	-£37.15	-£7.38	-£52.03	£7.51	-£82.98	-£82.75	-£82.75
Scenario 4	Replace VH & H over 60; L & M over 70	£66.14	£145.32	-£13.05	£97.81	£34.46	£52.68	£82.58	£66.69	£65.59	£51.89	£80.38	£37.64	£94.63	£8.25	£8.24	£8.24
Scenario 5	Replace VH & H over 50; L & M over 70	£58.11	£137.62	-£21.39	£89.92	£26.31	£44.61	£74.62	£58.67	£57.56	£43.81	£72.42	£29.51	£86.72	£0.00	-£0.00	-£0.00

Table 2 : Summary of Sensitivities