SP Proposed Method For Determining Marginal Costs

Demand

Step 1. For each Network Group, undertake P2/6 analysis to identify which circuits/ transformers are overloaded in outage conditions, to determine the maximum current capacity of the group (excluding the contribution of distributed generation). Determine the cost of reinforcement and the additional headroom the reinforcement provides. This is determined for demand increases of c.40% greater than the current maximum demand and may involve a series of reinforcements.

NETWORK PLANNING INFORMATION		
Demand		
Demand when 1st Reinforcement Required	60,000	kVA
Projected Cost of 1st Reinforcement	1,730	k
Additional Headroom provided by 1st Reinforcement	20,000	kVA
Projected Cost of 2nd Reinforcement	0	k
Additional Headroom provided by 2nd Reinforcement	0	kVA
Projected Cost of 3rd Reinforcement	0	k
Additional Headroom provided by 3rd Reinforcement	0	kVA
Projected Cost of 4th Reinforcement	0	k
Additional Headroom provided by 4th Reinforcement	0	kVA

Step 2. Identify time periods for costing:-

Period 1	Winter WeekDay Peak	16:00 – 19:00	(Nov – Feb)
Period 2	Winter WeekDay Day	07:00 – 16:00, 19:00 – 24:00	(Nov – Feb)
Period 3	Winter Weekend Day	07:00 – 24:00	(Nov – Feb)
Period 4	Summer Day	07:00 – 24:00	(Mar – Oct)
Period 5	Night	00:00 – 07:00	(All Year)

Step 3. Obtain from network loadings the maximum demand for each time period.

DEMAND INFORMATION		
Maximum Demand - Period 1	50,800	kVA
Maximum Demand - Period 2	42,160	kVA
Maximum Demand - Period 3	37,000	kVA
Maximum Demand - Period 4	30,990	kVA
Maximum Demand - Period 5	34,540	kVA

Step 4. Determine the annuitised value of each reinforcement using forecast asset lives and discount rates. Divide by the additional capacity provided by the reinforcement.

COST INFORMATION		
Discount Rate	6.9%	
Asset Life	40	years
Reinforcement 1	£6.41	/kVA/annum
Reinforcement 2	£0.00	/kVA/annum
Reinforcement 3	£0.00	/kVA/annum
Reinforcement 4	£0.00	/kVA/annum

Step 5. Determine the annuitised MEA value of the refurbishment of the existing network (likely to exclude cable costs as these are rarely refurbished). Divide by the capacity of the existing network to determine the £/kVA.

COST INFORMATION		
Refurbish MEAV	£9,082	k
Discount Rate	6.9%	
Asset Life	40	years
Refurbishment	£11.22	/kVA/annum

Step 6. Calculate the annual projected growth rate from the information provided in the Long Term Development Statement and, where appropriate specific customer data.

	Transformer Details			Firm		Maximum Demand (MW)					
Substation	No.	MCR/ ER (MVA)*	Ratio	Capacity (MVA)	Power Factor	Actual 04/05	Predicted 05/06	06/07	07/08	08/09	09/10
	2	5	33/11	5	0.97	3	3	3.1	3.1	3.1	3.2
	2	24	33/11	24	0.97	15.8	16	16.1	16.3	16.4	16.6
	1	10	33/11	10	0.97	2.3	2.3	2.3	2.4	2.4	2.4
	2	10	33/11	10	0.97	6.8	6.9	6.9	7	7.1	7.1
	2	10	33/11	10	0.97	6.5	6.6	6.6	6.7	6.8	6.8
	2	21	33/11	21	0.97	9.1	9.2	9.3	9.4	9.5	9.6
	2	10	33/11	10	0.99	4	4	4.1	4.1	4.2	4.2
	2	10	33/11	10	0.98	6.6	6.7	6.7	6.8	6.9	6.9
	2	5	33/11	5	0.97	3	3	3.1	3.1	3.1	3.2

Customer Data

Substation	Capacity (MVA)	Power Factor	Actual 04/05	Predicted 05/06	06/07	07/08	08/09	09/10
	0	0.97	0	0	0	0	0	0

												Annual
PROJECTED LOAD GROWTH						57.1	57.7	58.2	58.9	59.5	60	1.0%

Step 7. Calculate the time to each reinforcement for each time period using the formula. If the result is negative then it is set to zero.

$$\text{years} = \frac{\log(\text{Capacity}) - \log(\text{Demand})}{\log(1 + \text{Growth Rate\%})}$$

	Time to Each Reinforcement (years)			
	Reinf 1	Reinf 2	Reinf 3	Reinf 4
Period 1	16.7	45.6	45.6	45.6
Period 2	35.5	64.4	64.4	64.4
Period 3	48.6	77.5	77.5	77.5
Period 4	66.4	95.3	95.3	95.3
Period 5	55.5	84.4	84.4	84.4

If Growth Rate% is less than or equal to zero and the Demand is greater than the Capacity then years equals zero.

If Growth Rate% is less than or equal to zero and the Demand is less than the Capacity then years is infinite.

Step 8. Calculate the present value of each reinforcement in £/kVA and for each time period.

$$\text{Present Value} = \frac{\text{Reinforcement Cost (£/kVA)}}{(1 + \text{Discount Rate\%})^{\text{years to reinforce}}}$$

If the years to reinforce is infinite then the Present Value is zero.

Step 9. Calculate the total cost for each time period by adding the costs of each reinforcement.

DEMAND COSTS					
Present Value of Reinforcement (£k)					
	Reinf 1	Reinf 2	Reinf 3	Reinf 4	Total
Period 1	£2.10	£0.00	£0.00	£0.00	£2.10
Period 2	£0.60	£0.00	£0.00	£0.00	£0.60
Period 3	£0.25	£0.00	£0.00	£0.00	£0.25
Period 4	£0.08	£0.00	£0.00	£0.00	£0.08
Period 5	£0.16	£0.00	£0.00	£0.00	£0.16

Step 10. Add the cost of refurbishment calculated in Step 5 to the cost of the time period with the highest demand.

DEMAND COSTS						Refurb Cost	Total Cost
Present Value of Reinforcement (£k)							
	Reinf 1	Reinf 2	Reinf 3	Reinf 4	Total	£/kVA	£/kVA
Period 1	£2.10	£0.00	£0.00	£0.00	£2.10	£11.22	£13.32
Period 2	£0.60	£0.00	£0.00	£0.00	£0.60	£0.00	£0.60
Period 3	£0.25	£0.00	£0.00	£0.00	£0.25	£0.00	£0.25
Period 4	£0.08	£0.00	£0.00	£0.00	£0.08	£0.00	£0.08
Period 5	£0.16	£0.00	£0.00	£0.00	£0.16	£0.00	£0.16

[In addition it is probably appropriate to add the annuitised cost of any reinforcement undertaken in the past five years into the period with the highest maximum demand. This will avoid prices dropping immediately after reinforcement has been undertaken which would reduce the impact of the pricing signal.]

Generation

Step 11. Determine the key network parameters for generation in the Network Group; the maximum reverse power rating of the group; the P2/6 contribution factor for the generation that is likely to connect into the group; the maximum additional generation that can be connected before reinforcement is required; the cost of the generation reinforcement and the additional generation that can be connected as a result of the reinforcement.

NETWORK PLANNING INFORMATION		
Generation		
Maximum Reverse Power Rating	30,000	kVA
P2/ 6 Generation Contribution Factor	30%	
Maximum additional generation without Reinforcement	0	kVA
Cost of Generation Reinforcement	1,200	k
Additional Generation Headroom provided by Generation Reinforcement	30,000	kVA

Step 12. Calculate the annuitised generation reinforcement cost using the Cost of the generation reinforcement, the discount rate and asset life. Divide by the sum of the maximum generation that can be added without reinforcement and the headroom provided by the reinforcement to determine the cost per kVA.

Annuitised Generation Reinforcement Cost

Maximum Additional Generation without Reinforcement	+	Additional Generation Headroom provided by Reinforcement

COST INFORMATION		
Discount Rate	6.9%	
Asset Life	40	years
Generation	£2.97	/kVA/annum

Step 13. Determine key network loading information. The minimum demand on the network, the maximum demand without generation connected; the maximum generation that can be connected. This is calculated as:-

Maximum Generation = Maximum Reverse Power Rating + Minimum Demand.

Calculate the contribution to network security by multiplying the Maximum Generation by the P2/6 Contribution Factor.

DEMAND INFORMATION		
Minimum Demand	10,000	kVA

Maximum Demand Without Generation	50,800
Maximum Generation in Group	40,000
Contribution to Network Security Under P2/6	12,000

Step 14. Calculate the time to each reinforcement with and without the generation contribution using the following formulae. If the result is negative then it is set to zero.

$$\text{years} = \frac{\log(\text{Capacity}) - \log(\text{Demand})}{\log(1 + \text{Growth Rate\%})}$$

$$\text{years} = \frac{\log(\text{Capacity}) - \log(\text{Demand} - \text{Generation Contribution})}{\log(1 + \text{Growth Rate\%})}$$

If Growth Rate% is less than or equal to zero and the Demand minus the Generation Contribution is greater than the Capacity then years equals zero.

If Growth Rate% is less than or equal to zero and the Demand minus the Generation Contribution is less than the Capacity then years is infinite.

GENERATION COSTS				
	Time to Each Reinforcement (years)			
	Reinf 1	Reinf 2	Reinf 3	Reinf 4
Without	16.7	45.6	45.6	45.6
With	43.8	72.7	72.7	72.7

Step 15. Calculate the present value of each reinforcement in £/kVA, with and without the generation connected. The generation benefit (in £/kVA) is the difference in these two values multiplied by the P2/6 contribution factor.

$$\text{Present Value Without generation} = \frac{\text{Reinforcement Cost (£/kVA)}}{(1 + \text{Discount Rate\%})^{\text{years to reinforce}}}$$

$$\text{Present Value With generation} = \frac{\text{Reinforcement Cost (£/kVA)}}{(1 + \text{Discount Rate\%})^{\text{years to reinforce with generation}}}$$

GENERATION COSTS						
	Present Value of Reinforcement (£k)					
	Reinf 1	Reinf 2	Reinf 3	Reinf 4	Total	£/ kVA
Without	£2.10	£0.00	£0.00	£0.00	£2.10	£/ kVA
With	£0.34	£0.00	£0.00	£0.00	£0.34	£/ kVA
Generation Benefit					-£0.53	£/ kVA

If the years to reinforce is infinite then the Present Value is zero.

Step 16. Deduct the generation benefit from the generation cost to determine the total generation cost per kVA. If the result is negative then it is set to zero.

GENERATION COSTS		
Generation Benefit	-£0.53	£/ kVA
Generation Cost	£2.97	£/ kVA
Net Generation Cost	£2.44	£/ kVA