CMP375 Workgroup 2 slides

Sept 2021

nationalgridESO

Current EC data received

This is captured under STCP 14-1 Appendix C - https://www.nationalgrideso.com/document/41076/download

Appendix C: Expansion Constant Tables

Expansion Constants OHL

Cost of Construction (£/km)

Voltage	Tower Type	Conductor & count	Temp	Route MVA (winter)	£(000)/km Double Circuit	Cct Length (km) <10 Yrs old	Notes
400kV	L12	2 x 700mm AAAC	75°C	5040	£600	170	
275kV	L66	2 x 300mm AAAC	65°C	1350	£410	30	
132kV	L7	1 x 300mm AAAC	75°C	482	£350	0	

Assumptions

1. Costs are estimated costs per km of new overhead lines assuming a normal route of 30km or more in length with 70 percent of towers of the suspension type
2. Rating is as per TGN26, winter post-fault. Note it is ROUTE, ie 2* circuit rating.
3. Assume no road, motorway, dual carriageway, railway, powerline or canal crossings.
4. Assume no requirement for extra height towers.
5. Exclude land costs
6. Exclude bay costs

Note: Data is example data

Expansion Constants OTHER

Supplementary data:

Q1 What is the average asset life for your OHL and Cable routes? **50 years OHL & Cables**

Q2 Please populate the following table:

132kV

Summary	Total 132kV cct km	Total 132kV due to be uprated to (as per SYS) 400kV	275kV
SPT	1,803	0	0
SHETL	3,290	1,021	0

New 275kV GB table

Summary	Total 275kV cct km	Total 275kV capable of being uprated to 400kV
SPT	1,711	1,540
SHETL	1,562	1,206

Expansion Constants CABLE

Cost of Construction (£/km)

Voltage	Cables equivalent to double circuit overhead line construction type	Route MVA (winter)	£(000)/km RURAL	£(000)/km URBAN	Cable Sealing End (Both)	Notes
400kV	1320MVA Double Cct	2640	£2,100	N/A	£1,400	
275kV	1320MVA Double Cct	2640	£1,700	N/A	£1,200	
132kV	1 x 630mm Cu	160	£250	£1,000	£420	

Assumptions

1. Cable ratings have assumed to correspond to the post-fault continuous winter rating of the equivalent overhead line
2. Route profiles have been taken to be reasonably flat and requiring only one stop-joint bay per 2km
3. Cable sealing end costs include test charges and other fixed items such as oil tanks, link pillars and boxes
4. Joint costs include link boxes/pillars and associated bonding leads, structures and foundations and stop joins costs include for oil tanks
5. Cable costs include joints at the normal maximum drum length interval for the size of cable, plus auxiliary cables, bonding leads and associated contractors engineering and design costs
6. For cable installations where it is necessary to adopt forced cooling to meet the specified power transmission rating, the route interval between cooling stations has assumed to be 2km and the estimates include system pipe work, pumping and heat exchanger equipment, associated sundries, also civil and land costs for the cooling stations
7. Ignore costs of minor works such as diversion of services and obtaining consents over public and private property.
8. Assume no railway or river crossings
9. Assume no SF6 cable sealing ends
10. Assume XLPE cable for 132kV
11. Excludes bay costs

Note: Data is example data

Current EC calc methodology

From 14.15.63

400kV OHL expansion constant calculation					
MW	Type	£(000)/k	Circuit km*	£/MWkm	Weight
A	B	C	D	E = C/A	F=E*D
6500	La	700	500	107.69	53846
6500	Lb	780	0	120.00	0
3500	La/b	600	200	171.43	34286
3600	Lc	400	300	111.11	33333
4000	Lc/a	450	1100	112.50	123750
5000	Ld	500	300	100.00	30000
5400	Ld/a	550	100	101.85	10185
Sum			**2500 (G)**		**285400 (H)**
				Weighted Average (J= H/G):	**114.160 (J)**

Example data

14.15.64 The weighted average £/MWkm (J in the example above) is then converted in to an annual figure by multiplying it by an annuity factor. The formula used to calculate of the annuity factor is shown below

$$Annuityfac\,tor = \frac{1}{\left[\frac{\left(1-\left(1+WACC\right)^{-AssetLife}\right)}{WACC}\right]}$$

14.15.66 The final step in calculating the expansion constant is to add a share of the annual transmission overheads (maintenance, rates etc). This is done by multiplying the average weighted cost (J) by an 'overhead factor'. The 'overhead factor' represents the total business overhead in any year divided by the total Gross Asset Value (GAV) of the transmission system.

400kV OHL expansion constant calculation	Ave £/MWkm
OHL	114.160
Annuitised @ 6.6%	7.535
Overhead @ 1.8%	2.055
Final	**9.589**

RIIO-2 Annuity and Overhead Factors

	Parameters
Asset Life (years)	50
Annuity Factor (%)	4.25%
Overhead Factor (%)	1.55%

Expansion Constant and Expansion Factors - 2019/20 (example)

Table 1.1: TNUoS Calculation Parameters

Parameter	Value/Basis
Transport model network, nodal generation & nodal demand data	Based upon various data sources as defined in Section 14 of the Connection and Use of System Code (CUSC)
Expansion constant	£14.552251 /MWkm
Annuity factor	5.8%
Overhead factor	1.8%
Locational onshore security factor	1.8

Table 1.2: Onshore Wider Cable and Overhead Line (OHL) Expansion Factors

TO Region	Cable Expansion Factor			OHL Expansion Factor		
	400kV	275kV	132kV	400kV	275kV	132kV
Scottish Hydro Electric Transmission Ltd	10.20	11.45	20.77	1.00	1.20	2.59
SP Transmission Ltd	10.20	11.45	22.58	1.00	1.20	2.87
National Grid Electricity Transmission plc	10.20	11.45	22.58	1.00	1.20	2.87

Table 1.3 Onshore Local Expansion Factors (All TO Regions)

2dp	400kV	275kV	132kV			
			Single Circuit <200MVA	Double Circuit <200MVA	Single Circuit >=200MVA	Double Circuit >=200MVA
Cable Expansion Factor	10.20	11.45	22.58	22.58	22.58	22.58
OHL Expansion Factor	1.00	1.20	10.33	8.388	5.912	3.950

Extracts from The Statement of Use of System Charges, effective 1 April 2019

Transmission Reinforcement Option Summary

The below table summarises the types of reinforcement undertaken on the transmission network and how they could impact on the EC (and EF) calculations

Type	Description	Examples	Current EC Methodology?	Creates MW capacity	Includes Km
New circuit build	Construction of a new circuit	Brand New 400kV circuit	Y	Y	Y
Circuit Reinforcement	Reusing existing towers but reinforcing conductor	Reconductoring, hot wiring, circuit rebuild	N	Y	Y
New non-circuit build	Build of new assets not linked to a circuit	New substations and associated assets	N	Y	N
Substation reinforcement	Replacement or enhancement of assets at substations	Transformer/CB replacement, forced cooling	N	Y	N
'SMART' reinforcement	Works to allow increased network utilisation.	Intertrips, ANM	N	N	N
Life extension	Works to keep existing assets in use for longer than originally intended	Transformer/asset refurbishments	N	N	N
Non-thermal solutions	Reinforcement to solve a non-thermal constraint (e.g. fault level) allowing access to MW capacity as a secondary benefit	Circuit Breaker replacement, voltage pathfinders	N	N	N

CMP375 Original Option(s)

We have provided two ‘Original’ options to reflect a ‘big’ and ‘small’ change to the Expansion Constant

Option A – ‘Big’ change

Overview – Fundamentally change the scope of works included in the calculation of the EC so that any works which affect the 400kV OHL network are included in the calculation of the EC. This principle would then be applied to the calculation of the EFs.

Scope of Works – All works which affect the 400kV OHL network

Data included – 5 years historic data plus data submitted as part of the latest NOA update.

Data ESO receives as part of NOA is listed in Appendix B of the NOA methodology (https://www.nationalgrideso.com/document/204196/download) and includes TO proposed options and expected Costs

Refresh timescales – As today, the EC would be recalculated (i.e. data gathered in time for) the start of each price control with these costs index linked (CPI) each year within the price control.

Option B – ‘Small’ change

Overview – This is designed to be a minimal enduring change to the EC calculation that will ensure it is always possible to perform the calculation.

We would directly (or commission a consultant to) ask a minimum of 3 manufacturers to provide the cost of individual components which are needed for a 400kV OHL build and other components needed to calculate the Expansion Factors.

Scope of Works – No change from today (New build 400kV OHL in EC, other asset types for EFs)

Data included – Prospective data (i.e. not actual or forecast project cost data).

Refresh timescales – As today, the EC would be recalculated (i.e. data gathered in time for) the start of each price control with these costs index linked (CPI) each year within the price control.