ELECTRICAL RETICULATION

CITY OF CAPE TOWN TECHNICAL STANDARDS: CTEF100

	Description Load Estimation	City of Cape Town Standards	Applicable
1.	Residential	NRS 034-1:2001 Table 3 as amended (attached [1])	
	Voltage Regulation Calculation Method	NRS 034-1:2001 [2]	
	Voltage Regulation: LV Feeder	8% (attached [3])	
	Voltage Regulation: Service Connection	2% (attached [3])	
	Voltage Regulation: Street Lighting	mercury vapour: 10%; high pressure sodium vapour: 7%; metal halide: 5%	
	Commercial	80 VA/m²	
	Light Industrial	40 VA/m²	
	Industrial	100 VA/m²	
	Heavy Industrial	apdr	
	Primary Schools	70 kVA	
	Secondary Schools	100 kVA	
	Churches	25 kVA	
	Clinics / Crèches	25 kVA	
	Garage / Service Station	70 kVA	
	Circuit Breaker Size: Informal Housing	40 A 1Φ	
	Circuit Breaker Size: Low Cost Housing	40 A 1Φ	
	Circuit Breaker Size: Middle Income Housing	60/80 A 1Φ	
	Circuit Breaker Size: Luxury Housing	60/80 A 1Φ / 40/60/80/100 A 3Φ	

Notes:
- All guidelines indicate typical minimum requirements
- apdr - as per developer requirements
- VA/m² - unit refers to leasible floor area

[1] *Appendix A:* The attached Standard NRS 034-1 Tables 3a (Appendix A2) and 3b (Appendix A3) are included for reference purposes only. The load parameters and customer load classes for City of Cape Town usage are shown in the CoCT Modified Table 3 (Appendix A1).

[2] Herman-Beta method

[3] *Appendix B:* The attached schedules depict the assumptions behind these percentages for the standard MV voltages of 11 660 V (Appendix B1) and 11 500 V (Appendix B2) respectively. The 8%:2% split for LV feeder and service connection is arbitrary - as long as the total voltage regulation from the LV terminal of the transformer to the customer does not exceed 10%.

2. **APPENDIX A1: NRS 034-1 Table 3 - Typical Design Load Parameters for Domestic Customers**

FOR CITY OF CAPE TOWN USAGE

1 Single Phase Loads

Current Type			Load Parameters - 7 years							Load Parameters - 15 years						
Customer Load Class	SU LSM Class	Average Income (Gross R/month)	α	ß	c	ADMD (kVA)	μ (A)	σ (A)	Var (A^2)	α	ß	c	ADMD (kVA)	μ (A)	σ (A)	Var (A^2)
Informal Settlement	LSM 3 & 4	1 318 / 1 724	0,74	5,34	40	1,13	4,87	4,92	24,2	0,87	4,61	40	1,46	6,33	5,73	32,9
Township Area	LSM 5 & 6	2 421 / 3 897	-	-	-	-	-	-	-	0,98	2,41	40	2,66	11,54	8,65	74,8
Urban Residential I	LSM 7	5 859	-	-	-	-	-	-	-	1,22	2,96	60	4,04	17,48	11,98	143,5
Urban Residential II	LSM 8 & 9	8 053 / 10 732	-	-	-	-	-	-	-	1,05	1,70	60	5,31	22,98	15,06	226,8
Urban Upmarket I	LSM 10	15 931	-	-	-	-	-	-	-	0,94	1,25	60	5,96	25,80	16,64	276,9
2 Three Phase Loads (per phase)																
Urban Upmarket I	LSM 10	15 931	-	-	-	-	-	-	-	0,41	1,51	40	1,99	8,60	9,61	92,3
Urban Upmarket I	LSM 10	15 931	-	-	-	-	-	-	-	0,54	3,25	60	1,99	8,60	9,61	92,3
Urban Upmarket II	> LSM 10	> 15 931	-	-	-	-	-	-	-	0,32	0,81	40	2,65	11,47	12,39	153,5
Urban Upmarket II	> LSM 10	> 15 931	-	-	-	-	-	-	-	0,50	2,12	60	2,65	11,47	12,39	153,5
Urban Upmarket II	> LSM 10	> 15 931	-	-	-	-	-	-	-	0,59	3,53	80	2,65	11,47	12,39	153,5
Urban Upmarket II	> LSM 10	> 15 931	-	-	-	-	-	-	-	0,64	4,97	100	2,65	11,47	12,39	153,5

Assumptions:

Escalation factor of mean value:	1,120	(Percentage escalation for Cape Peninsula region according to Table 3a Note 4 = 12%)
Formula to calculate escalated standard deviation (single phase):	2,19 + 0,56μ	(Acceptable assumption where μ > 4,8 A)
Formula to calculate escalated standard deviation (per phase of three):	(2,19 + 0,56 * 3μ)/√3	(Acceptable assumption where μ > 4,8 A)

LSM Classes:

The All Media and Product Survey Living Standard Measure (AMPS LSM) compiled on a regular basis by the SA Advertising Research Foundation (SAARF) was superseded in 2001 by the SAARF Universal Living Standard Measure (SU LSM). The new system makes use of 10 classes, with AMPS LSM 7 Low & High and AMPS LSM 8 Low & High becoming SU LSM 7, 8, 9 & 10 respectively. SAARF envisages that the range will eventually be extended beyond LSM 10. Average household income levels shown here for comparative purposes are in 2002 Rands. All income data collected at a later date should be deflated by the CPI to allow a direct comparison. (www.saarf.co.za)

Customer Load Classes:

Informal Settlement (7 years) - informal dwellings (built area typically less than 40 m²); area not subdivided & often unproclaimed
Informal Settlement (15 years) - subdivided erven; informal dwellings or government subsidy low cost housing (built area typically less than 40 m²); no hot water cylinders
Township Area - subdivided erven; (more than) government subsidy low cost housing (built area typically 50 - 80 m²); low to medium hot water cylinder penetration
Urban Residential I - middle income housing (mostly blue-collar); single storey free-standing (built area typically 80 - 170 m²) or high density townhouse units; high hot water cylinder penetration
Urban Residential II - middle income housing (mostly white-collar); single storey free-standing (built area typically 190 m²) or townhouse units within security complex (built area typically 80 - 150 m²)
Urban Upmarket I - high income housing; large or multi-storey free-standing (built area typically 250 - 500 m²); often in area with desirable natural feature (eg a view)
Urban Upmarket II - same as Urban Upmarket I, but for customer category beyond LSM 10; three phase supply required (assumption: diversified load 33% higher than for Urban Upmarket I)

3. **APPENDIX A2: NRS 034-1 Table 3a - Typical Design Load Parameters for Domestic Consumers**
(Standard Table as Published at www.nrs.eskom.co.za as part of NRS 034-1:2001 (Amendment No 2: February 2001))

FOR REFERENCE PURPOSES ONLY

Current Type			Load Parameters - 7 years						Load Parameters - 15 years					
Consumer Load Class	AMPS LSM Class	Income Range (Gross R/month)	α	ß	c	ADMD (kVA)	μ (A)	σ (A)	α	ß	c	ADMD (kVA)	μ (A)	σ (A)
Rural Settlement	LSM 1 (low end)	0 to 600	0,30	2,98	20	0,42	1,83	2,78	0,35	2,88	20	0,50	2,17	3,03
Rural Village	LSM 1 & 2	400 to 900	0,43	2,52	20	0,67	2,91	3,55	0,48	2,13	20	0,84	3,65	4,07
Informal Settlement	LSM 3 & 4	800 to 1 500	0,77	9,88	60	1,00	4,35	4,56	0,91	8,80	60	1,30	5,65	5,36
Township Area	LSM 5 & 6	1 500 to 3 000	1,05	7,81	60	1,64	7,13	6,18	1,22	5,86	60	2,37	10,30	7,96
Urban Residential I	LSM 7	3 000 to 5 500	1,23	5,56	60	2,50	10,87	8,28	1,25	3,55	60	3,59	15,61	10,93
Urban Residential II	LSM 7 & 8	5 500 to 8 500	1,45	6,07	80	3,54	15,39	10,81	1,42	4,10	80	4,72	20,52	13,68
Urban Townhouse Complex	LSM 8	8 500 to 12 000	1,45	5,75	80	3,70	16,09	11,20	1,42	4,13	80	4,70	20,43	13,63
Urban Multi-Storey / Estate	LSM 8 (high end)	12 000 to 24 000	1,43	4,41	80	4,50	19,57	13,15	1,37	3,39	80	5,30	23,04	15,09

Note 1: Living Standard Measure (LSM) as quoted in the All Media and Product Survey (AMPS) conducted on a regular basis by the SA Advertising Research Foundation.

Note 2: Average household income ranges shown for comparative purposes are in 1999 Rands. All income data collected at a later date should be deflated by the CPI to allow a direct comparison.

Note 4: Parameters have been normalised to the climate in the interior of South Africa, where the winters are generally cold and with low rainfall. In regions where winter is cold and wet (eg Cape Peninsula) the ADMD is about 12% higher than given. In climates similar to the Durban coastal region the ADMD is about 12% lower than given.

4. APPENDIX A3: NRS 034-1 Table 3b - Description of Consumer Load Classes
(Standard Table as Published in NRS 034-1:2001 (Edition 3.3))

FOR REFERENCE PURPOSES ONLY

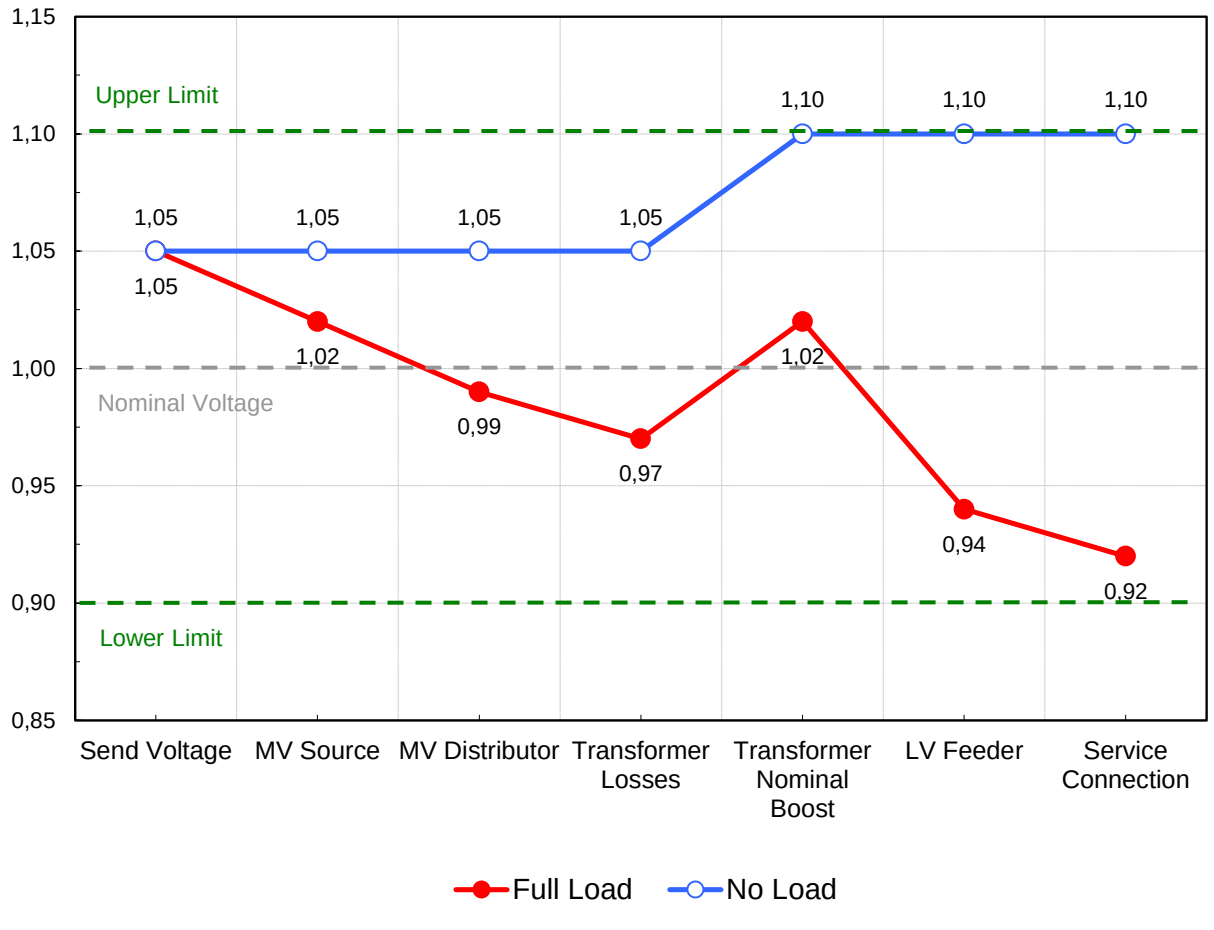
1	2	3	4	5
Consumer load class	**Derivation of income**	**Description of dwellings**	**Type of roads**	**Water reticulation**
Rural settlement	Mainly from pensions and subsistence farming. Some breadwinners work far away in cities.	Mainly based on traditional construction methods.	Normally tracks with difficult access.	Normally none.
Rural village	From pensions and subsistence farming. Some breadwinners are employed in nearby industrialised areas and commute daily.	Mixture of modern and traditional construction methods.	Mainly gravel with main roads tarred.	Some communal stand-pipes.
Informal settlement	From work in a nearby town/city - largely from the informal sector.	A range from shacks to newer "government subsidy" houses made from blocks. Self-build schemes fall into this category. Built area of dwellings generally less than 40 m^2.	A range, from tracks in informal areas to gravel in planned areas.	None in informal areas. Planned areas generally have water piped to a tap in the yard of each dwelling.
Township area	From work in cities/towns, pensions and some informal employment.	A range from low-income flats to old township houses and newer government scheme houses (mid-range), to small semi-detached houses. Built area of dwellings generally 50 m^2 - 80 m^2.	Mostly tarred.	Piped to most houses - half of which eventually have working electrical hot water cylinders.
Urban residential I	From blue-collar jobs in cities.	Houses ranging in size from 80 m^2 - 170 m^2. Most houses have some visible repair/maintenance in progress.	All tarred.	Piped to all houses.
Urban residential II	From formal employment in cities, mostly white-collar jobs.	The built area of main dwellings is typically 190 m^2. None of the houses are multistorey.	All tarred.	Piped to all houses, all of which have electrical hot water cylinders.
Urban townhouse complex	Mainly from professional jobs in cities, level of employment is high.	Normally very high density, in complexes that incorporate security or other shared services. Dwellings are single or multistorey. Floor area in the range 80 m^2 - 150 m^2 per unit.	All tarred.	Piped to all houses. A high percentage of such houses have multiple electrical hot water cylinders.
Urban multistorey/estate	Mainly from professional jobs in cities, level of employment is very high.	Large, constructed of brick or concrete, floor area 250 m^2 - 500 m^2. In regions with some desirable natural feature (eg a view).		

5. **APPENDIX B1: Distribution Voltage Regulation**

a) Nominal MV Voltage 11 660 V

	Voltage Drop	Voltage			
		pu	MV (V)	LV (V)	
			Line	Line	Phase
Nominal Voltage	-	1,00	11 660	400	230
Upper Limit	-	1,10	-	440	253
Send Voltage	0,0%	1,05	12 243	-	-
MV Source	3,0%	1,02	11 893	-	-
MV Distributor	3,0%	0,99	11 543	-	-
Transformer Losses	2,0%	0,97	-	388	223
Transformer Nominal Boost	-5,0%	1,02	-	408	235
LV Feeder	8,0%	0,94	-	376	216
Service Connection	2,0%	0,92	-	368	212
Lower Limit	-	0,90	-	360	207

	Max Allowable Volt Drop from LV Terminal of Dbn Transformer		
	%	LV (V)	
		Line	Phase
Excluding Service Connection	8,0%	32	18
Including Service Connection	10,0%	40	23



Sources and Assumptions:

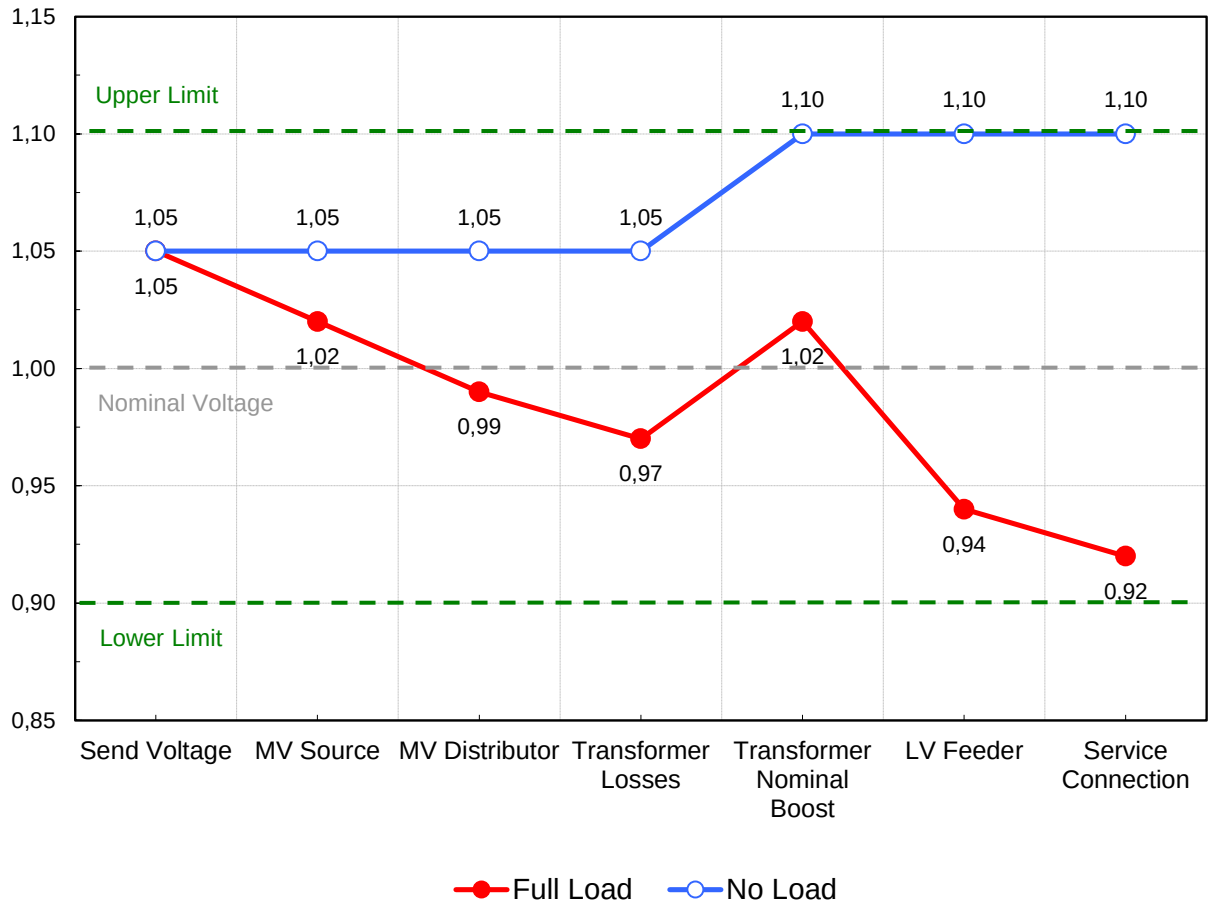
- All percentages are based on nominal voltage.
- Distribution transformers are manufactured with a 5% nominal boost (11 500/420 V).
- Voltage regulation limits are in accordance with the amended Electricity Act (Act 41 of 1987) as promulgated on 1996-01-26.
- Voltage drop contribution assumptions are in accordance with NRS 034-1:2001 (Edition 3.3)

6. **APPENDIX B2: Distribution Voltage Regulation**

b) Nominal MV Voltage 11 500 V

	Voltage Drop	Voltage			
		pu	MV (V)	LV (V)	
			Line	Line	Phase
Nominal Voltage	-	1,00	11 500	400	230
Upper Limit	-	1,10	-	440	253
Send Voltage	0,0%	1,05	12 075	-	-
MV Source	3,0%	1,02	11 730	-	-
MV Distributor	3,0%	0,99	11 385	-	-
Transformer Losses	2,0%	0,97	-	388	223
Transformer Nominal Boost	-5,0%	1,02	-	408	235
LV Feeder	8,0%	0,94	-	376	216
Service Connection	2,0%	0,92	-	368	212
Lower Limit	-	0,90	-	360	207

	Max Allowable Volt Drop from LV Terminal of Dbn Transformer		
	%	LV (V)	
		Line	Phase
Excluding Service Connection	8,0%	32	18
Including Service Connection	10,0%	40	23



Sources and Assumptions:

- All percentages are based on nominal voltage.
- Distribution transformers are manufactured with a 5% nominal boost (11 500/420 V).
- Voltage regulation limits are in accordance with the amended Electricity Act (Act 41 of 1987) as promulgated on 1996-01-26.
- Voltage drop contribution assumptions are in accordance with NRS 034-1:2001 (Edition 3.3)