ELECTRICITY CONTROL BOARD

ECB GUIDELINE: GUIDELINES FOR DETERMINATION OF AFTER DIVERSIFIED MAXIMUM DEMAND (ADMD) FOR RESIDENTIAL CUSTOMERS IN NAMIBIA

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Signed:

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Prof. Tjama Tjivikua
Board Deputy Chairperson

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1 Publication schedule

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1.1 Definitions

After diversity maximum demand (ADMD) means the electric maximum demand in kVA measured from a large number of consumers at a known aggregation time interval, expressed per consumer.

Customer strata means a group of customers sharing a similar consumption level.

Density means the current dwelling density per erf. The metric used to describe density shall be stated explicitly, e.g., dwellings per hectare, households per erf, or connections per erf, floor area per erf or coverage per erf.

Densification means the increase over time in the dwelling density due to non-availability of serviced or affordable land.

Dwelling means any structure intended or used for human habitation. Therefore a storeroom and an abandoned house may in some circumstances be a 'dwelling'. Dwellings can usefully be identified by aerial survey and photo interpretation.

Dwelling density means the number of dwellings per unit area. Unless otherwise stated, dwelling density should be expressed in dwellings per hectare, and the basis of measurement shall be clearly stated, for example gross area or net residential area, i.e., after excluding areas for roads and public open spaces.

ECB means the Electricity Control Board of Namibia.

Erf means a piece of land registered in a deeds registry as an erf, lot, plot, or stand. In many informal township areas, the concept of an 'erf' can be difficult to evaluate because land is not registered and apparent borders may shift over time as existing structures are extended. This may also be regarded as ad hoc subdivision.

ESI means the Electricity Supply Industry.

Herman Beta (HB) Method means a statistical approach used for design calculations. ADMD values determined in these Guidelines serve as the direct statistical inputs for HB Beta-distribution calculations.

Electrical supply/connection means a formal electricity supply to an erf by a legal authority.

Household means a household consisting either of one person living alone or a group of persons, who live together and whose expenditure on food and other household items is

jointly managed. As such, a "household" is a largely social construct, invisible from air and untracked by local administration.

Kilowatt-hour (kWh) means a measurement unit for a legal electric energy consumption imported from the electricity network, measured by a meter, and expressed in this report as an average per month on an annual basis.

Load Class means a named category of a group of customers with similar load behaviour and readily identifiable by relevant contextual demographic attributes, such as their living conditions and any other relevant descriptors in line with the Load Research.

1.2 Background and Purpose

The establishment of standardised After Diversified Maximum Demand (ADMD) guidelines for residential consumers is critical for consistent, transparent, and locally appropriate distribution network design and planning. In fulfilment of its mandate to regulate the Namibian Electricity Supply Industry (ESI), the Electricity Control Board (ECB) commissioned these Guidelines to address the lack of standardised ADMD practices in Namibia. The Guidelines establish a consistent basis for demand characterisation and distribution network design and support planning and design outcomes that appropriately balance reliability and cost-efficiency.

This Guideline is supported by a separate document titled "Research Report for Namibia Residential ADMD Determination", which contains the detailed research methodology, literature review, survey analytical basis, and extended appendices underpinning the guideline.

The ADMD values adopted herein are intended for application with the Herman Beta (HB) method, a probabilistic distribution design approach, in which customer classes are represented through stochastic load definitions and network design is assessed using probabilistic voltage-drop estimation.

The primary beneficiaries of these Guidelines include:

- **Electrical Engineering Consulting Firms:** Providing a validated baseline for professional design calculations and statutory submissions.
- **Regional Electricity Distributors, Municipalities and Local Authorities:** Ensuring consistent application of distribution-planning principles across municipal electricity departments and Regional Electricity Distributors (REDs).
- **Residential Estate Developers and Planning Entities:** Offering transparency in infrastructure requirements and associated capital contributions.
- **Electricity Control Board of Namibia (ECB):** Serving as a reference framework to support regulatory oversight and industry alignment.

2 Description of domestic load classes

The following domestic load classification system is adopted for Namibia.

- **Classification system:** Detailed qualitative and quantitative descriptions for each subclass (e.g., Load Classes 1 through 5).

The following table defines the five primary Load Classes for the Namibian context. Boundary values have been harmonized for mathematical consistency across the ESI.

Table 1: Consumer class definition (kWh bins and demand average)

Load class ID	Consumption band per class (kWh)	ADMD] (kVA)	A	B	C
1	0kWh <= Class 1 <= 235kWh	0.6	0.32	6.99	60
2	235kWh < Class 2 <= 800kWh	2.0	0.85	5.05	60
3	800kWh < Class 3 <= 1376kWh	4.0	1.30	3.20	60
4	1376kWh < Class 4 <= 2340kWh	6.7	1.39	1.48	60
5	2340kWh < Class 5 <= 3933kWh	11.2	0.31	0.07	60

The ADMD values assigned to the respective Load Class IDs shall be used for design calculations under the Herman Beta (HB) method.

- **Class descriptors:** Categorization based on measurable features such as monthly income, property value, dwelling size, and appliance penetration.

Categorizing residential customers into distinct bins is a strategic necessity to ensure equipment and conductor sizing is sufficient to meet peak demand while avoiding the financial burden of over-provisioning.

Table 2 provides a concise description of Namibian property characteristics within each load class, based on survey data and analysis of Namibian residential customers. Erf coverage indices are derived from the GIS methodology, related assumptions, and sample densification outputs presented as appendices to the Research Report, while the remaining indices are based on dwelling-level survey questionnaires. The table is intended to link load classes to property types using the relevant load class parameters applied in ADMD determination for both new and existing developments.

Table 2: Property type and profile parameters typical of load classes

Property type (See appendix 1 for detail)	**Load class profile parameters**	**Load class (Table 1)**
Freestanding home	**Basic/Informal residential.** Total dwelling floor area: 50-90m^2, Erf size: 300-600m^2, Dwellings/property: 1.5 Erf coverage: 30-70%, Whole Income: N$15k per month People/erf: 6 Employed/erf :1–2 households /erf :2.5 Rooms: 3.4 Geyser penetration: 48%	**1**
	Standard residential. Total floor area: 144m^2 Erf size: 300-700m^2 dwellings/property: 2.4 Erf coverage: 35-42% Whole Income: N$29k per month, People/erf: 7 Employed 2-3 Households/erf: 2.4 Rooms: 3.9 Geyser penetration: 75% Around 4% solar water heating	**2**
	Higher income residential. Total floor area: 261 m^2, Erf size: 330-1200 m^2 Dwellings/property: 2.5 Erf coverage: 40-50% Whole Income: N$49k per month, People/Erf: 9 Employed: 3–4 Households/erf: 3.8 Rooms: 5.9 Geyser penetration: 92% Around 5% solar water heating.	**3**

	Upper income residential or Multi-household. Total dwelling floor area: 374 m^2, Erf size: 1012m^2 Dwellings/property :4.4 Erf coverage: 44% Whole income: N$83k per month People: 13-14 Employed: 7 Households /erf :9.5 Rooms: 7.9 Geyser penetration 100% * modification to data.	**4**
Flat or apartment in block of flats	**Small units.** Total dwelling floor area: 51 m^2 Erf size: 2257 m^2 Erf coverage: 45% Whole income N$20k per month People: 2.6 Employed: 1 Households/erf: 1 Rooms :1.8 Geyser penetration 49%, with 17% solar water heating	**1**
	Standard flat living. Total dwelling floor area: 80 m^2 Erf size: 3137 m^2 Erf coverage: 80% Whole income: N$34k per month People: 3 Employed: 1–2 Households/erf: 1 Rooms: 2.6 Geyser penetration 98%	**2**
Semi-detached housing in a complex	**Compact units, mostly single occupant.** Total dwelling floor area: 67 m^2 Erf size: 8995 m^2 Erf coverage: 53% Whole Income: N$12k per month People:1.7 Employed: 1 Households/erf :1 Rooms: 2.2 Geyser penetration 100%	**1**

	Larger units, Standard semi-detached. Total dwelling floor area: 149 m² Erf size: 5184m² Erf coverage: 60% Whole Income: N$40k per month People/Erf :3 Employed/Erf: 1 Households/erf: 1 Rooms: 3.5 Geyser penetration 78%, with 16% solar water heating	**2**
Semi-detached housing, not in a complex	**Small units, Informal or basic semi-detached.** Whole floor area: 47m² Erf size: 212 m² Dwellings/property: 1.86 Erf coverage: 35% Whole income:≤N$10k per month People/erf: 5 Employed:1 Households/erf: 5.29 Rooms: 3.3 Geyser penetration 7%	**1**
	Mid-size units, standard non-estate. Whole floor area: 167 m² Erf size: 903 m² Dwellings/property: 1.4 Erf coverage: 45% Whole income: N$41k per month People/erf: 4 Employed: 1-2 Households /erf: 2.6 Rooms: 3.5 Geyser penetration 80%	**2**
	Larger units, upper non-estate. Whole floor area: 225 m² Erf size: 1144 m² Erf coverage: 42% Dwellings/property: 1 Whole income: N$57k per month People/erf: 4 Employed/erf: 2 Households /erf: 1 Rooms: 4.8 Geyser penetration 60%, with 40% solar water heating	**3**

Properties often contain more than one dwelling. In the case of "free-standing property types", the tables reflect summed values from all dwellings on that property, therefore:

- Sum of all built floor area on property (i.e. Whole floor area)
- The sum of all income earned (i.e. Whole income)
- The count of all people on property
- The number of all rooms (spaces a person can sleep; incl. bedroom, dining, lounge, study, excl.; toilet and kitchen on property)

The following forms of 'collective living' are recognised:

- Flats or apartments (multi-storey residential buildings)
- Townhouses or cluster housing developments located within residential complexes or estates
- Semi-detached houses located on individual erven and not forming part of a residential complex

For these types of residential developments, the values in Table 2 apply to *a single dwelling unit only*. The total load for the development should therefore be determined based on the *number* of similar dwelling units.

In the case of high-rise flats, the floor area ratio and dwelling density can be very high, resulting in a high electrical load density per erf.

3 Methodology to determine load design parameters for projects

This section sets out the methodology for determining the load design parameters for a project (feeder or load zone). The project may either be an established neighbourhood or one that is still in the development or design phase. Both cases are addressed below.

3.1 Homes already built

In the case of homes that are already built, the first step is to determine the characteristics of dwellings in a neighbourhood in accordance with the structure of Table 2:

1. Determine the nearest property type (Column 1 of Table 2).
2. Determine the load class profile parameters (Column 2 of Table 2).
3. Read off the load class from column 3.

Table 3 below gives a framework on which this process can be executed.

This process should be followed for as many different dwelling or building types as are relevant to the project in question. Different types can be recorded by inserting additional columns in Table 3 for a specific load zone, feeder zone, or project.

The characteristic "load class profile parameters" of a feeder, load zone, or project area are to be determined using the parameters listed in rows 3 to 11 of Table 3.

Using as much information from rows 3 to 11 of Table 3 as is reasonably determinable or available, the load class can be identified from Table 1. The applicable A, B, and C parameters for the load zone, feeder, or project can then be selected accordingly.

If there is a mix of load classes, users should look up each participant class and apply a weighted average in the following form per load zone:

$$ADMDwa = sum(\ PTLCi * Wi)/sum(Wi)$$

Where:

ADMDwa = weighted average ADMD.
PTLCi = Property type and Load class for customer group(i).
Wi = Number instances of Load type PTLCi.
Users should then refer to Appendix 2 ,Table 8, select nearest ADMD, and use associated load parameters.
The character of a built or new development can be expressed in the parameters marked with an "X":

Table 3: Methodology determining loading parameters of a feeder, load area or project

1	Characteristic	Type 1 similar units	Type 2 ..... Type n.
2	"Property type" in terms of Table 2 column 1.	X Type	
3	Number of similar units	X No	
4	Whole built floor area m^2	X m^2 Mean	
5	Erf size	X m^2 Mean	
6	Dwellings/ property	X No	
7	Whole income per month	X N$ Mean for group	
8	People per erf	X No	
9	Employment per erf	X No	
10	Households per erf	X No	
11	Geyser present	X %	

12	Load class: Determine from Table 2 Column 3		
13	Determine the median consumption from Table 1	kWh	
14	Adjust the consumption with the offsets in chapter 12 where applicable.	kWh	
15	Determine ADMD corresponding to nearest consumption - Read from Appendix 2, Table 8, column 2	kVA	
16	A - Read from Appendix 2, Table 8, column 5		
17	B - Read from Appendix 2, Table 8, column 6		
18	C - Read from Appendix 2, Table 8, column 7	A	
19	Total ADMD for the Type of dwellings/ customers	= Demand x Number of similar units	

The above table should be developed for the entire area or for a sample that represents the area fairly.

3.2 Homes not yet built

Follow the same outline as Table 3 for ADMD evaluation, and use Table 2 above for guidance across a range of external criteria, including property type, erf size, erf coverage, number of dwellings, and property value.

Carry out an assessment for a new design area with respect to the plan in hand and the probable load classes the development is intended to attract.

4 Application notes for offsets and modifying factors

This section sets out the adjustment framework applicable to the standard ("typical") ADMD and consumption values where local conditions justify deviation from the default design basis. Unless otherwise approved in terms of this Guideline, all network designs shall be based on the national ADMD values specified in Table 1, or as otherwise determined in Table 10. Any application of offsets or modifying factors shall be limited to exceptional cases supported by verifiable evidence and agreed to by both the licensee and the developer. Where agreement cannot be reached, the ECB shall mediate the matter and issue a final determination.

4.1 Urban density offsets

This subsection aims to provide guidance on the impact of densification on the determined ADMD.

4.1.1 On-erf built floor area ADMD adjustment.

On-erf growth occurs at the individual property level. In free-standing homes, densification can grow through building extensions that grow gross floor area, or by addition of new freestanding dwellings.

In collective living complexes, densification is typically static, as these are normally built at best marketable density and restricted by municipal zoning.

Densification from a characteristic operating point has been correlated with Consumption for the 16 research sites studied in Namibia.

The recommendation for densities that are greater or less than average is to apply an offset from the ADMD operating point on the following basis:

- Look up characteristic kWh for load class. Estimate offset from densification.
    - **For temperate subtropical climate zones:** Add/subtract **2.159 kwh/m^2/month**, for every m^2 above/below class average.
    - **For all other zones:** Add/subtract **2.52kwh/m^2/month** for every m^2 above/below class average.
- Estimate modified kWh = kWh_class +/- kWh_Offset
- Look up kWh match from Appendix 2 and Table 8 and read off ADMD parameters.

4.1.2 In-suburb densification (In-fills)

In-suburb growth involves the development of vacant land within existing townships.

For free-standing homes, this is driven by general demand and land availability.

For multi-dwelling residential development, in-fills are dictated by municipal zoning on a per-application basis, requiring developers to evaluate risks related to demand and land availability.

The designer will gather prospective and objective development information, especially related to housing types, prior to estimation of ADMD as described in Section 3.

4.2 Solar Water Heating System (SWHS) offsets

Adjustment of the ADMD value to account for a SWHS shall be based on the approximate average monthly water-heating energy reduction, in kWh, as provided in Table 4. This must be guided by the climatic zones listed for certain Namibian towns in Appendix 3.

Table 4: Potential energy production of solar geysers (kWh/mth)

	Flat plate			**Vacuum tube**			
	100	150	200	100	150	200	Geyser size (l)
Climate	1.4	2.1	2.8	1.4	2.1	2.8	Panel m2
C	80.7	121.0	161.3	132.5	198.7	265.0	
S	130.6	195.9	261.2	159.6	239.4	319.2	
D	153.6	230.4	307.2	153.6	230.4	307.2	
TST	104.1	156.2	208.2	136.7	205.0	273.3	

4.3 PV System offsets

Adjustment of the ADMD value to account for the potential average PV energy generation reduction shall be based on the values provided in Table 5. This must be guided by the climatic zones listed for certain Namibian towns in Appendix 3.

Table 5: Potential average PV energy generation from a single 520W panel (kWh/mth/panel)

Climate	**PR avg**	**Solar kWh supplement**	**Yield**
		(kWh/mth/panel)	
C	0.82	58.5	14.6%
S	0.76	68.3	17.1%
D	0.78	74.2	18.6%
TST	0.74	59.6	14.9%

The generated energy per month in the above table is per $2m^2$ panel and the total energy in kW per month would sum linearly depending on the number of panel.

4.4 Gas Cooking Offset

Gas cooking replaces the use of electric stoves or hotplates in situations where electric cooking would otherwise be used.

Adjustment of the ADMD value to account for the impact of gas cooking is estimated by reducing the initial design ADMD by the average ADMD levels given in Table 6.

Table 6: Average demand reduction from gas cooking

Impact	**Income class**		
	Low	Middle	High
Average peak reduction (kVA)	0.37	0.38	0.41
Equivalent energy avoided (kWh)	52.9	55.8	64.3

5 Worked examples for estimation of ADMD

5.1 Estimation of ADMD for single load class

A network designer must evaluate network sufficiency for planning purposes.

After gathering the relevant information, it is determined that the area is, or will be, mostly made up of semi-detached housing estates.

The information suggests these will be "starter homes", in complexes around 70m^2.

This identifies as semi-detached complex, LC1. from Table 2:

- Coverage = 53%
- Average Erf size = 8995m^2
- Average unit = 67m^2

The average count of connections in such an estate is total of built floor area divided by area per housing unit:

$$N_{units} = 0.53 * 8995/67 = 71\ dwelling\ units$$

First row in Table 1 identifies the parameters of these LC1 customers:

ADMD = 0.6 kVA, with Herman Beta parameters (ABC) of 0.29, 7.11 (at 60A base).

- Because the customers move into such premises with most appliances, load growth approaches saturation very quickly (less than 7 years).
- Because such complexes have no possibility of densifying at household level, load growth by densification is minimal.

5.2 Estimation of ADMD for mixed load classes

Let us now assume the situation is more complicated.
Supply is required to a similar complex, with both small and medium units, in roughly equal amounts.

Referring to Table 2: Property type and profile parameters typical of the load classes as listed, it can be seen that Load Class 1 and Load Class 2 are involved. Table 1 shows targeted 0.6 kVA and 2 kVA.

It is appropriate to perform a weighted average to estimate the mixed ADMD.

ADMD = (0.5*0.6+0.5*2)/(0.5+0.5) = 1.3kVA.

Now refer to Appendix 2, Table 8 and look up the closest ADMD to 1.3kVA.
The value is 1.23kVA, with corresponding Herman Beta parameters (ABC) of 0.59, 5.97 (at 60A).

5.3 Densification

Densification is unlikely to impact housing types which involve formalised collective living, by their very nature.

Let's assume we want to estimate impact of a 10% increase in densification for freestanding erf of Load Class 3, which the planner expects (by some objective plausible measure) may increase from 45% to 55%, We also know the target area is near Windhoek (thus not a Temperate climate).

With reference to section 4.1.1 we would inflate the consumption of class midpoint by 2.52kwh/m^2/mth for every 1 m^2 above class-average.

With reference to Table 1, class mid-point consumption is 1088kWh

With reference to Table 2, midpoint erf size for class 3 is 765m^2.

An increase of 10% coverage is equivalent to adding an average 76.5m^2 built area.

Thus increased energy requirement is 2.52*76.5 = 192.78kWh

Thus after-densification consumption will be approximately 192.78+1088 = 1280.78 kWh.

We then use Appendix 2, Table 8, to identify closest consumption value ADMD, which is 4.7kVA with A being 1.38, B identified is 2.65 (at 60A).

5.4 Evaluation of renewables impact

Below example illustrates the likely demand impact of installing solar water heating:

For this example, let us suppose a group of Free-standing homes, of Load class 2 has been targeted for a solar water heating program.

Inspecting the load class reveals 16% currently has no water heating system. What if one were installed, how much might it reduce ADMD of such customers?

Assume the technology chosen for rollout is flat panel solar, with 150l storage geyser and the site is *Coastal*. Table 4 shows this would supplement household typical mid-point consumption of 517kWh (or 2KVA) by 121kWh/mth, but only for 16% customers. So we perform a weighted average to reflect the reduction of only a portion of customers.

The new estimated consumption is thus:

kWh = 517-0.16*121 = 497kWh (approximate)

By using the lookup in Appendix 2 Table 8, revised estimate ADMD may be estimated:

ADMD = 1.93kVA, a peak reduction estimated at 70W

6 Implementation and Enforcement of the Guideline

A transitional period of six (6) months from the date of approval of this Guideline shall apply to facilitate implementation and capacity building. Upon expiry of the transitional period, this Guideline shall be enforceable under Section 3(5) of the Electricity Act and shall serve as a regulatory clarification of the Distribution Grid Code provisions applicable to network planning.

7 Appendix 1: Definition of domestic property types encountered in Namibia

The table illustrates property types adopted during the underlying surveys that supports these Guidelines.

Table 7: Definition and measurement of property types

ID	Title	Type	Definition	Measurement of areas
1	Free-standing dwelling	Normal	Freestanding dwelling on residential erf	Dwelling area: Total living area per thermal envelope. **Property area: Erf Area**
2	Flat or apartment in block of flats	Special	Multi-storey residential buildings.	Dwelling area: Floor area of flat serviced by this electricity meter. **Property area: Erf Area of complex**
3	Townhouse (estate)	Special	Self-contained dwelling with private grounds within *common ground* for other dwellings. May be multi-storey.	Dwelling area: Total living area of this townhouse as serviced by this electricity meter only. **Property area: Erf area of Estate.**
4	Cluster housing (estate)	Special	Like townhouse, except small plots, and shared amenity/s (i.e. shared pool, gym, gardens...).	Dwelling area: Total living area of this cluster-house, as serviced by this electricity meter only. **Property area: Erf area of Estate**.
5	Semi-detached housing (complex)	Special	Semi-detached housing in a complex.	Dwelling area: Total living area of this dwelling, as serviced by this electricity meter only. **Property area: Erf area of complex.**

6	Semi-detached (non-estate)	Special	Semi-detached housing sharing common wall on separate adjacent erven	Dwelling area: Total living area of this dwelling, as serviced by this electricity meter only. **Property area: Erf area of complex**.
7	Other	Undefined	Anything else.	Dwelling area: Total living area of dwelling, as serviced by this electricity meter only. **Property area: Full erf area.**

8 Appendix 2: Load parameters by kWh

Table below shows load parameters by average kWh consumption.

Table 8: Load parameters by kWh

Consumption	ADMD	Iave	Istdev	A	B	C
(kWh)	(KVA)	(A)	(A)			(A)
100	0.53	2.32	4	0.29	7.11	60
200	0.88	3.85	5.22	0.44	6.48	60
300	1.23	5.37	6.23	0.59	5.97	60
400	1.58	6.89	7.11	0.72	5.52	60
500	1.93	8.41	7.9	0.83	5.11	60
600	2.28	9.93	8.63	0.94	4.74	60
700	2.63	11.46	9.31	1.03	4.38	60
800	2.98	12.98	9.95	1.12	4.05	60
900	3.33	14.5	10.55	1.19	3.74	60
1000	3.68	16.02	11.12	1.25	3.44	60
1100	4.03	17.54	11.67	1.31	3.16	60
1200	4.38	19.06	12.2	1.35	2.90	60
1300	4.73	20.59	12.7	1.38	2.65	60
1400	5.08	22.11	13.19	1.41	2.41	60
1500	5.43	23.63	13.67	1.42	2.18	60
1600	5.78	25.15	14.13	1.42	1.97	60
1700	6.13	26.67	14.57	1.42	1.77	60
1800	6.48	28.19	15.01	1.40	1.58	60
1900	6.83	29.72	15.43	1.38	1.40	60
2000	7.18	31.24	15.85	1.34	1.24	60
2100	7.53	32.76	16.25	1.30	1.08	60
2200	7.88	34.28	16.65	1.25	0.94	60
2300	8.23	35.8	17.03	1.18	0.80	60
2400	8.58	37.32	17.41	1.11	0.68	60
2500	8.93	38.85	17.79	1.03	0.56	60
2600	9.28	40.37	18.15	0.95	0.46	60
2700	9.63	41.89	18.51	0.85	0.37	60
2800	9.98	43.41	18.87	0.74	0.28	60
2900	10.33	44.93	19.21	0.62	0.21	60
3000	10.68	46.46	19.56	0.50	0.15	60
3100	11.03	47.98	19.89	0.37	0.09	60
3200	11.38	49.5	20.23	0.22	0.05	60
3300	11.73	51.02	20.55	0.07	0.01	60
3400	12.08	52.54	20.88	1.52	0.79	80
3500	12.43	54.06	21.19	1.43	0.69	80
3600	12.78	55.59	21.51	1.34	0.59	80
3700	13.13	57.11	21.82	1.25	0.50	80
3800	13.48	58.63	22.12	1.14	0.42	80

3900	13.83	60.15	22.43	1.03	0.34	80

The parameters in this table have been interpolated from curves fitted to real data, collected by load research conducted in Namibia and RSA as contained in the research report.

$$ADMD = .0035 * kWh + 0.1847$$

Note: Above 12kVA/2400kWh, 60A circuit breaker will (on average) curtail the load (as indicated by negative A and B values). For this reason, 80 circuit breakers are suggested.

The following formulae have been applied to build this table:

$$ADMD = .0035 * kWh + 0.1847$$

$$Iave = ADMD/0.23$$

$$Istdev = 2.5552 * Iave^{0.5302}$$

$$A = Iave * (C * Iave - Iave^2 - Istdev^2)/(C * Istdev^2)$$

$$B = (C - Iave)(C * Iave - Iave^2 - Istdev^2)/(C * Istdev^2$$

9 Appendix 3: Climatic zones listed for certain Namibian towns

Table 9: Towns and associated climatic zones of Namibia

Town	Climatic zone	Average annual solar insolation (kWh/m2/day)
Swakopmund	C	5.4
Walvis Bay	C	5.4
Keetmanshoop	D	7.2
Mariental	D	7.2
Okahandja	S	6.8
Otjiwarongo	S	6.8
Rehoboth	S	6.8
Windhoek	S	6.8
Ondangwa	TST	6.1
Ongwediva	TST	6.1
Oshakati	TST	6.1
Rundu	TST	6.1
Tsumeb	TST	6.1

Key:

- C= Coastal (Benguela)
- D = Desert
- S = Semi-desert

TST= Temperate sub-tropical