



Quantification of Energy Efficiency in the Utilities of the U.S. Affiliate States (Excluding US Virgin Islands)

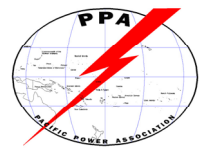
Data Handbook



Pacific Power Association.

Prepared for Kosrae Utility Authority.

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1. Introduction

KEMA Inc has been awarded by the Pacific Power Association (PPA) in Fiji to carry out a project called "Quantification of Energy Efficiency in the Utilities of the U.S. Affiliate States (Excluding US Virgin Islands)".

In this report, an Electrical Data Handbook contains all the electrical characteristics of the power system high voltage equipment in Kosrae Utility Authority (KUA) is provided. All relevant data of the high and medium voltage assets, such as generation data, impedances of lines, cables, transformers, and other equipments if exists. KEMA has incorporated major data of components and equipment in power generation, transmission, distribution and metering. Data template is established to hold comprehensive equipment data, for example for transformers data collected power ratings, primary and secondary voltages, load and no load losses, tap changer data, BIL ratings, cooling class, applicable standards, weight, etc.

2. Data Content

All data contents are identified based on the information KEMA received.

2.1 Generator

There are a total of 5 generators in the TOFOL power station of KUA. However, 2 out of 5 are damaged and the other 3 are operating with de-rated output.

Table 1 - Generators

KUA	Substation	TOFOL	TOFOL	TOFOL	TOFOL	TOFOL
	Engine #	CAT2	CAT4	CAT6	CAT7	CAT8
GENERATOR DETAILS	ENGINE MAKE	CATERPILLAR	CATERPILLAR	CATERPILLAR	CATERPILLAR	CATERPILLAR
	ENGINE MODEL	D398	D398	CAT 3600	CAT 3600	CAT 3512B
	ENGINE SERIAL NUMBER	-	-	-	-	-
	NAME PLATE RATING (kW)	740	740	1,500	1,650	1,015
	DE-RATED (kW)	560	560	-	-	-
	SPEED (RPM)	1200	1200	900	900	1200
	FUEL TYPE	Diesel	Diesel	Diesel	Diesel	Diesel
	YEAR INSTALLED	1980	1984	1990	1996	2007
ALTERNATOR DETAILS	MAKE	Kato	Kato	Kato	Kato	Caterpillar
	TYPE	Brushless	Brushless	Brushless	Brushless	Brushless
	MODEL NO.	A222040001	A222040001	A24752000	A247520004	SR4B
	SERIAL NO.	95892-05	95892-03	96447	11865	8TZ00583
	VOLTAGE (V)	4,160	4,160	4,160	4,160	4,160
REMARKS		For Repair	Operational	Operational	For Repair/Overhaul	Operational

2.2 Station Transformer

Two substation step-up transformers are operated in the KUA system to transfer power from the 4.16 kV generator bus to the 13.8 kV substation bus. In normal operation, both transformers are energized with only one carrying load. NO LOAD and FULL LOAD losses are as specified in *losses KUA.xlsx*. Z1, Z0 impedances are typical value for transformer in the same class of voltage and kVA capacity¹. KUA shall update the data with specific values provided by the transformer manufacturer.

Table 2 Station Transformers

KUA	SUBSTATION NAME		TOFOL	TOFOL
	TRANSFORMER NO.		T-1	T-2
	SERIAL NO.		96V 3362-1	96V 3362-2
	YEAR OF MANUFACTURE		1997	1997
ELECTRICAL CHARACTERISTICS	RATING (MVA)		2.5	2.5
	NO. OF PHASES		3	3
	VECTOR GROUP			
	VOLTAGE (V)	HIGH	13800	13800
		LOW	4160	4160
	IMPEDANCE (%)	Z1	5.75	5.75
		Z0		
	LOSSES (WATTS)	NO LOAD	2300	2300
		FULL LOAD	16700	16700
	MAX. CURRENT (A)	HV	105	105
		LV	348	348
TANK, CORE & OIL DETAILS	OIL	VOL (GALS)	650	650
		WEIGHT (LBS)		
	WEIGHT (LBS)	NET CORE, COIL & TC	16000	16000
TAPS & TC DETAILS	NO. OF	TAPS	5	5
	TAPCHANGER	TYPE	Manual	Manual
COOLING METHOD			OA	OA

¹ Reference: Electric Power Distribution System Engineering, Turan Gonen



REMARKS		VANTRAN Brand	VANTRAN Brand
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2.3 Distribution Feeder

2.3.1 Feeder

There are 3 main distribution feeders in KUA system. Majority of the feeder are 13.8k V overhead lines , with the exception of a section of underground cable to airport . A summary of feeder information can be found in the table below.

Table 3 Feeders

NAME	Malem Utwa	Lelu	Lelu	Tafunsak	Tafunsak (Airport)
CONDUCTOR PER PH ASE	1	1	1	1	1
MATERIAL	Copper	Copper	Copper	Aluminum	Aluminum
SIZE	No. 4	No.4	No. 6	336 kcm	XLPE 1/0
LENGTH	51,000 Ft	9,500 Ft.	5,000 Ft.	41,000 Ft	6,000 Ft
TEMP	75	75	75	75	75
EARTH RESISTANCE	100	100	100	100	--
GMD	9.88	9.88	9.88	9.88	--
AVERAGE HEIGHT	39 Ft.	39 Ft.	39 Ft.	39 Ft.	--
R1 (Ohms/mile)	1.639	1.639	2.6	0.3321	0.034886
X1 (Ohms/mile)	0.8866	0.8866	0.9147	0.7467	0.007955
R0 (Ohms/mile)	1.925	1.925	2.886	0.617	0.069773
X0 (Ohms/mile)	2.941	2.941	2.969	2.801	0.015909
Xc (MOhm-mile)	0.2094	0.2094	0.2162	0.1743	0.006326
Xc0 (MOhm-mile)	0.3934	0.3934	0.4003	0.3583	0.006326
RATING Amps	170	170	128	530	185
REMARKS					Underground Cable

2.3.2 Distribution Transformer

Distribution transformers are listed in the tables below:

Table 4 – Transformer count and kVA capacity sum

KUA kVA	PHASE A	PHASE B	PHASE C	3-PHASE	TOTAL	TOTAL kVA
5	21	8	19		48	240
10	24	27	27		78	780
15	14	10	15		39	585
20	2	0	0		2	40
25	7	6	8		21	525
37.5	12	13	9		34	1275
50	0	0	1		1	50
75	2	2	2		6	450
150				2	2	300
1500				1	1	1500
500				1	1	500
Total					232	6245

Z%, R%, X%, No Load and Full Load Losses are typical values for transformer in the same class of voltage and kVA capacity. KUA shall update the data with specific values provided by the transformer manufacturer.²

Table 5 - 13.8KV Single Phase Transformers

KUA	Impedance			Losses (Watts)		Number of Transformer	Total kVA Installed
kVA rating	Z%	R%	X%	No Load	Full Load		
5	2.2	2.1	0.8	41	144	48	240
10	1.8	1.4	1.2	68	204	78	780
15	1.7	1.3	1.2	84	282	39	585
20						2	40

² Reference: Electric Power Distribution System Engineering, Turan Gonen

25	1.7	1.2	1.2	118	422	21	525
37.5	1.7	1.1	1.3	166	570	34	1275
50	1.8	1.1	1.4	185	720	1	50
75	1.7	0.9	1.4	285	985	6	450
Total						229	3945

Table 6 - 13.8kV Three Phase Transformer s

KUA	Impedance			Losses		Number of Transformer	Total kVA Installed
	kVA rating	Z%	R%	X%	No Load	Full Load	
	150	1.9	1.1	1.6	560	2250	300
	500	1.7	1.0	1.4	1600	6800	500
	1500	5.7	1.1	5.6	2900	19400	1500
Total						4	2300

2.4 Circuit Breaker and Switches

There is no circuit breaker data or switch data provided for KUA system.

The table below is provided as a template for future data capture.

Table 7 - HV Circuit Breakers (VCBS and OCBS)

Location	Type	Voltage Rating	Quantity
Tofol Substation			
Total			

Table 8 – Pad Mount Switches

Location	Voltage Rating	Quantity
Feeder Lelu		
Feeder Malem		
Feeder Tafunsak		
Total		

2.5 Reactor and Capacitor

There is no reactor or capacitor in KUA system.

The table below is provided as a template for future capacitor data.

Table 9 – Future Capacitor/Reactor Data

Location	Voltage Rating	MVAR	Quantity
Total			

2.6 Yard Lights

A total of 156 MWh estimated annual Yard Lights consumption is accounted for. If this usage is not billed, this should be counted as part of financial loss, rather than as part of system loss.



Appendices

No Appendix for this document.