



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

Data Handbook



Pacific Power Association.

Prepared for Kwajalein Joint Utility Corporation

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1. Introduction

KEMA Inc has been asked by the Pacific Power Association (PPA) 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 Kwajalein Joint Utility Corporation (KAJUR) 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 Power Station

There is 1 power station in KAJUR system, as listed in the table below:

Table 1 – Power Stations

FACILITY	EBEYE	EBEYE	EBEYE	EBYEY
DATE OF STARTUP	1984	1984	1984	Oct 2008
ENGINE MAKE	Cummins	Caterpillar	Enterprise D5R-4	Cummins
ENGINE MODEL	KTA 50 TQ1286E			
NUMBER OF GENERATORS	4 units	2 unit	2 unit	2 units
SERIAL NUMBERS	Engine # 1 = LS220649/1 Engine # 2 = LS220649/2 Engine # 3 = LS220649/3 Engine # 4 = LS220649/4	Engine #	Engine # = 840	
RATED POWER OUTPUT	1.2MW @ 1800Rpm each unit	1.5MW @ 450Rpm	1.5MW @ 450Rpm	1.5MW
DISTRIBUTION SYSTEM	13800 Volt, 3 Phase.	13800 Volt, 3 Phase.		
FUEL STORAGE CAPACITY	3,000,000 USGals			

Note: data gathered from multiple sources, some information is not consistent with each other.
Source 1: FACILITY DATA SHEET published on <http://www.mecrmi.net/Ebeye.htm>; Source 2: Utility Engine Data Template - KAJUR.xls; Source 3. Ebeye 2008 Situation Report CABINET2.doc

2.2 Generator

There are a total of 8 generators in the KAJUR power station. However, effectively, only 2 generators operating at the time of site visit.

Table 2 - Generators

MEC	Substation	EBEYE	EBEYE	EBEYE	EBEYE	EBEYE	EBEYE
	Engine #	1	2	3	4	5,6	7,8
GENERATOR DETAILS	ENGINE MAKE	Cummins	Cummins	Cummins	Cummins	Caterpillar	Enterprise
	ENGINE MODEL	KTA 50 TQ1286E	KTA 50 TQ1286E	KTA 50 TQ1286E	KTA 50 TQ1286E		D5R-6
	ENGINE SERIAL NUMBER	LS220649 /1	LS220649/2	LS220649/3	LS220649/4	84004	
	NAME PLATE RATING (KW)	1,200	1,200	1,200	1,200	1,500	1,500
	DE-RATED (KW)					800	2.6
	SPEED (RPM)	1800	1800	1800	1800	450	450
	FUEL TYPE	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
	YEAR INSTALLED	1984	1984	1984	1984	1984	1984
ALTERNATOR DETAILS	MAKE	Leroy Sommer	Leroy Sommer	Leroy Sommer	Leroy Sommer		
	TYPE	Brushless	Brushless	Brushless	Brushless		
	MODEL NO.	XJ1564-R					
	SERIAL NO.	123425					
	VOLTAGE (V)	11,000					
	REMARKS	Overdue for 12,000 hours service				Damaged	Very old

Note: data gathered from multiple sources, some information is not consistent with each other.

Source 1: FACILITY DATA SHEET published on <http://www.mecrmi.net/Ebeye.htm>; Source 2:

Utility Engine Data Template - KAJUR.xls; Source 3. Ebeye 2008 Situation Report

CABINET2.doc

2.3 Station Transformer

2 step-up transformers are connected in parallel to transfer generator output from 480v into 13.8kv into KAJUR distribution system, only one of the two transformers is online . There is one 750kVA transformer connected from 13.8kV bus to serve the power station self usage. Z1, NO LOAD and FULL LOAD loss, as well as the BIL rating are typical value for transformer in the same class of voltage and k VA capacity¹. KAJUR shall update the data with specific values provided by the transformer manufacture.

Table 3 Station Transformers

MEC	SUBSTATION NAME		EBEYE	EBEYE
	TRANSFORMER NO.		T1, T2	Station Use
	SERIAL NO.			
	YEAR OF MANUFACTURE			
ELECTRICAL CHARACTERISTICS	RATING (MVA)		3	0.75
	NO. OF PHASES		3	
	VECTOR GROUP			
	VOLTAGE (V)	HIGH	13800	13800
		LOW	480	207/120
	IMPEDANCE (%)	Z1	5.7	4.8
		Z0		
	LOSSES (WATTS)	NO LOAD	5650	1800
		FULL LOAD	31050	10200
	MAX. CURRENT (A)	HV		
		LV		
TANK, CORE & OIL DETAILS	OIL	VOL (GALS)		
		WEIGHT (LBS)		
	WEIGHT (LBS)	NET		
		CORE, COIL & TC		
TAPS & TC DETAILS	NO. OF	TAPS		
	TAPCHANGER	TYPE		

¹ Reference: Electric Power Distribution System Engineering, Turan Gonen

COOLING METHOD				
REMARKS		One online, one backup		

Transformer Data provided in the *Utility Engine Data Template - KAJUR.xls* indicates capacity of 10 MVA, is not included here .

2.4 Distribution Feeder

2.4.1 Primary Feeder

There are 2 13.8kV primary distribution feeders in KAJUR system. A summary of primary feeders can be found in the table below.

Table 4 Primary Feeders

NAME	FROM BUS	TO BUS	CONDUCTOR PER PHASE	MATERIAL	SIZE	LENGTH
Feeder 1	F1-01S	F1-01T	1	AI	1/o	20
	F1-01S	F1-01-2T	1	AI	1/o	80
	F1-01-2T	F1-01-3T	1	AI	1.o	80
	F1-01S	F1-03V	1	AI	4/o	1000
	F1-01v	F1-03-1T	1	AI	1/o	18
	F1-03-1T	F1-03-2T	1	AI	1/o	100
	F1-03-V	F1-04V	1	AI	4/o	120
	F1-04V	F1-04-1T	1	AI	2/o	150
	F1-04V	F1-05V	1	AI	4/o	750
	D1-05V	F1-05-1T	1	AI	1/o	200
	F1-05V	F1-05 -2T	1	AI	1/o	30
	F1-05v	F1-06V	1	AI	4/o	420
	F1-06v	F1-06-1T	1	AI	1/o	70
	F1-05V	F1-06-3T	1	AI	1/o	80
	F1-06V	F1-07S	1	AI	4/o	5000
	F1-07s	F1-07-2T	1	AI	1/o	320
	F1-07s	F1-07-3T	1	AI	1/o	280
	F1-07-3T	f1-07-4T	1	AI	1/o	320
	F1-07S	F1-08V	1	AI	4/o	550
	DF1-08V	F1-08-1T	1	AI	1/o	150
	F1-08V	F1-08-2T	1	AI	1/o	150
	F1-08v	F1-08-3T	1	AI	1/o	100
	F1-08-3T	F1-06-4T	1	AI	1/o	30
	F1-08v	F1-9V	1	AI	4/o	480
Feeder 2	Fi-09V	F1-09-2T	1	AI	1/o	75
	F1-09v	F1-09-3T	1	AI	1/o	320
	F1-09v	F1-10V	1	AI	4/o	220
	F1-10V	F1-10-1T	1	AI	1/o	20
	F1-10-1T	F1-10-2t	1	AI	1/o	250
	F1-10V	F1-103T	1	AI	1/o	630
Feeder 2	F2 Sw	F2-02V	1	AI	4/o	500
	F2-02V	F2-02-1T	1	AI	1/o	300

F2-02V	F2-02-2T	1	AI	1/o	40
F2-02V	F2-02-3T	1	AI	1/o	200
F2-02V	F2-03-V	1	AI	4/o	1000
F2-03-V	F2-03-3T	1	AL	1/o	100
F2-03-3T	F2-03-1T	1	AL	1/o	375
F2-03 1T	F2-03 2T	1	AL	1/o	80
F2-03-V	F2-03-4T	1	AL	1/o	360
F2-03-V	F2-o4S	1	AL	4/o	600
F2-04S	F2-04-1T	1	AL	1/o	200
F2-04S	F2-05V	1	AI	4/o	1000
F2-05V	F2-05-3T	1	AI	1/o	100
F2-05-3T	F2-05-2T	1	AI	1/o	140
F2-05-2t	F2-05-1T	1	AI	1/o	250
F2-05V	G2-06V	1	AI	4/o	670
F2-06v	G2-06-1T	1	AI	1/o	430
F2-06V	F2-06-2T	1	AI	1/o	150
F2-06V	F2-06-3T	1	AI	1/o	110
F2-06-3T	F2-064T	1	AI	1/o	200
F2-06V	F2-07S	1	AI	4/o	1000
F2-07S	F2-07-1T	1	AI	1/o	20
F2-07-1T	F2-07-2T	1	AI	1/o	110
F2-07-2T	F2-07-3T	1	AI	1/o	330
F2-07S	F2-11V	1	AI	4/o	300
F2-11V	F2-07-4T	1	AI	1/o	200
f2-07-4T	F2-07-5T	1	AI	1/o	500
F2-07S	F2-GUS	1	AI	4/o	300
F2-GUS	F2-07-6T	1	AI	1/o	20
F2-DUS	F2-EB-oo	1	AI	1/o	265
F2-EB-00	F2-EB-iP	1	Cu-OH	2/o	165
F2-EB-1p	F2-EB-2P	1	Cu-OH	2/o	265
F2-EB-2P	F2-EB-3P	1	CU-OH	2/o	265
F2-EB-3P	F2-CU-4P	1	CU-OH	2/o	265
F2-CW-4p	F2-CW-5p	1	Cu-OH	2/o	265
F2-CW-5P	F2-CW-6P	1	Cu-OH	2/o	265
F2-CW-6P	F2-CW-7P	1	Cu-OH	2/o	265
F2-CW-7p	F2-CW-8P	1	Cu-OH	2/o	265
F2-CW-8P	F2-CW-9P	1	Cu-OH	2/o	265
F2-Cu-9p	F2-CW-10	1	Cu-OH	2/o	265
F2-CW-10p	CW-11p	1	Cu-OH	2/o	265
F2-CW-11 p	CW-12P	1	Cu-OH	2/o	265
F2 CW-12P	CW-13ap	1	Cu-OH	2/o	265
F2-CW-12P	CW-14p	1	Cu-OH	2/o	265
F2-CW-14	CW-15P	1	Cu-OH	2/o	265
F2-CW-15P	CW-16P	1	Cu-OH	2/o	265
F2-CW-16P	CW-17P	1	Cu-OH	2/o	265

F2-CW-17P	CW-18P		1	Cu-OH	2/o	265
F2-CW-18P	CW-19P		1	Cu-OH	2/o	265
F2-CW-19P	CW-20P		1	Cu-OH	2/o	265
F2-CW-20P	CW-21P		1	Cu-OH	2/o	265
F2-CW-21P	CW-22P		1	Cu-OH	2/o	265
F2-CW-22P	CW-23P		1	Cu-OH	2/o	265
F2-CW-23P	CW-24P		1	Cu-OH	2/o	265
F2-CW-24	CW-25P		1	Cu-OH	2/o	265
F2-CW-25P	CW-26		1	Cu-OH	2/o	265
F2-CW-26P	CW-27P		1	Cu-OH	2/o	265
F2-CW-27P	CW-28P		1	Cu-OH	2/o	265
F2-CW-28P	CW-29P		1	Cu-OH	2/o	265
F2-CW-28P	CW-30P		1	Cu-OH	2/o	265
F2-CW-30P	CE-31P		1	Cu-OH	2/o	265
F2-CW-31P	CW-32P		1	Cu-OH	2/o	265
F2-CW-32P	CW-33P		1	Cu-OH	2/o	265
F2-CW-33P	CW-34P		1	Cu-OH	2/o	265
F2-CW-34P	CW-35P		1	Cu-OH	2/o	265
F2-CW-35P	CW-36P		1	Cu-OH	2/o	265
F2-CW-36P	CW-37P		1	Cu-OH	2/o	265
F2-CW-37P	CW-38P		1	Cu-OH	2/o	265
F2-CW-38P	W-39P		1	Cu-OH	2/o	265
F2-CW-39P	CW-40P		1	Cu-OH	2/o	265
F2-CW-40P	CW-41P		1	Cu-OH	2/o	265
F2-CW-41P	CW-42P		1	Cu-OH	2/o	265
F2-CW-42P	CW-43P		1	Cu-OH	2/o	265
F2-CW-43P	CW-44P		1	Cu-OH	2/o	265
F2-CW-44P	CW-45P		1	Cu-OH	2/o	265
F2-W-45P	CW-46P		1	Cu-OH	2/o	265
F2-CW-46P	CW-47P		1	Cu-OH	2/o	265
Fe-CW-47P	Cw-48P		1	Cu-OH	2/o	265
F2-CW-48P	CW-49P		1	Cu-OH	2/o	265
F2-CW-49P	CW-80P		1	Cu-OH	2/o	265
F2-CW-50P	CW-51P		1	Cu-OH	2/o	265
F2-CW-51P	CW-52P		1	Cu-OH	2/o	265
F2-CW-52P	CW-53P		1	Cu-OH	2/o	265
F2-CW-53P	CW-54P		1	Cu-OH	2/o	265
F2-CW-54P	CW-55P		1	Cu-OH	2/p	265
F2-CW-55P	CW-56P		1	Cu-OH	2/o	265
F2-CW-56	CW-57P		1	Cu-OH	2/o	265
F2-CW-57P	CW-58		1	Cu-OH	2/o	265
F2-CW-58	CW-59P		1	Cu-OH	2/o	265
F2-CW-59P	CW-60P		1	Cu-OH	2/o	265
F2-CW-60P	CW-61P		1	Cu-OH	2/o	265
F2-CW-61P	CW-62P		1	Cu-OH	2/o	265

F2-Cw-62P	CW-63P		1	Cu-OH	2/o	265
F2-W-63P	CW-64P		1	Cu-OH	2/o	265
F2-CW-64P	CW-65P		1	Cu-OH	2/o	265
F2-CW-65P	CW-66P		1	Cu-OH	2/o	265
F2-CW-66P	CW-67P		1	Cu-OH	2/o	265
F2-CW-57P	CW-68P		1	Cu-OH	2/o	265
F2-CW-68P	CW-69P		1	Cu-OH	2/o	265
F2-CW-69P	CW-70P		1	Cu-OH	2/o	265
F2-CW-70P	CW-71P		1	Cu-OH	2/o	265
F2-CW-71P	CW-72P		1	Cu-OH	2/o	265
F2-CW-72P	CW-73P		1	Cu-OH	2/o	265
F2-CW-73P	CW-74P		1	Cu-OH	2/o	265
F2-CW-74P	W-75P		1	GU-UG	2/o	265
F2-CW-76P	Gu HH 1		1	GU-UG	2/o	100
F2-GU-Hhi	GU-HH2		1	GU-UG	2/o	150
F2-GU-HH2	GU-HH3		1	GU-UG	2/o	150
F2-GU-HH3	GU-HH4		1	GU-UG	2/o	150
F2-GU-HH4	GU-HH5		1	GU-UG	2/o	150
F2-GU-HH5	GU-HH6		1	GU-UG	2/o	150
F2-GU-HH5	GU-1T		1	GU-UG	2/o	100
F2-GU-1T	Gu-2T		1	GU-UG	2/o	160
F2-GU-HH6	GU-3T		1	GU-UG	2/o	30
F2-GU-HH6	GU-HH7		1	GU-UG	2/o	200
F2-GU-HH7	GU-HH8		1	GU-UG	2/o	275
F2-GU-HH8	GU-4T		1	GU-UG	2/o	12
F2-GU-HH8	GU-HH9		1	GU-UG	2/o	250
F2-GU-HH9	GU-HH10		1	GU-UG	2/o	150
F2-GU-HH10	GU-5T		1	GU-UG	2/o	12
F2-GU-HH10	GU-hh11		1	GU-UG	2/o	150
F2-GU-HH11	GU-5T		1	GU-UG	2/o	12

A summary of secondary conductors based on the information collected during site visit are listed in the table below.

Table 5 – Secondary Conductors

Type	Secondary Line	Secondary Drop
Material	Cu	Cu
Size	#2	#4
Typical Length	100 feet	40 feet

2.4.2 Distribution Transformer

Distribution transformers are listed in the tables below, identified on feeder base :

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

Table 6 - Distribution Transformers

Feeder	Xfmr No.	kVA Rating	Impedance	Phase	Volts H WDG	Volts X WDG	no load loss	full load loss
Feeder 1	1 F1-01-1T	50	1.5	1	13800Y/7970	240/120	185	735
	2 F1-03-1T	112.5	2.3	3	13800Gy/7970	208/120	530	1800
	3 F1-03-2T	50	1.5	1	13800Gy/7970	240/120	185	735
	4 F1-041-T	50	1.5	1	13800Gy/7970	240/120	185	735
	5 F1-04-2T	50x2	1.8	1	13800Gy/7970	240/120	370	1470
	6 F1-05-1T	50x2	1.5	1	13800Gy/7970	240/120	370	1470
	7 F1-05-2T	150	2.3	3	13800Gy/7970	208/120	560	2250
	8 F1-06-1T	50	1.5	1	13800Gy/7970	240/120	185	735
	9 F1-06-3T	150	2.3	3	13800Gy/7970	208/120	560	2250
	10 F1-07-2T	225	2.4	3	13800Gy/7970	208/120	880	3300
	11 F1-07-3T	500	4.8	3	13800-Delta	208/120	1600	6800
	12 F1-07-4T	150	2.2	3	13800-Delta	208/120	560	2250
	13 F1-08-1T	50	1.5	1	13800Gy/7970	240/120	185	735
	14 F1-08-2T	50	1.5	1	13800Gy/7970	240/120	185	735
	15 F1-08-3T	150	2.3	3	13800Gy/7970	208/120	560	2250
	16 F1-08-4T	500	2.1	3	13800-Delta	480/277	1600	6800
	17 F1-09-2T	75	1.4	1	13800Gy/7970	240/120	285	1050
	18 F1-09-3T	150	2.3	3	13800Gy/7970	208/120	560	2250
	19 F1-10-1T	50x2	1.5	1	13800Gy/7970	240/120	370	1470
	20 F1-10-2T	50x2	1.5	1	13800Gy/7970	240/120	370	1470
	21 F1-10-3T	150	2.3	3	13800Gy/7970	208/120	560	2250
Feeder 2	1 F2-02-1.1T	75	4	3	13800-Delta	208/120	360	1350
	2 F2-02-1.2T	150	2.2	3	13800-Delta	208/120	560	2250
	3 F2-02-1T	50X2	1.5	1	13800Gy/7970	240/120	370	1470

² Reference: Electric Power Distribution System Engineering, Turan Gonen

Feeder		Xfmr No.	kVA Rating	Impedance	Phase	Volts H WDG	Volts X WDG	no load loss	full load loss
	4	F2-02-2T	50	1.5	1	13800Gy/7970	240/120	185	735
	5	F2-02-3T	50	1.5	1	13800Gy/7970	240/120	185	735
	7	F-203-1T	20	1.5	1	13800Gy/7970	240/120	185	735
	6	F2-03-1T	50	1.5	1	13800Gy/7970	240/120	185	735
	8	F2-03-3T	225	2.3	3	13800Gy/7970	208/120	880	3300
	9	F2-03-4T	50X2	1.5	1	13800Gy/7970	240/120	370	1470
	10	F2-04-1T	50X2	1.5	1	13800Gy/7970	240/120	370	1470
	11	F2-05-1T	50	1.5	1	13800Gy/7970	240/120	185	735
	12	F2-05-2T	50	1.5	1	13800Gy/7970	240/120	185	735
	13	F2-05-3T	50	1.5	1	13800Gy/7970	240/120	185	735
	14	F2-05-4T	750	5.8	3	13800Gy/7970	208/120	1800	10200
	15	F2-05-5T	112.5	2.3	3	13800Gy/7970	208/120	530	1800
	16	F2-06-1t	50	1.5	1	13800Gy/7970	240/120	185	735
	17	F2-06-2R	50	1.5	1	13800Gy/7970	240/120	185	735
	18	F2-06-3T	50	1.5	1	13800Gy/7970	240/120	185	735
	19	F2-06-4T	50	1.5	1	13800Gy/7970	240/120	185	735
	22	F2-07-1t	50	3.1	1	13800-Delta	240/120	185	735
	21	F2-07-2T	50	1.5	1	13800Gy/7970	240/120	185	735
	20	F2-07-3T	50	1.5	1	13800Gy/7970	240/120	185	735
	23	F2-07-4T	150	2.4	3	13800Gy/7970	208/120	560	2250
	24	F2-07-5T	75	1.4	1	13800Gy/7970	240/120	285	1050
	25	F2-07-6T	75	3.2	1	13800-Delta	240/120	285	1050
	26	F2-EB-1	25	1.6	1	13800-Delta	240/120	118	437
	27	F2-EB-2T	50X2	1.6	1	13800-Delta	240/120	370	1470
	28	F2-EB-3T	50	1.6	1	13800-Delta	240/120	185	735
	33	F2-GU-1T	50	3.1	1	13800-Delta	240/120	185	735
	34	F2-GU-2T	50	2.6	1	13800-Delta	240/120	185	735
	35	F2-GU-3T	150	2.2	3	13800-Delta	208/120	560	2250
	36	F2-GU-4T	75	4	3	13800-Delta	208/120	360	1350
	37	F2-GU-5T	75	4	3	13800-Delta	208/120	360	1350
	38	F2-GU-6T	75	4	3	13800-Delta	208/120	360	1350
	32	F2-HI-7T	50	1.6	1	13800-Delta	240/120	185	735
	30	F2-NL-5T	50	1.6	1	13800-Delta	240/120	185	735
	29	F2-SI-4T	50	1.6	1	13800-Delta	240/120	185	735
	31	F2-SI-6T	15	3.3	1	13800-Delta	240/120	84	305

2.5 Circuit Breaker and Switches

There is no data provided for circuit breaker and switches. The tables below are provided as template to fill in data in the future.

Table 7 - HV Circuit Breakers

Location	Type	Voltage Rating	Quantity
Total			

Table 8 – Pad Mount Switches

Location	Voltage Rating	Quantity
Total		

2.6 Reactor and Capacitor

There is no reactor or capacitor in KAJUR system.

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

Table 9 – Future Capacitor Data

Location	Voltage Rating	MVAR	Quantity
Total			

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

Table 10 – Future Reactor Data

Location	Voltage Rating	IMPEDANCE	Quantity
Total			

2.7 Street Lights

Street lights information is collected during site visit. There are 45 street lights in KA JUR. Power consumed by street light is neither metered nor billed. Based on 175watts per light, annual consumption is 34.5 MWh for 12 hour daily usage.

2.8 Water System Equipments

Water system equipment usage information is collected during site visit and listed in the table below.

Table 11 – Water System Equipment Data

Pump Type	Number of Units	Hp per Unit	Daily Operation Hours
Sewage	3	10	24
Sea Water	1	10	24



No Appendix for this document.