FEDERAL PACIFIC ELECTRIC COMPANY

SAN JOSE, CALIFORNIA

TRANSFORMER TEST REPORT

PURCHASER U.S. DEPT. OF ENERGY

TYPE LT-AUTO PHASE 3 HERTZ 60 COOLING OA/FA/FA TEMP RISE DEGREE C 65

TEST DATE	DEC. 1983
IMMERSANT	OIL
PURCHASER'S ORDER NO.	DE-AC65-82WPC5647
FPE order No	90044
FPE SERIAL No	90044-2
DESIGN No. F-1322-A-	90044

WINDING	H	X	Y
kV	230.00Y / 132.79	115.00Y / 66.40	13.8
MVA	120/ 160/ 200/	120/ 160/ 200/	24/ 32.4/ 40.5/

ALL CHARACTERISTICS ARE AT REFERENCE TEMPERATURE OF 85 DEGREE C.

FOR 3 PHASE TRANSFORMERS RESISTANCES GIVEN ARE THE SUM OF THE 3 PHASES IN SERIES

		RESISTANCE OHMS			EXCITATION		NO LOAD LOSS
WINDING	TAP POSITION	H	X	Y	% VOLTS	% AMPS	kW
HV	1	0.9769			100	0.198	52.2
HV	3	0.8872			110	0.614	85.59
HV	5	0.7967					
LV	N		0.7672				
TV				0.06553			
					GUAR. 100%		65.0

LOAD LOSS AND IMPEDANCE

KV	241.5	230.0	218.9	230.0	115.0				
KV	115.0	115.0	115.0	13.8	13.8				
MVA	200	200	200	200	200				
KW	518.74	509.10	507.31						
%IZ	9.69	8.89	8.21	29.5	18.2				

TOTAL LOSS GUARANTEE	640 kW @ 200 MVA	% IZ GUARANTEE	5.0 % 120 MVA
TOTAL LOSS TEST * See Page 2	637.08 kW @ 200 MVA	% IZ TEST	5.33 % 120 MVA

	% EFFICIENCIES				100% POWER FACTOR	% REGULATION			
	FULL LOAD	75% LOAD	50% LOAD	25% LOAD	% LOAD	100% P.F.	% P..F.	80% P.F.	% P.F.
TEST	99.80	99.83	99.84	99.79		0.295		3.412	
GUARANTEE									

REF.TEMP.20 DEGREE C	WINDING POWER FACTOR	CAPACITANCE micro F	CORE TO GROUND RESISTANCE 800 Megohms
H To L & G			
L To H & G			
H & L To G			

HEAT RUN RESULTS FROM 90035

TEMPERATURE RISE IN DEGREE C	HV TAP POSITION 1				LV TAP POSITION			
AVERAGE ULTIMATE TEMPERATURE RISE, WITH WINDINGS	TEMP.RISE OF WINDING(BY RESISTANCE)				TOP OIL RISE	AMBIENT TEMP.	MVA	COOLING
LOADED AS SHOWN, CORRECTED TO INSTANT OF SHUTDOWN *	H	X	Y	GUAR.*				
TEMPERATURE RISE GUARANTEE IS BASED ON AN	51.1	53.1		65	50.7	19.0	120	OA
ALTITUDE NOT EXCEEDING 3300 FEET.	58.5	60.0		65	57.7	20.2	200	FA

DIELECTRIC TESTS

VOLTAGE APPLIED TO INDICATED WINDING.	VOLTAGE OF WINDING TESTED	TEST VOLTAGE APPLIED	DURATION IN SECONDS
ALL OTHER WINDINGS CONNECTED TO CORE AND GROUND.	230 kV	34 kV	60
	115 kV	34 kV	60
	13.8 kV	34 kV	60

SWITCHING SURGE &

ANSI	IMPULSE TEST	INDUCED VOLTAGE TEST 1.8 TIMES RATED VOLTAGE ACROSS FULL WINDING AT	SINGLE PHASE INDUCED TEST
HV	750 kV (BIL)	200 Hz FOR 7200 CYCLES 395 kV BETWEEN 218.9 kV LINE TERMINALS.	HV To GROUND 284 kV
LV	450 kV (BIL)	TEST OF RATIO AND PHASE RELATION WERE PERFORMED AND FOUND TO BE	LV To GROUND 185 kV
TV	110 kV (BIL)	CORRECT.	

PREPARED BY J. CLAIR CLARK DATE 1/4/84 APPROVED BY W Bottger

FEDERAL PACIFIC ELECTRIC COMPANY

TRANSFORMER TEST REPORT

ZERO PHASE IMPEDANCE AT 120 MVA

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        4.2 %          0.32 %
H   __/\/\/\/\/\/\_______/\/\/\/\/\/\__   X
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                 |
                 /
                 \
                 /   10.1 %
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RIV MEASURED DURING 1 HOUR AT 1.5 X NORMAL VOLTS

(results in microvolts)

TERMINAL	START	10 MIN.	20 MIN.	30 MIN.	40 MIN.	50 MIN.	60 MIN.
H1	15	13	10	8	8	8	8
H2	16	16	10	10	8	8	8
H3	13	12	8	8	7	7	7

RIV MEASURED AT FULL INDUCED TEST LEVEL OF 412 kV

TERMINAL	MEASURED RIV
H1	19 microvolts
H2	20 microvolts
H3	17 microvolts

SERIAL No 90044-2

* H = 200 MVA @ .979 PF LAG
X = 195.85 MVA @ 1.0 PF LAG
Y = 40.585 MVA @ 0 PF LAG

H+X+Y = 580.32 KW
NO LOAD LOSS = 52.20 KW
AUXILIARY LOSS = 4.56 KW
637.08 KW

CAPACITANCE AND DISSIPATION FACTOR MEASUREMENTS

TWO WINDING TRANSFORMER

S. O. NUMBER 90044 SN 90044-2

TEST NO.	TEST POS.	CAPACITANCE SYMBOL	TEST LEAD CONN		TEST		CAPACITANCE			% DF 25.5°C	P.F.		REMARKS
			BLACK CxH	RED CxL	KV	MA	DIAL RDNG	MULTR	CAP (PF)		25.5°C %	20° C %	
1	3	C_{HL}	H+L	Y	10	41	51.42	200	10284	3.36	0.32	0.28	
2	4	$C_{HL} + C_{HG}$	H+L	Y	10	60	80.66	200	16132	3.41	0.32	0.29	Y at GND
3	5	C_{HG}	H+L	Y	10	24	58.50	100	5850	3.60	0.34	0.30	Y at GUARD
4	3	C_{HL}	Y	H+L	10	39	50.25	200	10050	3.61	0.34	0.30	
5	4	$C_{HL} + C_{LG}$	Y	H+L	10	90	46.24	500	23120	4.22	0.39	0.35	L+H at GND
6	5	C_{LG}	Y	H+L	10	50	26.15	500	13075	4.60	0.42	0.37	L+H at GUARD
7	5	$C_{HG} + C_{LG}$	H & L&Y		10	70	94.10	200	18820	4.16	0.38	0.34	

MEASUREMENT INTERCHECK

$C_1 = C_2 - C_3$

$C_4 = C_5 - C_6$

$$DF_1 = \frac{C_2DF_2 - C_3DF_3}{C_2 - C_3}$$

$$DF_4 = \frac{C_5DF_5 - C_6DF_6}{C_5 - C_6}$$

H HIGH VOLTAGE WINDING

L LOW VOLTAGE WINDING

G GROUND

Y TERTIARY

FORM Q12.0

TURNS RATIO TESTS

Tap Pos NLTC	HIGH VOLTAGE	LOW VOLTAGE	H1-H0X0 X1-H0X0	H2-H0X0 X2-H0X0	H3-H0X0 X3-H0X0	CALC. RATIO	
1	241500	115000	2.100	2.101	2.104	2.100	OK
2	235750	115000	2.049	2.050	2.053	2.050	OK
3	230000	115000	1.998	1.999	2.002	2.000	OK
4	224250	115000	1.948	1.948	1.951	1.950	OK
5	218500	115000	1.897	1.897	1.900	1.900	OK
Tap Pos NLTC	HIGH VOLTAGE	LOW VOLTAGE	X1-H0X0 Y1-Y2	X2-H0X0 Y2-Y3	H3-H0X0 Y3-Y1	CALC. RATIO	
N/A	115000	14490	4.586	4.585	4.585	4.582	OK
N/A	115000	13800	4.816	4.815	4.815	4.811	OK
N/A	115000	13110	5.067	5.066	5.066	5.064	OK

SUBTRACTIVE POLARITY AND 30 DEGREES DISPLACEMENT (Group 2 ANSI C57-12.90.6.3, Fig.7)

OIL TESTS

		MAIN	
Dielectric Breakdown (ASTM 1816)	=	35	KV
Temperature of oil	=	19	C
PCB content	=	ND	PPM

INSULATION EVALUATION MEASUREMENT C.F.= 1.000

Insulation Measured	Megger Volts DC	Temp C	Mohms Meas.	% Pwr. Fact. Measured	@ 10 KVAC Corr. to 20C		
HV-LV to GRD	2500	19	20000	0.280	0.280	CH	5708pF
TV to GRD	2500	19	20000	0.260	0.260	CL	11457pF
HV-LV to TV	2500	19	20000	0.330	0.330	CHL	10340pF
Core to Grd	500	19	2000				

WINDING RESISTANCE

Winding Connection		Test Deg C =	19.0	Ohms @ Test Deg C	Ohms @ 85 Deg C
High Volts	H1-X1	H2-X2	H3-X3		
241500	0.2620	0.2617	0.2642	0.7879	0.9930
230000	0.2375	0.2375	0.2397	0.7147	0.9008
218500	0.2133	0.2134	0.2156	0.6423	0.8095
Low Volts	X1-H0X0	X2-H0X0	X3-H0X0		
115000	0.212400	0.213100	0.213500	0.6390	0.8054
Low Volts	Y1-Y2	Y2-Y3	Y3-Y1		
14490	0.012956	0.013359	0.012600	0.05834	0.07949
13800	0.012308	0.012691	0.011970	0.05543	0.07543
13110	0.011693	0.012056	0.011372	0.05265	0.07167

MEASUREMENT OF NO LOAD LOSS

FREQUENCY 60 HZ **120000** **KVA BASE**

% Rtd Volts	3 Phase Voltage Volts RMS	Volts AVG	3 Phase Amperes	% Exciting Current	Kilowatts Measured	Kilowatts Corrected
90	12410	12512	4.160	0.083	41.000	41.336
100	13784	14000	6.980	0.139	52.400	53.217
105	14501	14774	9.320	0.186	60.000	61.122
110	15123	15251	11.930	0.238	67.700	68.271

MEASUREMENT OF LOAD LOSS AND POSITIVE SEQUENCE IMPEDANCE FREQUENCY 60 HZ

High Volts	Low Volts	KVA	Meas. Amps	Meas. Volts	% Z	Meas KW	KW @ 85 C
241500	115000	120000	288.60	14513	5.97%	207.500	224.627
230000	115000	120000	299.90	12566	5.49%	200.800	216.673
218500	115000	120000	320.30	11196	5.07%	202.900	215.437
High Volts	Low Volts	KVA	Meas. Amps	Meas. Volts	% Z	Meas KW	KW @ 85 C
241500	115000	200000	478.00	24029	9.95%	576.000	623.655
230000	115000	200000	502.00	21044	9.15%	558.000	602.047
218500	115000	200000	528.00	18455	8.45%	564.000	598.746
High Volts	Low Volts	KVA	Meas. Amps	Meas. Volts	% Z	Meas KW	
230000	13800	24000	39.40	4592	3.05%	12.000	
115000	13800	24000	211.30	4247	2.11%	85.000	

Total Losses @ 230000Y/132791-115000-13800 VOLTS and 120 MVA 269.890 Kilowatts @ 85C

Impulse Tests

Phase	KV Required	KV Applied	Oscillograph	Phase	KV Required	KV Applied	Oscillograph
H1	375	374	16	X3	225	222.0	28
H1	825	823	17	X3	495	488	29
H1	825	826	18	X3	495	492	30
H1	750	747	19	X3	450	445	31
H2	375	374	20	X2	225	222.0	32
H2	825	826	21	X2	495	487	33
H2	825	821	22	X2	495	486	34
H2	750	750	23	X2	450	443	35
H3	375	375	24	X1	225	222.0	36
H3	825	826	25	X1	495	486	37
H3	825	828	26	X1	495	488	38
H3	750	747	27	X1	450	444	39
Y3	55	54.8	25	Y2	55	55.2	33
Y3	121	120.9	26	Y2	121	120.4	34
Y3	121	120.7	27	Y2	121	120.4	35
Y3	110	109.3	28	Y2	110	110.9	36
Y1	55	55.5	29	H0X0	55	55.4	37
Y1	121	122.3	30	H0X0	110	109.2	38
Y1	121	122.2	31	H0X0	110	109.3	39
Y1	110	110.9	32				

APPLIED POTENTIAL

Insulation Meas.	Required Kvolts	Applied Kvolts	Duration	
HV-LV to Grd	34 KV	34 KV	60 seconds	**TEST OK**
TV to Ground	34 KV	34 KV	60 seconds	**TEST OK**

INDUCED POTENTIAL

Apply 13714 Volts Phase to Ground on Y winding for 18 seconds (7200 cycles @ 400 Hertz).
Then 12000 Volts Phase to Ground for 1 hour.

Connection: 2415000-115000-13800 (NLTC TAP 1;TV TAP 2)

Induced Test Voltage: HV 240000 Volts Phase to Ground for 18 seconds.
HV 210000 Volts Phase to Ground for 1hour.

Measurement of R.I.V.

The measurement is made at a frequency of ONE MEGAHERTZ by the bushing capacitance method at the test voltage during the induced potential tests.

Test Results

Time Minute	Test KV % of Rated	KV- H to G	H1 Terminal	H2 Terminal	H3 Terminal
	Background	0	4	4	4
start 18"	172	240	55	40	25
start	151	210	5	5	5
5	151	210	5	5	5
10	151	210	5	5	5
15	151	210	5	5	5
20	151	210	5	5	5
25	151	210	5	5	5
30	151	210	5	5	5
35	151	210	5	5	5
40	151	210	5	5	5
45	151	210	5	5	5
50	151	210	5	5	5
55	151	210	5	5	5
60	151	210	5	5	5
	Background	0	5	5	5

J.O. 10074P

INSULATION POWER FACTOR TEST

APPARATUS INFORMATION

DATE: 09/28/02 (M/D/Y)

COMPANY: WAPA

TRANSFORMER LOCATION: UST (Final Test) DESIGNATION: 10083P

ENVIRONMENT

WEATHER: Indoors

AIR TEMP.: 19C

OIL TEMP: 19C

WINDING TEMP: 19C C.F. = 1.00

REL. HUMIDITY: 24%

TRANSFORMER NAME PLATE DATA

MFGR: UST/FPE S/N: 100740902 YEAR: 2002

TYPE: ONAN/ONAF/ONAF MVA: 120/160/200 65C RISE FORM: CORE

HIGH SIDE KV: 230GRDY/132.79 +/-2.5, 5% No Load Taps LOW SIDE KV: 115GRDY/66.395 TERT KV: 14490;13800;13110

									POWER FACTOR (%)		
TEST NO.	H.V.	CxRED		MENU SELECT	VOLTS (KV)	AMPS (mA)	POWR (W)	MEAS	CORR TO 20C	CAP. (pf)	INSUL. RATE.
1*	HIGH	LOW	GND	CH +CHL	10	60.500	1.886			16050	G
2	HIGH	LOW	GRD	CH	10	21.520	0.607	0.280	0.280	5708	G
3**	HIGH	LOW	UST	CHL(UST)	10	38.980	1.284	0.330	0.330	10340	G
4***	LOW	HIGH	GND	CL + CHL	10	82.170	2.421			21798	G
5	LOW	HIGH	GRD	CL	10	43.190	1.134	0.260	0.260	11457	G
6**	LOW	HIGH	UST	CLH(UST)	10	38.980	1.282	0.330	0.330	10340	G

* Compare the Capacitance and Watts readings of this test to the sum of the Capacitance and Watts readings for Test No's. 2+3. Ideally they should be the same.

** Compare the results of this test result with the results of Test No. 6. Ideally they should be the same.

*** Compare the Capacitance and Watts readings of this test against the sum of the Capacitance and Watts readings for Test No's. 5+6. Ideally they should be the same.

EXCITATION TESTS (AUTOTRANSFORMER)				
TEST KV - 10.0				
LOAD TAP CHANGER POSITION	ENERGIZE H1 UST H0X0	ENERGIZE H2 UST H0X0	ENERGIZE H3 UST H0X0	NO LOAD TAP CHANGER POSITION
	milliAMPS	milliAMPS	milliAMPS	
N/A	41.200	33.570	45.660	1
N/A	43.190	34.750	47.180	2
N/A	45.290	36.480	50.070	3
N/A	47.420	38.220	52.530	4
N/A	50.010	40.040	55.280	5