Exhibit ___ (YKGM-4)
Docket Nos. UE-040640, et al.
Witness: Yohannes K.G. Mariam

BEFORE THE WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, Complainant, v. PUGET SOUND ENERGY, INC. Respondent.	DOCKET NO. UG-040640 DOCKET NO. UE-040641 *(consolidated)*

EXHIBIT TO TESTIMONY OF

Yohannes K.G. Mariam

STAFF OF
WASHINGTON UTILITIES AND
TRANSPORTATION COMMISSION

Streamflow Statistical Analyses

September 23, 2004

Exhibit__(YKGM-4): Table 1a:Tests of Normality Based on Bi-weekly Grand Coulee Streamflow Data, 1928-1978

Parameters	Apr-15	Apr-30	Aug-15	Aug-31	Annual	Dec-15	Dec31	Feb-14	Feb-15	Jan-15	Jan-31	Jul-15	Jul-31	Jun-15	Jun-30	Mar-15	Mar-31	May-15	May-31	Nov-15	Nov-30	Oct-15	Oct-31	Sep-15	Sep-30
Mean	11.20882	11.75411	11.58011	11.30615	11.58047	10.58929	10.5642	10.49924	10.54763	10.44481	10.46626	12.25545	11.93105	12.7199	12.54898	10.61454	10.85553	12.23951	12.61504	10.68253	10.60593	10.74109	10.73292	11.08998	10.84343
Median	11.24434	11.76343	11.57674	11.29197	11.60669	10.52455	10.4765	10.44424	10.50374	10.40887	10.46488	12.2842	11.89951	12.75783	12.5877	10.60981	10.8698	12.24296	12.59126	10.62398	10.62126	10.7278	10.68459	11.05119	10.81361
Maximum	12.12372	12.69258	12.19987	12.13419	11.93941	11.50737	11.87474	11.35296	11.40154	11.60117	12.07906	12.95002	12.43694	13.3203	13.35075	11.43561	11.9416	12.91438	13.18389	11.54733	11.29017	11.31169	11.58291	11.82735	11.64753
Minimum	10.34875	10.96803	11.22889	10.8772	11.10204	9.848926	9.880782	9.622384	9.832421	9.54824	9.560927	11.46641	11.47344	12.19785	11.89444	10.02127	10.15596	11.56446	11.84586	9.968666	9.893589	10.31048	10.15436	10.69437	10.49646
Std. Dev.	0.441074	0.45753	0.203026	0.222025	0.197999	0.362213	0.402814	0.403303	0.376685	0.352123	0.433937	0.333584	0.250981	0.264924	0.314813	0.323885	0.348759	0.32533	0.284378	0.333575	0.320323	0.250536	0.328764	0.222565	0.255043
Skewness	-0.063741	0.020295	0.657412	1.143451	-0.537501	0.397346	0.784308	0.155972	0.215306	0.175637	0.815734	-0.302749	0.305917	0.017963	0.162233	0.12272	0.299781	0.059759	-0.215459	0.224738	-0.203863	0.47277	0.536109	1.249634	1.052912
Kurtosis	2.357957	2.132153	3.517921	5.515276	2.625088	2.807157	3.875294	2.731004	2.435392	4.906522	5.705591	2.572872	2.081256	2.78063	2.748176	2.824685	3.702352	2.344438	3.124268	3.055048	2.56547	2.701321	2.915465	5.041894	4.003712
Jarque-Bera	0.892648	1.572514	4.160422	24.07612	2.70039	1.393175	6.72228	0.353475	1.050433	7.829626	20.79564	1.143887	2.538399	0.102945	0.351445	0.189533	1.77661	0.925095	0.419026	0.427205	0.739701	2.048447	2.409998	21.69931	11.33735
Probability	0.639976	0.455547	0.124904	0.000006	0.25919	0.498283	0.034696	0.838	0.591427	0.019944	0.00003	0.564427	0.281057	0.94983	0.838851	0.909585	0.411353	0.629677	0.810979	0.807669	0.690838	0.359075	0.299692	0.000019	0.003452
Observations	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50

Exhibit__(YKGM-4): Table 1b:Tests of Normality Based on Monthly Grand Coulee Streamflow Data, 1928-1978

Parameters	APR	AUG	DEC	FEB	JAN	JUL	JUN	MAR	MAY	NOV	OCT	SEP
Mean	11.60518	11.53084	10.59477	10.55532	10.48373	12.14629	12.66143	10.77672	12.48429	10.68164	10.80132	11.04354
Median	11.66213	11.52772	10.53712	10.55414	10.50993	12.12793	12.65096	10.80346	12.43752	10.61936	10.76962	11.03385
Maximum	12.42633	12.15459	11.64524	11.30168	11.62757	12.73425	13.16439	11.71002	12.94749	11.32091	11.48419	11.62596
Minimum	10.84838	11.26452	9.998081	9.794796	9.585451	11.57088	12.12262	10.12608	11.98005	10.00619	10.39851	10.77241
Std. Dev.	0.375661	0.181607	0.361505	0.360325	0.371712	0.276299	0.261273	0.307123	0.251824	0.3047	0.248685	0.185687
Skewness	-0.116443	0.903724	0.61782	0.064297	0.400889	-0.095315	-0.068061	0.197207	-0.121695	-0.068779	0.71652	1.327551
Kurtosis	2.31376	4.339153	3.173288	2.705817	4.884772	2.28001	2.349082	3.634606	2.112575	2.697834	3.318052	5.149865
Jarque-Bera	1.094084	10.54209	3.24341	0.214751	8.740022	1.155676	0.921298	1.163097	1.764085	0.229639	4.489091	24.3156
Probability	0.578659	0.005138	0.197562	0.898188	0.012651	0.56111	0.630874	0.559032	0.413937	0.891527	0.105976	0.000005
Observations	50	50	50	50	50	50	50	50	50	50	50	50

Exhibit__(YKGM-4) Table 1c:Test of Normality of Annual Data Using PSE's data

Parameters	COULEE	Dalles	PSE's Generation (MWH)[1]
Mean	81.45687	131.74	2528.656
Median	81.21709	137.1438	2535.482
Maximum	109.6288	183.0663	3160.803
Minimum	51.64236	82.1549	1962.287
Std. Dev.	13.71829	24.45235	313.2943
Skewness	-0.17651	-0.231724	0.068378
Kurtosis	2.428869	2.507267	1.988299
Jarque-Bera	0.939194	0.95327	2.171334
Probability	0.625254	0.620869	0.337677
Observations	50		50

1- The sum of generation at Wells, Rocky Reach, Rock Island 1, Rock Island 2, Wanapum, Priest Rapids, Upper Baker, Lower Baker, and PSE Small Plants in aMW.

Exhibit__(YKGM-4): Table 2. Unit Root Tests for Streamflow from Coulee and Dalles, and Generation Data							
Null Hypothesis: COULEE has a unit root				Null Hypothesis: Dalles] has a unit root		Null Hypothesis: PSE's Generation (TOT) has a unit root	
		t-Statistic	Prob.*	t-Statistic	Prob.*	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.865733	0	-5.355468	0	-4.411213	0.0009
Test critical values:	1% level	-3.57131		-3.57131		-3.57131	
	5% level	-2.922449		-2.922449		-2.922449	
	10% level	-2.599224		-2.599224		-2.599224	
*MacKinnon (1996) one-sided p-values.							

Exhibit__(YKGM-4): Table 3: Tests of Causality Between Streamflow and Generation, 1928-1978				
Pairwise Granger Causality Tests				
Null Hypothesis:	Obs	F-Statistic	Probability	
COULEE does not Granger Cause AMW	48	9.01658	5.40E-04	
AMW does not Granger Cause COULEE		4.08941	0.02367	
DALLES does not Granger Cause AMW	48	8.29734	0.0009	
AMW does not Granger Cause DALLES		4.30882	0.0197	
TOT does not Granger Cause COULEE	48	5.44107	0.00783	
COULEE does not Granger Cause TOT		15.4289	8.90E-06	
DALLES does not Granger Cause COULEE	48	3.77228	0.03094	
COULEE does not Granger Cause DALLES		2.73584	0.07613	
TOT does not Granger Cause COULEE	48	0.37286	0.69096	
COULEE does not Granger Cause TOT		3.36499	0.04388	
Where Coulee- natural flow from Coulee, AMW- average megawatt generated from most projects in the Colombia River basin, Dalles- natural flow from the Dalles, TOT-electricity Available to PSE				