High Pressure Turbine Replacement- Proposed Design

partial arc full arc

11/10/00

U1 Proposed Design Tests, Actual Cond Press,

	U1 92% HP VWO 6,750 kpph	U1 92% HP VWO 6,900 kpph	U1 92% HP VWO 6,975 kpph	U1 93% HP VWO 6,750 kpph
Gross Power (Mw)	929.7	947.7	956.7	932.7
NTCHR (Btu/kwh)	7,878	7,886	7,891	7,862
Throttle flow (kpph)	**6,750**	**6,900**	**6,975**	**6,750**
Throttle press (psia)	2,412.2	2,412.2	2,412.2	2,412.2
Throttle temp (°F)	1,000	1,000	1,000	1,000
Hot Reheat temp (°F)	1,000	1,000	1,000	1,000
Reheater flow (kpph)	5,440.1	5,575.3	5,643.0	5,438.1
% Reheater press drop (%)	6	6	6	6
Reheater duty (MBtu/h)	1,179	1,193	1,200	1,188
High Pressure Turbine				
Efficiency (%)	92	92	92	93
Wheel power (Mw)	297.0	299.7	301.1	300.2
% Total Wheel power	31.5	31.2	31.1	31.8
Section press drop (psi)	1,748.7	1,734.2	1,726.9	1,748.9
1st stg shell press (psia)	1,982.9	1,982.9	1,982.9	1,982.9
1st stg press drop (psi)	356.9	356.9	356.9	356.9
4th stg ext press (psia)	1,133.1	1,133.1	1,133.1	1,133.1
4th stg ext enthalpy (Btu/lb)	1,370.9	1,370.9	1,370.9	1,369.9
Exhaust press (psia)	591.1	605.6	612.9	590.9
Exhaust enthalpy (Btu/lb)	1,301.3	1,303.6	1,304.8	1,299.5
Intermediat Pressure Turbine				
Efficiency (%)	91.19	91.20	91.20	91.22
Wheel power (Mw)	281.4	288.3	291.7	281.3
% Total Wheel power	29.9	30.0	30.1	29.8
8th stg bowl press (psia)	544.54	557.88	564.57	544.35
Section press drop (psi)	417.22	427.54	432.72	417.08
Exhaust press (psia)	127.32	130.3	131.9	127.27
Exhaust enthalpy (Btu/lb)	1,338.4	1,338.1	1,337.9	1,338.4
Low Pressure Turbines				
Wheel power (Mw)	364.0	372.6	376.9	363.9
% Total Wheel power	38.6	38.8	38.9	38.5
LPA exhaust press ("hg)	3.87	3.97	4.02	3.87
LPB exhaust press ("hg)	2.89	2.95	2.98	2.89
LPC exhaust press ("hg)	2.70	2.75	2.78	2.70

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865

6615 e-28

IP7010531

High Pressure Turbine Replacement- Proposed Design

11/10/00

U1 Proposed Design Tests, Actual Cond Press,

	U1 92% HP VWO 6,750 kpph	U1 92% HP VWO 6,900 kpph	U1 92% HP VWO 6,975 kpph	U1 93% HP VWO 6,750 kpph
Stage Bowl Flow				
HP 1st stg flow (lb/hr)	6,745,167	6,895,167	6,970,167	6,745,167
HP 2-5th stg flow (lb/hr)	6,673,102	6,823,102	6,898,101	6,673,086
HP 6-7th stg flow (lb/hr)	6,034,859	6,191,318	6,269,832	6,033,889
IP 8th stg flow (lb/hr)	5,442,813	5,577,962	5,645,701	5,440,855
IP 9-11th stg flow (lb/hr)	5,460,487	5,596,070	5,664,026	5,458,526
IP 12-14th stg flow (lb/hr)	5,200,693	5,327,627	5,391,217	5,198,853
LP 15th stg flow (lb/hr)	4,759,073	4,873,793	4,931,244	4,757,366
LP 16th stg flow (lb/hr)	4,621,934	4,732,297	4,787,552	4,620,287
LP 17-18th stg flow (lb/hr)	4,306,869	4,407,883	4,458,435	4,305,354
LPA 19th stg flow (lb/hr)	1,382,280	1,414,479	1,430,589	1,381,797
LPB 19th stg flow (lb/hr)	1,382,695	1,414,903	1,431,018	1,382,211
LPC 19th stg flow (lb/hr)	1,382,280	1,414,479	1,430,589	1,381,797
LPA 20th stg flow (lb/hr)	1,342,130	1,373,143	1,388,646	1,341,676
LPB 20th stg flow (lb/hr)	1,320,914	1,351,420	1,366,669	1,320,472
LPC 20th stg flow (lb/hr)	1,328,216	1,358,941	1,374,300	1,327,771
Stage Bowl Pressure				
HP 1st stg press (psia)	2339.83	2339.83	2339.83	2339.83
HP 2-5th stg press (psia)	1982.91	1982.91	1982.91	1982.91
HP 6-7th stg press (psia)	1133.09	1133.09	1133.09	1133.09
IP 8th stg press (psia)	544.54	557.88	564.57	544.35
IP 9-11th stg press (psia)	461.29	472.59	478.25	461.13
IP 12-14th stg press (psia)	255.05	261.17	264.24	254.96
LP 15th stg press (psia)	127.32	130.34	131.85	127.27
LP 16th stg press (psia)	66.89	68.46	69.24	66.86
LP 17-18th stg press (psia)	43.35	44.35	44.85	43.34
LPA 19th stg press (psia)	12.84	13.13	13.27	12.83
LPB 19th stg press (psia)	12.84	13.13	13.27	12.83
LPC 19th stg press (psia)	12.84	13.13	13.27	12.83
LPA 20th stg press (psia)	5.48	5.61	5.68	5.48
LPB 20th stg press (psia)	6.11	6.25	6.33	6.11
LPC 20th stg press (psia)	5.86	6.00	6.07	5.86
Stage Press Drop				
HP 1st stg press drop (psi)	356.92	356.92	356.92	356.92
HP 2-5th stg press drop (psi)	849.82	849.82	849.82	849.82
HP 6-7th stg press drop (psi)	541.99	527.49	520.19	542.19
IP 8th stg press drop (psi)	83.25	85.29	86.32	83.22
IP 9-11th stg press drop (psi)	206.24	211.42	214.01	206.17
IP 12-14th stg press drop (psi)	127.73	130.83	132.39	127.69
LP 15th stg press drop (psi)	60.43	61.88	62.61	60.41
LP 16th stg press drop (psi)	23.54	24.11	24.39	23.52
LP 17-18th stg press drop (psi)	30.51	31.22	31.58	30.51
LPA 19th stg press drop (psi)	7.36	7.52	7.59	7.35
LPB 19th stg press drop (psi)	6.73	6.88	6.94	6.72
LPC 19th stg press drop (psi)	6.98	7.13	7.20	6.97
LPA 20th stg press drop (psi)	3.58	3.66	3.71	3.58
LPB 20th stg press drop (psi)	4.69	4.80	4.87	4.69
LPC 20th stg press drop (psi)	4.53	4.65	4.71	4.53

IP7010532

High Pressure Turbine Replacement- Proposed Design

11/10/00

U2 Proposed Design Tests, Actual Cond Press

	U2 92% HP VWO 6,750 kpph	U2 92% HP VWO 6,900 kpph	U2 92% HP VWO 6,975 kpph	U2 93% HP VWO 6,750 kpph
Gross Power (Mw)	960.7	979.6	989.0	963.6
NTCHR (Btu/kwh)	7,638	7,644	7,647	7,623
Throttle flow (kpph)	**6,750**	**6,900**	**6,975**	**6,750**
Throttle press (psia)	2,412.2	2,412.2	2,412.2	2,412.2
Throttle temp (°F)	1,000	1,000	1,000	1,000
Hot Reheat temp (°F)	1,000	1,000	1,000	1,000
Reheater flow (kpph)	5,483.3	5,619.8	5,688.2	5,481.3
% Reheater press drop (%)	7	7	7	7
Reheater duty (MBtu/h)	1,162	1,175	1,181	1,170
High Pressure Turbine				
Efficiency (%)	92	92	92	93
Wheel power (Mw)	293.2	295.8	297.0	296.4
% Total Wheel power	30.1	29.8	29.6	30.4
Section press drop (psi)	1,722.2	1,707.1	1,699.5	1,722.5
1st stg shell press (psia)	1,933.8	1,933.8	1,933.8	1,933.8
1st stg press drop (psi)	406.1	406.1	406.1	406.1
4th stg ext press (psia)	1,092.5	1,092.5	1,092.5	1,092.5
4th stg ext enthalpy (Btu/lb)	1,366.7	1,366.6	1,366.6	1,365.6
Exhaust press (psia)	617.6	632.7	640.3	617.3
Exhaust enthalpy (Btu/lb)	1,305.4	1,307.8	1,309.0	1,303.7
Intermediat Pressure Turbine				
Efficiency (%)	91.51	91.52	91.53	91.53
Wheel power (Mw)	285.3	292.3	295.8	285.2
% Total Wheel power	29.3	29.4	29.5	29.2
8th stg bowl press (psia)	562.85	576.66	583.58	562.65
Section press drop (psi)	428.76	439.39	444.71	428.61
Exhaust press (psia)	134.09	137.3	138.9	134.04
Exhaust enthalpy (Btu/lb)	1,337.0	1,336.6	1,336.4	1,337.0
Low Pressure Turbines				
Wheel power (Mw)	395.2	404.8	409.6	395.0
% Total Wheel power	40.6	40.8	40.9	40.4
LPA exhaust press ("hg)	3.87	3.97	4.02	3.87
LPB exhaust press ("hg)	2.89	2.95	2.98	2.89
LPC exhaust press ("hg)	2.70	2.75	2.78	2.70

945 - 50 895 → 865 @ 915 5%

IP7010533

High Pressure Turbine Replacement- Proposed Design

11/10/00

	U2 Proposed Design Tests, Actual Cond Press			
	U2 92% HP	U2 92% HP	U2 92% HP	U2 93% HP
	VWO 6,750 kpph	VWO 6,900 kpph	VWO 6,975 kpph	VWO 6,750 kpph
Stage Bowl Flow				
HP 1st stg flow (lb/hr)	6,745,170	6,895,170	6,970,170	6,745,170
HP 2-5th stg flow (lb/hr)	6,670,921	6,820,920	6,895,920	6,670,902
HP 6-7th stg flow (lb/hr)	6,088,214	6,246,676	6,326,207	6,087,183
IP 8th stg flow (lb/hr)	5,485,909	5,622,347	5,690,761	5,483,903
IP 9-11th stg flow (lb/hr)	5,503,758	5,640,636	5,709,270	5,501,750
IP 12-14th stg flow (lb/hr)	5,245,268	5,373,468	5,437,718	5,243,383
LP 15th stg flow (lb/hr)	4,781,339	4,896,783	4,954,617	4,779,586
LP 16th stg flow (lb/hr)	4,638,700	4,749,598	4,805,140	4,637,011
LP 17-18th stg flow (lb/hr)	4,318,857	4,420,239	4,470,991	4,317,304
LPA 19th stg flow (lb/hr)	1,382,928	1,415,155	1,431,288	1,382,434
LPB 19th stg flow (lb/hr)	1,383,343	1,415,580	1,431,717	1,382,849
LPC 19th stg flow (lb/hr)	1,382,928	1,415,155	1,431,288	1,382,434
LPA 20th stg flow (lb/hr)	1,335,265	1,366,242	1,381,799	1,334,813
LPB 20th stg flow (lb/hr)	1,328,296	1,359,030	1,374,466	1,327,841
LPC 20th stg flow (lb/hr)	1,332,328	1,363,194	1,378,695	1,331,872
Stage Bowl Pressure				
HP 1st stg press (psia)	2339.83	2339.83	2339.83	2339.83
HP 2-5th stg press (psia)	1933.75	1933.75	1933.75	1933.75
HP 6-7th stg press (psia)	1092.51	1092.51	1092.51	1092.51
IP 8th stg press (psia)	562.85	576.66	583.58	562.65
IP 9-11th stg press (psia)	452.05	463.14	468.70	451.89
IP 12-14th stg press (psia)	254.12	260.23	263.30	254.03
LP 15th stg press (psia)	134.09	137.27	138.87	134.04
LP 16th stg press (psia)	67.36	68.94	69.73	67.34
LP 17-18th stg press (psia)	44.03	45.05	45.55	44.02
LPA 19th stg press (psia)	12.84	13.13	13.28	12.84
LPB 19th stg press (psia)	12.84	13.13	13.28	12.84
LPC 19th stg press (psia)	12.84	13.13	13.28	12.84
LPA 20th stg press (psia)	5.66	5.79	5.86	5.66
LPB 20th stg press (psia)	5.35	5.47	5.53	5.34
LPC 20th stg press (psia)	5.46	5.59	5.65	5.46
Stage Press Drop				
HP 1st stg press drop (psi)	406.08	406.08	406.08	406.08
HP 2-5th stg press drop (psi)	841.24	841.24	841.24	841.24
HP 6-7th stg press drop (psi)	474.91	459.81	452.21	475.21
IP 8th stg press drop (psi)	110.80	113.52	114.88	110.76
IP 9-11th stg press drop (psi)	197.93	202.91	205.40	197.86
IP 12-14th stg press drop (psi)	120.03	122.96	124.43	119.99
LP 15th stg press drop (psi)	66.73	68.33	69.14	66.70
LP 16th stg press drop (psi)	23.33	23.89	24.18	23.32
LP 17-18th stg press drop (psi)	31.19	31.92	32.27	31.18
LPA 19th stg press drop (psi)	7.18	7.34	7.42	7.18
LPB 19th stg press drop (psi)	7.49	7.66	7.75	7.50
LPC 19th stg press drop (psi)	7.38	7.54	7.63	7.38
LPA 20th stg press drop (psi)	3.76	3.84	3.88	3.76
LPB 20th stg press drop (psi)	3.93	4.02	4.07	3.92
LPC 20th stg press drop (psi)	4.13	4.24	4.28	4.13

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