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## Annexure A



Cooling Requirements and Costs for Goba! Recirculation of Air

	Running costs						Maintenance cost						Capital cost						Present value cost							
	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%		
<b>SURFACE RESULTS</b>																										
<b>COSTS (kR)</b>																										
Pre-cooling tower	240	240	240	240	240	240													1205	1205	1205	1205	1205	1205	1205	
Condenser cooling tower	845	845	845	845	845	845													3237	3237	3237	3237	3237	3237	3237	
Refrigeration plant	6527	6527	6527	6527	6527	6527	8833	8833	8833	8833	8833	8833	275000	275000	275000	275000	275000	275000	352088	352088	352088	352088	352088	352088	352088	
Ice plant																			0	0	0	0	0	0	0	
Water treatment plant																			0	0	0	0	0	0	0	
Chilled water dam							240	240	240	240	240	240	12000	12000	12000	12000	12000	12000	13205	13205	13205	13205	13205	13205	13205	
Clean return water dam							240	240	240	240	240	240	12000	12000	12000	12000	12000	12000	13205	13205	13205	13205	13205	13205	13205	
Dirty return water dam																			0	0	0	0	0	0	0	
All surface pumps	1684	1684	1684	1684	1684	1684													8452	8452	8452	8452	8452	8452	8452	
<b>Total Surface Cooling Costs</b>	<b>9096</b>	<b>9096</b>	<b>9096</b>	<b>9096</b>	<b>9096</b>	<b>9096</b>	<b>9313</b>	<b>9313</b>	<b>9313</b>	<b>9313</b>	<b>9313</b>	<b>9313</b>	<b>299000</b>	<b>299000</b>	<b>299000</b>	<b>299000</b>	<b>299000</b>	<b>299000</b>	<b>391390</b>	<b>391390</b>	<b>391390</b>	<b>391390</b>	<b>391390</b>	<b>391390</b>	<b>391390</b>	
<b>TOTAL LEVEL RESULTS</b>																										
Refrigeration plant (RW)																			0	0	0	0	0	0	0	
Refrigeration plant (CT)	23047	26245	28354	31646	36246	39804	9871	9946	9931	9954	9918	9870	261673	263672	263275	263885	262930	261851	426880	445306	455418	472865	494616	510953		
Condenser cooling tower	1120	1084	1066	914	896	878													5821	5440	5350	4587	4497	4406		
Pelton turbine	-11592	-11665	-11505	-11554	-11610	-11682	1790	1803	1777	1784	1793	1804	16114	16225	15992	16060	16138	16237	-33080	-33270	-32830	-32973	-33131	-33338		
Hydrolift device																			0	0	0	0	0	0	0	
Throttle valve (OC at Dam)																			0	0	1	0	0	0	0	
Throttle valve (CC)							892	899	894	897	898	899	4458	4497	4489	4488	4491	4497	8935	9009	8958	8988	8998	9009		
Water treatment plants																			0	0	0	0	0	0	0	
High pressure pumps	60849	61218	60845	60753	60775	60797	16245	18398	18244	18273	18278	18285	270753	273295	270738	271219	271316	271417	658665	662831	658623	657794	658031	658273		
Low pressure pumps	4418	3984	3750	3530	3308	3085	315	285	268	252	238	220	2760	2490	2344	2206	2067	1928	26504	23915	22509	21187	19853	18515		
Ice mixing dams																			0	0	0	0	0	0	0	
Chilled water dams							3994	4023	3990	4003	4006	4009	38181	38454	38158	38277	38303	38334	58238	58844	58183	58367	58408	58454		
Clean return water dams							15659	15784	15896	15742	15746	15749	141910	143137	142249	142661	142699	142727	220499	222403	221023	221686	221724	221767		
Dirty return water dams																			0	0	0	0	0	0	0	
Settling dams																			0	0	0	0	0	0	0	
Pipes - down (ch. water)							501	501	501	501	501	501	33841	33841	33841	33841	33841	33841	36355	36355	36355	36355	36355	36355		
Pipes - up (return water)							801	801	801	801	801	801	29235	29235	29235	29235	29235	29235	33255	33255	33255	33255	33255	33255		
Pipes - Ice																			0	0	0	0	0	0	0	
<b>Total level Cooling Costs</b>	<b>77640</b>	<b>80866</b>	<b>82310</b>	<b>85289</b>	<b>89615</b>	<b>92882</b>	<b>50068</b>	<b>50450</b>	<b>50102</b>	<b>50207</b>	<b>50178</b>	<b>50138</b>	<b>796936</b>	<b>802846</b>	<b>798300</b>	<b>799870</b>	<b>799020</b>	<b>797867</b>	<b>1437870</b>	<b>1461889</b>	<b>1462843</b>	<b>1479891</b>	<b>1500607</b>	<b>1515649</b>		
<b>SUMMARY OF COST RESULTS FOR COOLING AND PUMPING</b>																										
<b>Base Case versus Global Recirculation</b>																										
		Percentage of air re-circulated																								
		0%	20%	30%	40%	50%	60%																			
Running costs	Surface	9096	9096	9096	9096	9096	9096																			
	Underground	77640	80866	82310	85289	89615	92882																			
Maintenance costs	Surface	9313	9313	9313	9313	9313	9313																			
	Underground	50068	50450	50102	50207	50178	50138																			
Capital costs	Surface	289000	299000	299000	299000	299000	299000																			
	Underground	796935	802846	798300	799870	799020	797867																			
Total costs	Surface	317409	317409	317409	317409	317409	317409																			
	Underground	924643	934162	930712	935368	938813	940887																			
<b>Total Cooling Cost: Surface and underground</b>		<b>1242052</b>	<b>1251571</b>	<b>1248121</b>	<b>1252775</b>	<b>1256222</b>	<b>1258296</b>																			
<b>Present Value (PV) Total Costs Cooling</b>		<b>1829260</b>	<b>1853279</b>	<b>1854233</b>	<b>1871261</b>	<b>1891997</b>	<b>1907039</b>																			





## Annexure B



**Fan Requirements and Costs for Gobal Reirculation of Air**

Costs (kR)	Running costs						Maintenance cost					Capital cost						Present value cost						
	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%
Surface Fans	20707	9120	6571	4602	3105	2004	5914	2605	1877	1314	887	572	64686	28491	20526	14375	9700	6262	198292	87336	62922	44064	29735	19195
Underground Recirculation Fans	0	760	1131	1497	1860	2221	0	258	383	508	631	753	0	2171	3229	4276	5312	6344	0	7281	10829	14339	17814	21271

**SUMMARY OF COST RESULTS FOR FANS: GLOBAL RE-CIRCULATION OF AIR**

		Percentage of air re-circulated					
		0%	20%	30%	40%	50%	60%
Running costs	Surface	20707	9120	6571	4602	3105	2004
	Underground	0	760	1131	1497	1860	2221
Maintenance costs	Surface	5914	2605	1877	1314	887	572
	Underground	0	258	383	508	631	753
Capital costs	Surface	64686	28491	20526	14375	9700	6262
	Underground	0	2171	3229	4276	5312	6344
Total costs	Surface	91308	40216	28974	20290	13692	8839
	Underground	0	3190	4744	6281	7803	9318
<b>Total Fan Costs: Surface and Underground</b>		<b>91308</b>	<b>43405</b>	<b>33717</b>	<b>26572</b>	<b>21495</b>	<b>18157</b>
<b>Present Value (PV) Total Fans Costs</b>		<b>198292</b>	<b>94617</b>	<b>73750</b>	<b>58404</b>	<b>47549</b>	<b>40466</b>

Total Cooling Cost: Surface and underground		Present Value (PV) Total Costs Cooling	
Surface	Underground	Surface	Underground
317409	317409	824643	856828
317409	317409	867763	870281
317409	317409	860945	870983
826238	831956	1274235	1278354
831956	831956	1265172	1287690
831956	831956	1242052	128392
831956	831956	1829260	1889707
831956	831956	1893689	1904928
831956	831956	1914109	1924725





## Annexure C



### Cooling Requirements and Costs for Localized Re-circulation of Air

	Running costs						Maintenance cost						Capital cost						Present value cost							
	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%		
<b>SURFACE RESULTS</b>																										
<b>COSTS (R)</b>																										
Pre-cooling tower	240	240	240	240	240	240	0	0	0	0	0	0	0	0	0	0	0	0	0	1205	1205	1205	1205	1205	1205	
Condenser cooling tower	645	645	645	645	645	645	0	0	0	0	0	0	0	0	0	0	0	0	0	3237	3237	3237	3237	3237	3237	
Refrigeration plant	6527	6527	6527	6527	6527	6527	8833	8833	8833	8833	8833	8833	275000	275000	275000	275000	275000	275000	275000	352088	352088	352088	352088	352088	352088	
Ice plant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Water treatment plant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Chilled water dam	0	0	0	0	0	0	240	240	240	240	240	240	12000	12000	12000	12000	12000	12000	12000	13205	13205	13205	13205	13205	13205	
Clean return water dam	0	0	0	0	0	0	240	240	240	240	240	240	12000	12000	12000	12000	12000	12000	13205	13205	13205	13205	13205	13205	13205	
Dirty return water dam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
All surface pumps	1684	1684	1684	1684	1684	1684	0	0	0	0	0	0	0	0	0	0	0	0	0	8452	8452	8452	8452	8452	8452	
<b>Total Surface Cooling Costs</b>	<b>9096</b>	<b>9096</b>	<b>9096</b>	<b>9096</b>	<b>9096</b>	<b>9096</b>	<b>9313</b>	<b>9313</b>	<b>9313</b>	<b>9313</b>	<b>9313</b>	<b>9313</b>	<b>299000</b>	<b>299000</b>	<b>299000</b>	<b>299000</b>	<b>299000</b>	<b>299000</b>	<b>391390</b>	<b>391390</b>	<b>391390</b>	<b>391390</b>	<b>391390</b>	<b>391390</b>		
<b>TOTAL LEVEL RESULTS</b>																										
Refrigeration plant (RW)																				0	0	0	0	0	0	
Refrigeration plant (CT)	23047	27204	27646	28088	29800	32441	9871	10393	10142	10128	9954	9736	261673	269227	268855	268483	263883	258095	426880	457917	458504	460280	463399	469771		
Condenser cooling tower	1120	1094	1082	1069	1056	1043													5621	5491	5430	5365	5300	5235		
Pelton turbine	-11592	-12578	-13097	-13627	-14162	-14715	1790	1943	2023	2105	2187	2273	16114	17465	18205	18941	19685	20454	-33080	-35909	-37373	-38885	-40415	-41989		
Hydrolift device	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Throttle valve (OC at Dam)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Throttle valve (CC)	0	0	0	0	0	0	892	958	964	989	1008	1017	4458	4789	4819	4846	5016	5083	8935	9597	9657	9910	10075	10187		
Water treatment plants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
High pressure pumps	60649	62403	62657	63334	63752	64148	16245	16715	16783	16964	17076	17183	270753	277849	279717	281585	284608	286376	656665	674923	678407	684581	690264	694556		
Low pressure pumps	4416	4215	4057	3938	3795	3650	315	301	290	281	271	261	2760	2634	2536	2460	2372	2281	26504	25299	24353	23624	22778	21909		
Ice mixing dams	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Chilled water dams	0	0	0	0	0	0	3994	4271	4314	4406	4467	4523	38181	38269	39098	39827	40482	40987	58236	59704	60749	62040	62901	63887		
Clean return water dams	0	0	0	0	0	0	15859	16520	16544	16832	16959	17070	141910	148776	149932	152538	153684	154689	220489	231686	232962	237014	238807	240369		
Dirty return water dams	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Settling dams	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Pipes - down (ch. water)	0	0	0	0	0	0	501	501	501	501	501	501	33841	33841	33841	33841	33841	33841	36355	36355	36355	36355	36355	36355		
Pipes - up (return water)	0	0	0	0	0	0	801	801	801	801	801	801	29235	29235	29235	29235	29235	29235	33255	33255	33255	33255	33255	33255		
Pipes - Ice	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
<b>Total level Cooling Costs</b>	<b>77640</b>	<b>82338</b>	<b>82345</b>	<b>82800</b>	<b>84241</b>	<b>86567</b>	<b>60068</b>	<b>52403</b>	<b>52362</b>	<b>53007</b>	<b>53224</b>	<b>53365</b>	<b>796935</b>	<b>822085</b>	<b>826238</b>	<b>831956</b>	<b>832816</b>	<b>831051</b>	<b>1437870</b>	<b>1498317</b>	<b>1502299</b>	<b>1513538</b>	<b>1522719</b>	<b>1533335</b>		
<b>SUMMARY OF COST RESULTS FOR COOLING AND PUMPING</b>																										
<b>Base Case versus Localized Recirculation</b>																										
		Percentage of air re-circulated																								
		0%	20%	30%	40%	50%	60%																			
Running costs	Surface	9096	9096	9096	9096	9096	9096																			
	Underground	77640	82338	82345	82800	84241	86567																			
Maintenance costs	Surface	9313	9313	9313	9313	9313	9313																			
	Underground	50068	52403	52362	53007	53224	53365																			
Capital costs	Surface	299000	299000	299000	299000	299000	299000																			
	Underground	796935	822085	826238	831956	832816	831051																			
Total costs	Surface	317409	317409	317409	317409	317409	317409																			
	Underground	924643	956828	960845	967763	970281	970983																			
<b>Total Cooling Cost: Surface and underground</b>		<b>1242052</b>	<b>1274235</b>	<b>1278354</b>	<b>1285172</b>	<b>1287690</b>	<b>1288392</b>																			
<b>Present Value (PV) Total Costs Cooling</b>		<b>1829260</b>	<b>1889707</b>	<b>1893689</b>	<b>1904928</b>	<b>1914109</b>	<b>1924725</b>																			



## Annexure D



### Fan Requirements and Costs for Localized Recirculation of Air

Costs (kR)	Running costs						Maintenance cost						Capital cost						Present value cost					
	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%	0%	20%	30%	40%	50%	60%
Surface Fans	20707	11697	8474	5966	4031	2520	5914	3341	2420	1704	1151	720	64688	36540	26471	18638	12591	7873	198292	112011	81146	57132	38598	24134
Underground Recirculation Fans	0	36	53	70	86	102	0	12	18	24	29	35	0	104	153	200	247	292	0	348	512	672	828	978

#### SUMMARY OF COST RESULTS FOR FANS: LOCALIZED RE-CIRCULATION OF AIR

		Percentage of air re-circulated					
		0%	20%	30%	40%	50%	60%
Running costs	Surface	20707	11697	8474	5966	4031	2520
	Underground	0	36	53	70	86	102
Maintenance costs	Surface	5914	3341	2420	1704	1151	720
	Underground	0	12	18	24	29	35
Capital costs	Surface	64688	36540	26471	18638	12591	7873
	Underground	0	104	153	200	247	292
Total costs	Surface	91308	51578	37366	26308	17773	11113
	Underground	0	152	224	294	363	428
<b>Total Fan Costs: Surface and Underground</b>		<b>91308</b>	<b>51730</b>	<b>37590</b>	<b>26602</b>	<b>18136</b>	<b>11541</b>
<b>Present Value (PV) Total Fans Costs</b>		<b>198292</b>	<b>112359</b>	<b>81658</b>	<b>57804</b>	<b>39426</b>	<b>25111</b>