SURAT FLOODS: HOW IT WAS AN PREVENTABLE DISASTER
Why was the water not released before allowing reservoir to be full?

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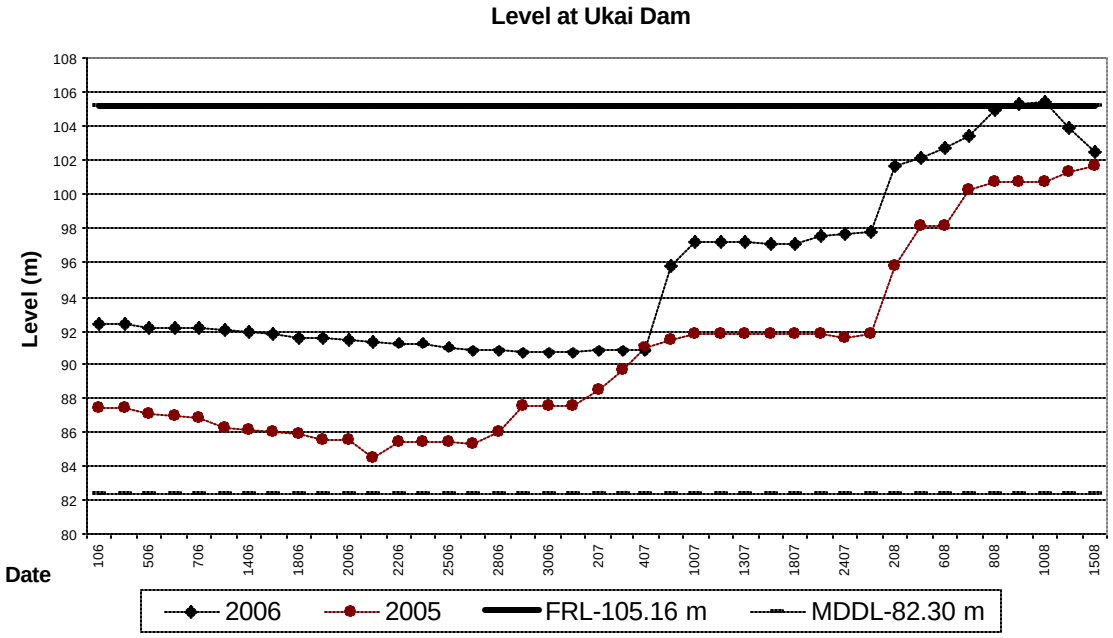
The unprecedented floods of Surat city and district in South Gujarat in western India earlier this month and the damages of over Rs 21 000 crores (according to Gujarat govt estimates, actual losses would be much higher if all the losses are properly accounted) were completely preventable. Had the authorities released even 3 lakh cusecs of water from the Ukai dam starting from Aug 1, Surat may not have experienced such a disaster. There was sufficient specific information available to take such an action, as is evident from the rainfall figures in Tapi basin talukas in Maharashtra. Due to lack of timely release of water by the Gujarat water resources department, the storage in the Ukai reservoir was allowed to go up beyond the levels it should have, leading to sudden release of unmanageable quantities of water from Aug 7, for prolonged periods. Since this coincided with the days of high tide when the river's drainage capacity is further reduced, the floods brought catastrophic results.

Rainfall As we can see from the salient features of the Ukai dam (Annexure 1, see www.sandrp.in/new/surat_floods_aug08.pdf), 97.85 % of the catchment area upstream from the dam site is in Maharashtra and Madhya Pradesh over 81.3 % in Maharashtra alone. We have compiled the list of dates when rainfall in the Tapi basin talukas in Maharashtra was more than 25 mm, during June 1, 2006 to August 14, 2006 (Annexure 2, see www.sandrp.in/new/surat_floods_aug08.pdf). We can see that such instances were spread all over July & Aug '06.

It is clear from these figures that Ukai was going to get large inflows in the days to come and there was sufficient actionable information available with the Gujarat water resources dept to release water from Ukai Dam in July itself.

Ukai Reservoir Level This was all the more important considering the rapid rise in water level at Ukai dam as shown in the graph below.



Highest pre monsoon, highest July end levels at Ukai When we compared the Ukai reservoir levels just before the monsoon and at the end of July for the last four years (for which we could get the data from Central Water Commission and Central Electricity Authority bulletins) we were surprised to find that the levels at Ukai dam were the highest this year in last four years, both with respect to the level just before the monsoon and also at the end of July, as is clear from the table below.

Year	Lowest level Before monsoon		Level (m) at the end of July
	Level, m	Date	
2003	89.91	June 17	94.56
2004	88.02	July 25	88.16
2005	85.37	June 24	94.26
2006	**90.71**	June 29	**97.8**

Source: Central Water Commission, Central Electricity Authority, Govt of India, bulletins of various dates

Water release figures from Ukai reservoir While the project authorities have yet to make public the hourly or even daily figures of inflows, outflows, levels and usage of water at Ukai throughout this monsoon, we could gather following figures from the govt statements and media reports.

Date	time	Inflows, cusecs	Outflows, cusecs	Water level, m
Aug 5	0800 am	85 958	26 664	102.20
	0800 pm	48554	23 640	102.26
Aug 6	0800 am	75 087	124 920	102.14
	0800 pm	330 216	254 780	102.57
Aug 7	0800 am	853 679	409 004	103.46
	0800 pm	1 072 680	816 036	104.22
Aug 8	0800 am	1 053 133	844 092	104.97
	0800 pm	961 466	907 316	105.33
Aug 9	0800 am	856 000	850 000	105.34
	0800 pm	711 757	650 000	105.38

It is disturbing to know that even as late as on Aug 6 evening, the water releases from Ukai reservoir were just 254 780 cusecs when the level had already built up to 102.57 m, that is reservoir was 83.6% full at 5.528 BCM live storage. A day earlier the releases were shockingly low at 23640 cusecs. This was when during the eight days preceding this, all the talukas of Nandurbar district had received over 25 mm rainfall at least for 4-5 days including an instance of 260 mm rainfall in a day and seven instances when rainfall was over 100 mm. Surgana taluka in Nashik was also getting similar pattern of rainfall.

WHAT COULD HAVE BEEN DONE? Had the Ukai dam authorities released 300 000 cusecs of water starting from Aug 1, the reservoir level at Ukai would have been reduced by over 3 BCM by the morning of Aug 6 and the level of water at the dam would have been 94.2 m (about 2.34 BCM storage). After this even with all the additional water coming in, continued outflow of 3-4 lakh cusecs would have been sufficient to ensure that reservoir does not get full and there would have been no big flood disaster in Surat district.

Sufficient actionable information available As we saw above, there was sufficient information available with all concerned about the increasing water level at Ukai reservoir and also about the high rainfall in the catchment.

Additional reasons There were additional reasons why such water releases of 300 000 cusecs starting from Aug 1 or earlier were justified:

1. As per Ukai reservoir design, the reservoir is supposed to have a flood cushion of 1.332 BCM. That means that this amount of storage should not be filled till the end of monsoon. Considering the current live storage capacity of 6.615 BCM, water level beyond 102.07 m (5.283 BCM) should not be filled up, in anticipation of floods. Since level at Ukai was already near this level on Aug 1, water releases of 300 00 cusecs should have been started from Aug 1 or earlier to reduce the storage at Ukai.
2. Moreover, this flood cushion was designed assuming that Tapi River could drain 8.5 lakh cusecs water. However, as noted by the report of the Govt of India's National Commission for Integrated Water Resources Development (Sept 1999, p 131), Tapi river's drainage capacity has gone down substantially in view of the experience in 1998 floods when even with an outflow of 6.73 lakh cusecs, Surat was badly flooded. The National Commission had in fact recommended a review of all the parameters of the Ukai dam operation. This should have required even greater flood cushion at Ukai, but neither such a review of the dam operation rules was done, nor was even old flood cushion properly used. All this also warranted release of 300 000 cusecs from Aug 1 or earlier.
3. The Central Water Commission Chair has accepted, as was known to Gujarat water resources dept that current water carrying capacity of the Tapi river is just 3.5-4.0 lakh cusecs. But this crucial information did not seem to be part of the equation of water releases from the Ukai dam.

The Gujarat Govt has a lot to explain why they did not start release of 300 000 cusecs from Aug 1 or earlier.

Power Generation at Ukai (Source: Central Electricity Authority (www.cea.nic.in))

Month	Generation, MU	Target, MU	% of target achieved
Jan 2006	45.79	74	61.88
Feb 2006	44.12	73	60.44
March 2006	53.52	66	81.09
April 2006	56.13	60	93.55
May 2006	50.25	71	70.77
June 2006	29.2	61	47.87
July 2006	13.85	33	41.97

One reason why the dam authorities tend to keep high storages at dams like Ukai is for maximization of power generation. So we looked at the power generation figures from Ukai Dam and the figures we found from the Central Electricity Authority equally shocking.

We can see from the above table is that even as the Ukai reservoir had unprecedented water storage and Gujarat was facing power deficit of up to 1500 MW, Ukai was not being used to generate power. And this situation continued right up to July 2006, when the power generation at Ukai was the lowest in 2006 so far. Here it should be remembered that the target figures in the second column above are fixed by the project authorities and do not signify the maximum power that Ukai can generate. In fact the potential of power generation at Ukai is much higher than these figures.

The loss of power generation benefit to economy is thus a big loss for the nation. The second consequence of this was that Ukai had unnecessarily high water levels throughout this period, leading, ultimately to disastrous floods in Surat district in August. Thirdly, this water flowed away without generating any power, which is also a loss of potential benefit. Who will be held answerable for these losses? (For Power generation figures at Ukai in the recent years, see Annexure 3 at: www.sandrp.in/new/surat_floods_aug08.pdf)

AVOIDABLE DISASTER It is clear from the above account that the unprecedented flood disaster that visited Surat district, earlier this month was totally preventable with lower pre-monsoon storages (which could have been achieved by higher power generation at Ukai in pre-monsoon months) and by timely releases of around 300 000 cusecs starting from Aug 1, for which there was sufficient actionable information available to all concerned. The commission of enquiry set up by the Gujarat govt is not likely to inspire much confidence and what is required is an independent, credible investigation of the events leading to the disaster. In the meantime, Gujarat water resources ministry would do well to release all the figures of inflows, outflows and levels at Ukai Dam from June 1 to Aug 15, 2006.

Recommendations What happened in Tapi basin could also be seen to the replicated in a number of other basins this monsoon, including Sabarmati, Mahi, Krishna, Godavari, among others. To reduce occurrence of such events in future, some immediate recommendations can be made:

⇒ **National Enquiry** A Nationwide independent enquiry should be set up on the issue of floods in India this year, particularly those from the sudden releases of dams all over India. With proper use of water in the reservoir before the monsoon and timely releases of water from the dams, many of these disasters could have been avoided or damages substantially reduced.

⇒ **High Pre Monsoon storages** As shown by SANDRP press release on Aug 10(www.sandr.in/new), a number of dams in these basins had high water storages, up to 47%. The investigation should also look into why this was the case, what were the consequences and how they could have been avoided.

⇒ **Transparency in Dam operations** The inflows, outflows, levels, storages and forecasts at all reservoirs should be routinely made public on daily basis.

⇒ The reservoir operation rules, the rule curves and disaster management plans should be in public domain for all reservoirs.

⇒ **Provide basin wise rainfall data, forecasts** Met Dept (& others, including state govts) should give basin wise rainfall data and the rainfall forecasts should be done river basin wise and not geographic area wise as is done now.

⇒ **Failure of CWC** The Central Water Commission's performance about flood forecasting leaves a lot to be desired. It seems to have totally failed to predict the floods, both due to heavy rainfall and due to releases from dams from all over India. For example, even as a number of river basins in Gujarat were experiencing floods due to releases from dams, the flood forecasts at CWC website was completely silent on all these floods.

⇒ **Review Dam Operation Rules** As recommended by the National Flood Commission (1980) and also the National Commission for Integrated Water Resources Development, periodic review of dam operation rules and rule curves should be taken up in a transparent manner and the same should be made public.

⇒ **UNDP reports inaccurate** UNDP routinely puts out flood situation reports, that seems to have no understanding of how the sudden releases of water from dams are leading to floods. It is expected that UNDP reports would give a more accurate picture of the situation.

⇒ **Citizens Groups** Most importantly, Citizens groups around the large dams in their respective areas all over India need to monitor the dam operations and flood situation and make the govt answerable for the avoidable disasters.

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Annexure 1

Salient features of Ukai Reservoir

Location	Songadh, Surat district
River	Tapi
Catchment Area	62 225 sq km
Gujarat	1 337 sq km (2.15 %)
Maharashtra	51 254 sq km (82.37 %)
Madhya Pradesh	9 634 sq km (15.48%)
Design flood discharge	49 490 cumecs (1.75 million cusecs)
Year of completion	1972
Gross storage capacity	8.511 BCM
Live storage capacity	7.092 BCM (current LS cap is 6.615 BCM, as per CWC, possibly due to siltation)
FRL	105.16 m (345 ft) (CWC flood forecast website says FRL is 102. 41m , possibly considering the flood cushion provision of 1.332 BCM)
MDDL	82.3 m (270 ft)
Riverbed level	47.87 m (157.05 ft)
Installed power generation capacity	305 MW (4 X 75 MW + 2 X 2.5 MW – this was added at a latter date)
Hydraulic head	34-57 m
Maximum discharge	213 cumecs (7522 cusecs)

Annexure 2

High (over 25 mm) Rainfall Days for the TAPI basin talukas (of respective districts, see below) During the Period : 01/06/2006 To 14/08/2006

AKOLA district

Date	Akot	Telhara	Balapur	Patur	Akola	Barshitakli	Murtijapur
04/06/2006	5.01	39.7	0	12	0	9.01	0
24/06/2006	2.4	3.6	32	22	25.7	18.1	37.2
25/06/2006	45.4	2.8	0.1	0.6	0.5	18.3	0
28/06/2006	0	5.4	9	18	20.8	50.2	5.4
30/06/2006	2.4	3.4	1.2	2	12.6	3.3	28.2
04/07/2006	51	65.5	31	119	57.6	107	35
05/07/2006	64.97	84	130	42	101.4	66	33
06/07/2006	27	18	0	3	0	0	0
23/07/2006	4.1	1	6	19	25.3	20	45
28/07/2006	8.2	13.2	18	11	18.5	44	22.3
05/08/2006	13	34.2	69	113	66.6	60	40
06/08/2006	102.2	96	135	194	134.4	129	77.1
07/08/2006	102.2	96	135	194	134.4	129	77.1
08/08/2006	33.2	31.4	21	7	9	5.2	10
09/08/2006	25.4	13	3	0	6	2	14.3

DHULE district

Date	Dhule	Sakri	Shirpur	Shindkheda
01/06/2006	0	33	4	14
19/06/2006	2	32	7	2
21/06/2006	0	20	34	8
25/06/2006	0	0	22	33.6
02/07/2006	7	27	5	30
03/07/2006	0	0	25	15
05/07/2006	40	36	113	77
06/07/2006	9	50	68	36
19/07/2006	8	4	25	20
22/07/2006	8	30	4	9
29/07/2006	19	24	63	34
30/07/2006	11	15	58	35
05/08/2006	12	6	14	44
06/08/2006	36	11	47	59
07/08/2006	95	66	159	113
08/08/2006	11	22	34	23

NANDURBAR district

Date	Nandurbar	Navapur	Shahada	Taloda	Akrani	Akkalkua
01/06/2006	16	3	7	20	12	32
03/06/2006	8	34	3	25	5	51
19/06/2006	80	0	4	3	15	24
24/06/2006	1	0	0	0	29	0
25/06/2006	41	0	31	7	0	0
28/06/2006	20	8	11	48	24	69
30/06/2006	16	20	70	22	10	17
01/07/2006	9	25	4	0	44	1
05/07/2006	38	163	59	110	41	67
06/07/2006	58	70	17	44	126	91
10/07/2006	6	4	13	25	3	9
19/07/2006	16	6	55	43	9	29
20/07/2006	2	30	0	3	4	34
22/07/2006	10	48	10	24	11	38
23/07/2006	5	5	26	18	9	36
25/07/2006	4	3	2	10	2	25
28/07/2006	32	7	9	18	13	30
29/07/2006	66	108	71	121	260	105
30/07/2006	63	167	58	91	140	100
31/07/2006	18	12	22	24	6	27
01/08/2006	4	7	29	59	106	85
02/08/2006	63	56	21	28	17	49
03/08/2006	20	85	13	33	31	24
04/08/2006	17	45	3	12	3	33
06/08/2006	41	8	36	14	78	20

Date	Nandurbar	Navapur	Shahada	Taloda	Akrani	Akkalkua
07/08/2006	169	113	118	161	230	110
08/08/2006	39	49	22	42	46	60
10/08/2006	9	10	51	28	55	20
11/08/2006	31	11	109	112	57	85
12/08/2006	15	6	4	6	96	26

WASHIM district

Date	Malegaon	Mangrulpir	Karanja
28/06/2006	4	27.2	55
04/07/2006	135	115	51.4
05/07/2006	19.4	15	47.6
31/07/2006	0	11.7	38.7
05/08/2006	87	70	75
06/08/2006	204.4	227	253.8
07/08/2006	118.8	74.2	88.8
10/08/2006	0	30.2	1

AMRAVATI district

Date	Dharni	Chikhaldhara	Amravati	Bhatkuli	Nandgaon-khandeshwar	Morshi	Daryapur	Anjangaon	Achalpur	Chandubaja
09/06	0	0	0	0	0	14.2	0	34.6	0	0
10/06	0.4	0	0	0	23.4	0	0	31.2	0	0
21/06	0	2	8.3	0	0	0	0	31.2	6	0
22/06	0	0	41.4	0	0	0	0	0	2	0
24/06	6.04	15.06	4.02	4.09	25	31.3	20.1	1	0	8.1
27/06	0	2.06	0	0.19	0.81	0	0	32	9	0
30/06	26.4	16	0	0	36	2.2	3.6	1.2	0	0
01/07	0	0.2	0	0	0	11.2	0	0	0	39
04/07	20.2	22.6	20.2	48.5	87	3.2	38.4	32.2	7	14.4
05/07	40.8	61	24.4	55.1	20.2	1.1	54.2	60	38	14.2
06/07	45.7	49.2	42.5	132.4	70.2	42.3	116.1	44.2	17	32
07/07	50.2	43.2	38.2	36.5	34.5	48.2	41.8	140	41	47
08/07	58	54.2	7.4	6.2	6.2	7.2	15.2	26.6	28	12
09/07	0	17	84.3	40.2	14.2	3.4	16.8	28.6	4	18.2
18/07	13.4	59.4	60.4	41.9	24	58	34.4	25.9	70	32
19/07	59.4	20.8	1.6	6.9	0	3	0	9.08	7	27
28/07	42.8	32.4	12.6	24.8	17.2	17.9	19.2	10.3	12	13.1
29/07	4.8	10.6	31.6	15.1	36.5	6.2	18.2	20.2	6	9
04/08	2.3	65.4	19.2	5.4	14.2	26.3	8.6	1	2	9
05/08	40.8	61	24.4	55.1	20.2	1.1	54.2	60	38	14.2
06/08	45.7	49.2	42.4	132.4	70.2	42.3	116.1	44.2	17	32

Date	Dharni	Chikhaldhara	Amravati	Bhatkuli	Nandgaon-khandeshwar	Morshi	Daryapur	Anjangaon	Achalpur	Chandubaja
07/08	50.2	43.2	38.2	36.5	34.5	48.2	41.8	140	41	47
08/08	58	54.2	7.4	6.3	6.2	7.2	15.2	26.6	28	12
09/08	0	17	84.3	40.2	14.2	3.4	16.8	28.6	4	19
14/08	28.4	46	10.2	1.9	7.2	12	12.4	10.6	18	11.2

AURANGABAD district

Date	Vaijapur	Kannad	Soegaon
24/06/2006	31.6	27.8	28.5
29/06/2006	2.6	3	28
03/07/2006	26.75	38	0
05/07/2006	94.9	113.8	71.5
05/08/2006	3.2	19.2	37
06/08/2006	43.8	81.3	116
07/08/2006	61.5	103	162
08/08/2006	32.5	21.5	20

BULDANA district

Date	Jalgaon (jamod)	Sangrampur	Chikhali	Buldhana	Mehkar	Khamgaon	Shegaon	Malkapur	Motala	Nandura
20/06	0	0	0	49	15	0	0	0	0	8
21/06	27	0	14	2	17	23.6	0	0	6	0
24/06	3	3	20	19.6	29	21.8	15.4	11.8	32	14
25/06	1	1	62	24.2	20	0	2.2	0	42	0
28/06	26	20	8	70.4	35	25.8	6.3	3.8	9	7
29/06	0	0	5	28.2	20	0	1.6	0	0	0
04/07	6	9	20	37.4	62	17	10	12	24	11
05/07	86	190	55	70	33	198.8	147	111	115	105
23/07	2	1	11	0	3	12.4	26.4	0	4	0
05/08	30	67	45	68.6	66	74.8	85.6	27	34	35
06/08	70	100	218	202	236	79.4	105	91	182	80
07/08	181	140	210	242	133	163.8	201	207	206	147
08/08	35	37	6	6	5	10.2	21	21	12	16
15/08	0	3	0	0	0	0	27	4	0	4

JALGAON district

Date	Jalgaon	Bhusawal	Yaval	Raver	Edlabad mukainagar)	Amalner	Chopda	Erandol	Parola	Chalisgaon	Jamner	Pachora	Bhadgaon
18/06	6.6	7	19	0	8	2	2	40	27	9	0	30.2	65.2
20/06	31.8	22.6	16	27	53	0	0	8	0	24	0	0	0
21/06	38.4	0	0	0	0	0	38	0	0	3	0	0	0
24/06	19	26	11	18	78	4.2	4	20	9.2	47	32	12	43
28/06	27.6	1.7	41	22	0	41.3	28	2	0	7	10	40	13
04/07	15	7.2	13	15	27	15.2	20	23	38.2	15	27	28	13
05/07	240	188	115	103	122	175.2	322	218	176	69	105	91	93
06/07	34.2	40	41	18	7	20.8	145	33	32.4	5	5	12	12
19/07	12.4	13.1	23	45	38	9.2	26	7	4.8	11	20	2.4	3
20/07	10	2.2	0	0	3	1.3	0	29	53.3	2	16	39	10
22/07	33	15.2	9	2	8	47	17	40	15.8	5	13	4	3
23/07	13.4	14.4	30	55	7	22.3	9	5	10.6	7	0	2	2
29/07	13.6	19.1	26	8	14	21.2	27	22	27	16	7	6	7
30/07	11.6	12.6	35	13	17	14.3	43	5	5	2	5	0	2
05/08	30.2	16.5	20	14	27	19.2	31	14	19	19	20	13	27
06/08	221	229	164	72	123	51.2	78	98	46	63	230	85	47
07/08	161	203	248	334	185	89.7	206	130	150	153	143	186	175
08/08	49	66	106	54	60	13	56	40	21.1	7	35	15	12
09/08	0	2	24	56	14	5.2	12	4	2	3	0	0	0.1
10/08	28	35	49	26	32	5.6	23	2	15.3	4	16	12	21.9
11/08	13.4	8.6	3	16	19.2	4	9	8	3.8	2	29	3	0
12/08	2	24.8	9	0	3	2	5	26	13	0	2	0	0

NASIK district

Date	Malegaon	Baglan	Kalwan	Nandgaon	Surgana	Chandwad
20/06/2006	4	1	20	37	18	72
21/06/2006	27	14	5	0	1	24.2
22/06/2006	0	0	0	25	0	0
23/06/2006	22	12	16	68	0	15.3
24/06/2006	9	15	25	50	0	18
25/06/2006	0	18	4	1	28	7
26/06/2006	6	0	3	3	43	0
01/07/2006	0	3	7	0	40	0
04/07/2006	35	9	5	33	5	3
05/07/2006	93	91	105	71.2	190	149
06/07/2006	17	19	23	14	90	17.3
07/07/2006	0	1	5	0	36	4
08/07/2006	0	0	2	0	25	1
22/07/2006	2	5	19	11	74	9
23/07/2006	5	9	12	12	30	41
24/07/2006	0	2	6	0	39	5
28/07/2006	2	7	18	1	72	7
29/07/2006	18	46	86	11.3	227	46
30/07/2006	2	9	25	1	109	18
31/07/2006	0	4	11	0	54	3
01/08/2006	0	1	5	1.5	39	1
02/08/2006	0	3	4	0	31	9
03/08/2006	3	8	17	6.4	69	5.2
04/08/2006	6	4	4	3	26	1

Date	Malegaon	Baglan	Kalwan	Nandgaon	Surgana	Chandwad
05/08/2006	4	3	24	0	48	21
06/08/2006	5	19	21	28.2	60	22
07/08/2006	86	74	89	77	149	100
08/08/2006	38	62	91	32	160	60
09/08/2006	12	33	78	26	164	81
10/08/2006	10	30	129	26	180	99
11/08/2006	4	16	35	0.5	84	5
12/08/2006	0	2	4	0	42	6.1
13/08/2006	0	3	5	0	108	4

JALNA district

Date	Bhokardhan	Jafrabad
19/06/2006	29.5	0
25/06/2006	29	6
05/07/2006	39	46.2
27/07/2006	39	6
05/08/2006	19.5	35.8
06/08/2006	135.5	228.2
07/08/2006	170	52

Source: Maharashtra Govt website: http://agri.mah.nic.in/agri/stat/HtmlArea/raindata_main.html

Annexure 3

Ukai Power Generation over the years

Year	Power generation, MU
1992-93	421
1993-94	921
1994-95	929
1995-96	476
1996-97	524
1997-98	866
1998-99	**946**
1999-2000	852
2000-01	456
2001-02	246
2002-03	570
2003-04	580.49
2004-05	466.07
2005-06	757
Apr ‘06-July ‘06	149.43

Source: Central Electricity Authority (www.cea.nic.in)