

MEMORANDUM

August 27, 2007

To: Shelley Keen
From: John Crockett 
Re: Brownlee Dam Hydropower Operation

As requested I have review the water right file for the Idaho Power Company (IPC) Brownlee hydropower facility. It is my understanding Idaho Power has existing water rights totaling 30,000 cfs for the facility and the purpose of your current review is to determine if the additional 5,000 cfs water right IPC is requesting is an appropriate amount for the maximum flow for the facility.

Your initial question to me was what water-to-wire electricity production efficiencies might be expected at a facility like Brownlee Dam. The short answer is efficiencies approaching ninety percent (90%). Information contained in the IPC water right file confirms this but not for the reason you might expect.

The previous IDWR investigation of maximum power flows through Brownlee, labeled Exhibit E and using data provided by IPC on June 4, 1985, assumed efficiencies ranging from 88 to 90 percent and back-calculated the flows. I developed a similar approach with the spreadsheet that is attached. With this spreadsheet I calculated the efficiencies, like the previous IDWR investigation, and adjusted the head to observe the impact the it had upon the power production and the subsequent flows that were being calculated.

After adjusting the head I determine that changing the head, within reasonable limits, did not have a significant effect on the back-calculated flow. I also plotted the water-to-wire efficiency from the June 4, 1985 data (also attached). Readable flows on this day were report to range from 28,545 to 35,725 cfs. With 5 turbines/generators sets at Brownlee facility you can expect the overall efficiency to be like a step function as flows change and different turbines/generators go on line. Based on the turbine efficiency curves provided in the in the water right file a 20-percent change in flow results in a change in turbine efficiency of about 5-percent even on the flattest portion of the efficiency curve. Since the 1985 data showed the efficiency only changed by about 1-percent with a 20-perent change in flow there is clearly an inconsistency with the data.

When evaluating any hydropower facility the two most difficult factors to determine are the flows and the efficiencies. While evaluating the 1985 data the nagging question I had was how IPC measured the flows reported on their data sheet. Flows are often difficult to measure, particularly flows in the 35,000 cfs range. I suspect the flows reported by IPC on June 4, 1985 were, in all likelihood, are not determined by measuring the flows but are calculated based on assuming an efficiency. However, based on my review I believe that a total water right for the Brownlee hydropower facility of 35,000 cfs is reasonable and appropriate.

BROWNLEE HYDROPOWER FACILITY

Headwater Max	2077.46	Tailwater Max	1805.6	Head	271.86
Headwater Min	2076.85	Tailwater Min	1798.1		278.75
Max. Static Head -----	274 Feet	Nominal Pipe Size-	1000.00	Inches I.D.	
Turbine Type -----	REACTION	Penstock Length -	200 Feet		
		Hazen-Williams "C" =	120		

@1000 IN ID

POWER CFS	VELOCITY Feet/Sec	TOTAL EFFICIENCY	NET HEAD	POWER KILOWATTS	TOTAL EFFICIENCY	MEASURED HEAD	NET HEAD	POWER KILOWATTS	REPORTED MW
28,545	5.23	88.64	274	587,008	89.3	271.98	271.97	587,041	587
31,000	5.68	88.71	274	637,992	89.21	272.46	272.45	638,011	638
31,980	5.86	88.70	274	658,085	89.47	271.6	271.59	658,015	658
32,700	6.00	88.85	274	674,038	89.75	271.23	271.22	674,016	674
32,800	6.01	88.84	274	676,023	89.67	271.43	271.42	675,972	676
33,040	6.06	88.84	274	680,969	89.63	271.58	271.57	680,991	681
33,330	6.11	88.85	274	687,023	89.65	271.5	271.49	686,919	687
33,550	6.15	88.78	274	691,012	89.68	271.22	271.21	690,971	691
33,700	6.18	88.77	274	694,023	89.52	271.69	271.68	694,023	694
33,700	6.18	88.77	274	694,023	89.48	271.79	271.78	693,968	694
34,000	6.23	88.74	274	699,964	89.35	272.14	272.13	700,029	700
34,460	6.32	88.56	274	707,995	89.55	270.95	270.94	707,979	708
34,500	6.33	88.58	274	708,976	89.3	271.82	271.81	709,091	709
34,575	6.34	88.64	274	710,999	89.25	272.12	272.10	711,019	711
34,630	6.35	88.13	274	708,032	88.85	271.75	271.73	707,994	708
35,380	6.49	87.96	274	721,970	88.73	271.63	271.61	722,032	722
35,725	6.55	87.72	274	727,020	88.4	271.88	271.86	727,029	727

Brownlee Dam Power Plant



