Dear Rod and Dan,
To clarify what I'm looking for, let me tell you what I'm doing now. The methods currently used are from my experience at Woodward while working on the original Index Test box. I'm not locked into this exact format for the data. I'm using the Woodward format because that's what I'm familiar with and the data I have to work with.

The fundamental item I hope to learn from Dan's data is the manipulation method and scaling factors for the data that he is using now, and what USACE would prefer to see.

The Index Test Box program will be adapted to work with the data in the same manner that Dan is using for his analysis now, and configures to manipulate the data in whatever manner USACE prefers.

It would be better for me to adopt Dan's conventions for handling this data, instead of forcing my methods on what he is already doing. The closer I get my methods to comply with Dan's, the easier it will be to integrate the Index Test Box output data into the existing body of information.

The following discussion explains what I'm doing now.

As shown at right, Woodward's convention was to use nethead in feet, and percentage of gate & blade, with blade at 10% intervals and gate values wherever the lines cross the blade lines.

This data was presented at 5 heads, usually in a graph as shown below in Fig 1. Whenever it was presented in this graphical format, the data was digitized into a data table similar to that shown at left (but without the flow and power values that I added for the simulation).

My software development to date has used data from the 1985 USACE index test and subsequent Woodward Index Test Box demonstration at Clarence Cannon dam in Missouri. These two data sets were merged and extrapolated to prepare the table shown at right.

At startup, the new Index Test Box program loads the data table from a file on disk into the data array shown at right. The bitmap to the right and below are the actual screen display of the program in operation.

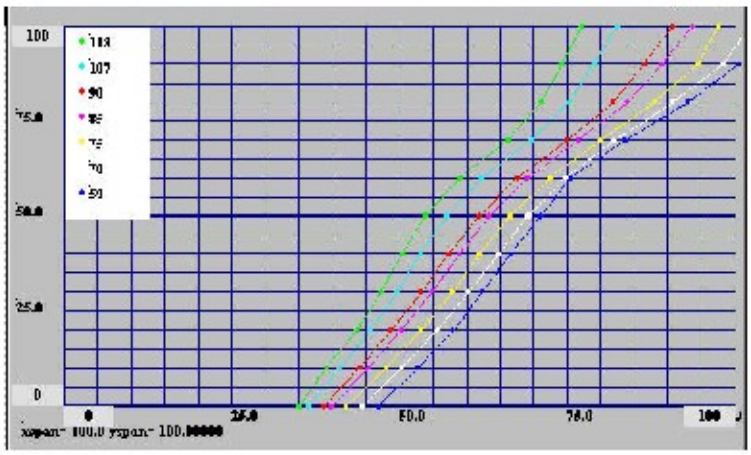

Figure 1: 3-D cam data at 5 heads.

	Head	Gate	Blade	Flow	Power
1	118	35.08	0	1353.58	12848.00
2	118	39.09	10	1610.90	15706.24
3	118	43.59	20	1864.06	18614.64
4	118	47.27	30	2084.37	21201.84
5	118	50.38	40	2284.80	23642.08
6	118	53.83	50	2503.93	26358.64
7	118	58.94	60	2834.61	30318.64
8	118	66.11	70	3267.03	35554.64
9	118	71.09	80	3731.17	41318.64
10	118	74.31	90	4104.75	46075.92
11	118	77.13	100	4257.36	48319.92
12	107	36.50	0	1426.09	13140.00
13	107	41.00	10	1699.05	16063.20
14	107	45.60	20	1967.81	19037.70
15	107	49.60	30	2201.53	21683.70
16	107	53.10	40	2414.27	24179.40
17	107	57.00	50	2646.93	26957.70
18	107	62.30	60	2997.50	31007.70
19	107	69.60	70	3456.20	36362.70
20	107	75.30	80	3948.82	42257.70
21	107	79.10	90	4344.89	47123.10
22	107	82.50	100	4506.43	49418.10
23	90	38.70	0	1661.38	13724.00
24	90	43.95	10	1981.28	16777.12
25	90	48.70	20	2296.47	19883.82
26	90	53.20	30	2570.40	22647.42
27	90	57.30	40	2819.85	25254.04
28	90	61.90	50	3092.74	28155.82
29	90	67.50	60	3503.39	32385.82
30	90	75.00	70	4040.98	37978.82
31	90	81.80	80	4618.61	44135.82
32	90	86.50	90	5082.59	49217.46
33	90	90.80	100	5271.55	51614.46
34	85	39.80	0	1753.19	14016.00
35	85	45.30	10	2091.51	17134.08
36	85	50.20	20	2424.93	20306.88
37	85	54.73	30	2714.64	23129.28
38	85	58.87	40	2978.50	25791.36
39	85	63.43	50	3267.20	28754.88
40	85	69.13	60	3701.41	33074.88
41	85	76.63	70	4269.95	38786.88

The Head, Gate and Blade numbers were obtained by digitizing the 3-D cam profile of Fig 1 that was used to program the blade position controller. This data was digitized to provide 11 discreet data points at 10% intervals for each of 5 heads. (complete data set is on the last page)

To prepare this table, the flow and power values at 75 feet were taken from the USACE index test in 1985. This test was done using the classical manual method. Data for 85 feet head was taken from the field test of the Woodward Index Test Box. The rest of the data in this table was extrapolated from these two reference data sets making many assumptions as to what the data should/would do.

I hope to get similar data for Unit #5 at McNary dam from this conversation so I can prepare a data table for this turbine similar to the data presented here.

When it runs, the new Index Test Box program draws two graphs, shown in Fig 2 and Fig 3, one with the on-cam line interpolated from the 5-head 3-D cam data set for the existing nethead.

As the program runs, the gates and blades are swept back and forth across this on-cam line by the program. At each point the program collects data for another data point, computes efficiency, then projects the new gate-blade data point onto the known 3-D cam data for the existing nethead, gate, and blade on-cam relationship as shown in Fig 2. The centerline from lower left to upper right is the On-cam line.

The yellow arcs fro upper left to lower right are the Constant Power lines. The Constant Power test employed by the Index test box will employ the unit's load-feedback governor to maintain power at the setpoint while the Index Test Box applies a bias between the gate-blade relationship to push the unit "off-cam."

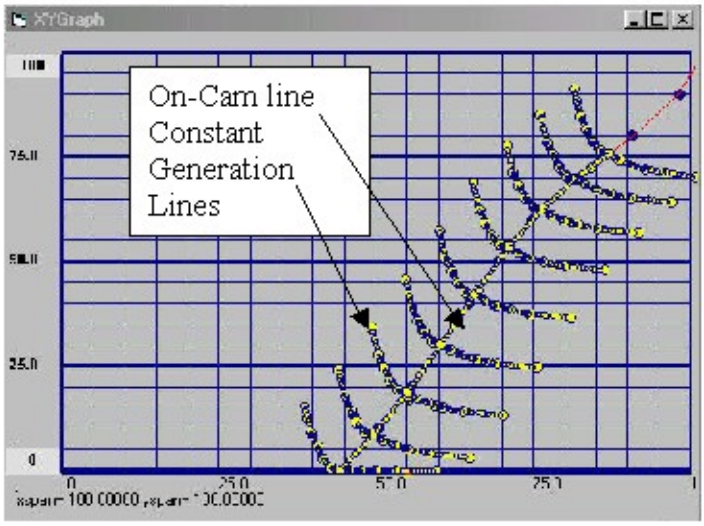

Figure 2: 3-D Cam On-cam data, X=Gate, Y=Blade

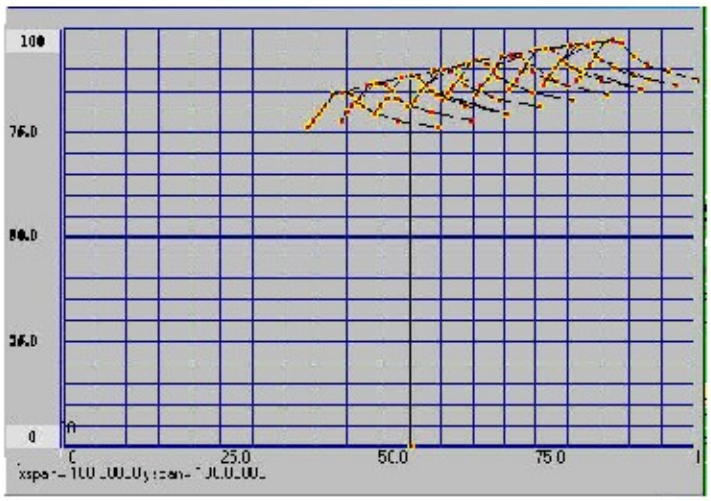

Figure 3 Predicted Efficiency map of Index Test

This method will cause the gate-blade motion to follow these "constant power" lines as shown at right.

At each data point efficiency will be computed, and projected onto a second graph, shown in Fig 3, the predicted efficiency for Clarence Cannon Dam's Kaplan turbine from the interpolated data table from the existing data.

New data will be projected on top of this graph in a different color as it is collected to provide a before/after image of the data being collected – on the fly.

So, having said all that; let me get back to my request.

I need the 3-D cam data that is programmed into the 3-D cam controller for Unit #5 at McNary dam.

I would also like whatever performance data; power, flow and efficiency (if available) for each discreet data point of the 3-D cam map so I can prepare another 3-D cam and turbine performance data table similar to the one I'm using now.

I'm not asking Dan to do any analysis work to prepare or format the data for my use. I'm wanting to get this data in whatever format Dan has it in and is using it in now – just give me what you've got.

I will format the data to fit my table, and adapt my system to use the data in whatever format it is received. The same methods and conventions that are currently employed by Dan in the USACE analysis of turbine performance data will be used wherever possible to make it easier to integrate the new Index Test Box data stream into the existing body of information on USACE turbine performance.
Thanks and best regards,
Doug.

	Head	Gate	Blade	Flow	Power
1	118	35.08	0	1353.58	12848.00
2	118	39.09	10	1610.90	15706.24
3	118	43.59	20	1864.06	18614.64
4	118	47.27	30	2084.37	21201.84
5	118	50.38	40	2284.80	23642.08
6	118	53.83	50	2503.93	26358.64
7	118	58.94	60	2834.61	30318.64
8	118	66.11	70	3267.03	35554.64
9	118	71.09	80	3731.17	41318.64
10	118	74.31	90	4104.75	46075.92
11	118	77.13	100	4257.36	48319.92
12	107	36.50	0	1426.09	13140.00
13	107	41.00	10	1699.05	16063.20
14	107	45.60	20	1967.81	19037.70
15	107	49.60	30	2201.53	21683.70
16	107	53.10	40	2414.27	24179.40
17	107	57.00	50	2646.93	26957.70
18	107	62.30	60	2997.50	31007.70
19	107	69.60	70	3456.20	36362.70
20	107	75.30	80	3948.82	42257.70
21	107	79.10	90	4344.89	47123.10
22	107	82.50	100	4506.43	49418.10
23	90	38.70	0	1661.38	13724.00
24	90	43.95	10	1981.23	16777.12
25	90	48.70	20	2296.47	19883.82
26	90	53.20	30	2570.40	22647.42
27	90	57.30	40	2819.85	25254.04
28	90	61.90	50	3092.74	28155.82
29	90	67.50	60	3503.39	32385.82
30	90	75.00	70	4040.93	37978.82
31	90	81.80	80	4618.61	44135.82
32	90	86.50	90	5032.59	49217.46
33	90	90.80	100	5271.55	51614.46

	Head	Gate	Blade	Flow	Power
34	85	39.80	0	1753.19	14016.00
35	85	45.30	10	2091.51	17134.08
36	85	50.20	20	2424.93	20306.38
37	85	54.70	30	2714.64	23129.28
38	85	58.87	40	2978.50	25791.36
39	85	63.43	50	3267.20	28754.38
40	85	69.13	60	3701.41	33074.28
41	85	76.63	70	4269.95	38786.38
42	85	83.86	80	4880.96	45074.38
43	85	89.17	90	5371.58	50264.64
44	85	93.70	100	5671.29	52712.64
45	75	42.00	0	1974.47	14600.00
46	75	48.00	10	2357.03	17848.00
47	75	53.20	20	2734.24	21153.00
48	75	57.80	30	3061.87	24093.00
49	75	62.00	40	3360.35	26866.00
50	75	66.50	50	3687.00	29953.00
51	75	72.40	60	4177.85	34453.00
52	75	79.90	70	4828.79	40403.00
53	75	88.00	80	5511.99	46953.00
54	75	94.50	90	6066.64	52359.00
55	75	97.50	100	6292.18	54909.00
56	70	44.50	0	2122.03	14308.00
57	70	50.30	10	2532.37	17491.04
58	70	55.60	20	2936.88	20729.94
59	70	60.20	30	3288.28	23611.14
60	70	64.80	40	3608.38	26328.68
61	70	69.20	50	3954.64	29353.94
62	70	74.70	60	4485.22	33763.94
63	70	82.00	70	5174.81	39594.94
64	70	90.70	80	5916.06	46013.94
65	70	98.30	90	6511.05	51311.32
66	70	102.10	100	6753.12	53910.32

	Head	Gate	Blade	Flow	Power
67	59	46.90	0	2499.47	13870.00
68	59	52.70	10	2981.80	16955.60
69	59	57.90	20	3457.15	20095.35
70	59	62.30	30	3870.18	22888.38
71	59	66.60	40	4246.36	25522.70
72	59	71.00	50	4657.95	28455.35
73	59	75.50	60	5276.99	32730.35
74	59	83.60	70	6087.54	38382.85
75	59	93.00	80	6958.65	44605.35
76	59	100.60	90	7658.11	49741.05
77	59	105.50	100	7942.83	52163.55
78					