

Fish Passage Plan (FPP) Change Form

Change Form # & Title: 24MCN004 – Updated Range for Turbines with ESBS
Date Submitted: 2-APR-2024
Project: McNary
Requester Name, Agency: Lisa Wright, Corps RCC
Final Action: **FINALIZED 11-APR-2024**

FPP SECTION: Chapter 5 (MCN), Table MCN-6. Turbine Operating Range.

JUSTIFICATION FOR CHANGE:

As part of the effort to develop more accurate turbine flow tables (see January 2022 [presentation](#) to FPOM), the Corps HDC has updated the operating ranges for McNary turbines based on reprocessing the 2023 Unit 9 index test and 1950 model test. These tables are for fully adjustable Kaplan units with fish screens in place (Units 5 and 6 with locked blades are not affected). Ranges for units with no ESBSs installed will be updated later this year.

The differences of the new turbine ranges and the previous ranges are largely based on new analysis techniques. Some of the specific analysis differences are as follows:

- a. The new tables are on a true “gross head” basis, considering head losses when applying the model test. This includes a more accurate accounting of head losses being dependent on flow.
- b. The new tables are based on a common methodology for accounting for efficiency losses.
- c. The new tables give greater weighting operation closer to the conditions of the index test and greater weighting to the model test when operation is further from the conditions of the index test.
- d. Data extraction from the envelope curve developed from the index test was at a finer resolution than previous efforts.
- e. Generator limits have been taken to unity power factor. In addition, cavitation limits have been taken to a standardized, conservative limit.

Over the head range from 62-77 feet, there is a smaller operational range compared to the previous tables, primarily attributed to a widening of the upper operating limit caused by more conservative cavitation limits. The head range of 79-92 feet has a slightly larger operating range compared with the previous tables.

PROPOSED CHANGES:

See existing table versus new table on following pages.

EXISTING TABLE:

Table MCN-6. McNary Dam Turbine Unit Power (MW) and Flow (cfs) at ±1% of Peak Turbine Efficiency (Lower and Upper Limits of 1% Range) and Operating Limits. ^{a, b}

Project Head (feet)	MCN Units 1–14 With ESBS ^b						MCN Units 1–14 No ESBS ^b					
	1% Lower Limit		1% Upper Limit		Operating Limit		1% Lower Limit		1% Upper Limit		Operating Limit	
	MW	cfs	MW	cfs	MW	cfs	MW	cfs	MW	cfs	MW	cfs
62	34.5	7,951	49.7	11,454	68.0	16,311	34.7	7754	50.8	11,346	68.0	15,710
63	35.2	7,963	51.0	11,552	69.6	16,399	35.4	7765	52.1	11,444	69.6	15,793
64	35.8	7,974	52.3	11,646	71.2	16,486	36.0	7776	53.5	11,537	71.2	15,875
65	36.5	7,984	53.7	11,736	72.8	16,571	36.7	7,786	54.8	11,627	72.8	15,955
66	37.0	7,959	55.2	11,869	74.1	16,574	37.2	7,762	56.3	11,759	74.1	15,945
67	37.5	7,934	56.7	11,997	75.3	16,574	37.7	7,739	57.9	11,887	75.3	15,933
68	38.0	7,911	58.2	12,121	76.6	16,572	38.2	7,716	59.4	12,009	76.6	15,919
69	38.5	7,887	59.7	12,240	77.8	16,567	38.7	7,694	60.9	12,128	77.8	15,903
70	39.0	7,864	61.2	12,355	79.0	16,560	39.2	7,671	62.5	12,243	79.0	15,884
71	39.6	7,874	62.1	12,355	79.7	16,433	39.8	7,681	63.4	12,243	79.7	15,782
72	40.2	7,883	63.1	12,354	80.4	16,303	40.4	7,691	64.4	12,242	80.4	15,676
73	40.9	7,892	64.0	12,353	81.0	16,169	41.1	7,699	65.3	12,241	81.0	15,567
74	41.5	7,901	64.9	12,351	81.6	16,033	41.7	7,708	66.3	12,240	81.3	15,455
75	42.2	7,909	65.8	12,350	82.2	15,893	42.4	7,716	67.2	12,239	81.3	15,340
76	42.8	7,907	66.4	12,282	82.5	15,705	43.0	7,714	67.9	12,172	81.3	15,161
77	43.4	7,905	67.1	12,216	82.8	15,513	43.6	7,713	68.5	12,107	81.3	14,979
78	44.0	7,903	67.7	12,151	83.1	15,319	44.2	7,711	69.1	12,044	81.3	14,795
79	44.6	7,900	68.3	12,088	83.3	15,122	44.8	7,709	69.7	11,981	81.3	14,608
80	45.2	7,897	68.9	12,026	83.4	14,922	45.5	7,706	70.3	11,920	81.3	14,418
81	45.9	7,911	70.0	12,067	83.7	14,747	46.1	7,720	71.5	11,961	81.3	14,256
82	46.5	7,925	71.1	12,106	83.8	14,569	46.8	7,734	72.6	12,000	81.3	14,091
83	47.2	7,939	72.2	12,145	84.0	14,389	47.4	7,747	73.7	12,038	81.3	13,924
84	47.9	7,952	73.3	12,182	84.1	14,206	48.1	7,759	74.9	12,076	81.3	13,754
85	48.5	7,964	74.4	12,219	84.2	14,020	48.8	7,772	76.0	12,112	81.3	13,582
86	49.2	7,987	75.1	12,179	84.0	13,806	49.5	7,794	76.7	12,073	81.3	13,373
87	50.0	8,008	75.7	12,140	83.8	13,588	50.2	7,815	77.3	12,034	81.3	13,161

a. Values provided by HDC (Mar 1999; updated Jan 2005). Flow (cfs) calculated based on turbine efficiency, project head, and power output (MW). "Operating Limit" is the maximum safe operating point based on cavitation or generator limit (added Feb 2018).

b. Units 5 and 6 have hydraulically locked blades and restricted operating ranges defined below in **Table MCN-6-A**.

NEW TABLE:

Table MCN-6. McNary Dam Turbine Unit Power (MW) and Flow (cfs) at ±1% of Peak Turbine Efficiency (Lower and Upper Limits of 1% Range) and Operating Limits. ^{a, b}

Project Head (feet)	MCN Units 1–4, 7–14 With ESBS ^b						MCN Units 1–4, 7–14 No ESBS ^b					
	1% Lower Limit		1% Upper Limit		Operating Limit		1% Lower Limit		1% Upper Limit		Operating Limit	
	MW	cfs	MW	cfs	MW	cfs	MW	cfs	MW	cfs	MW	cfs
62	35.1	7,886	51.0	11,476	65.7	15,244	34.7	7754	50.8	11,346	68.0	15,710
63	35.6	7,857	51.8	11,441	66.8	15,183	35.4	7765	52.1	11,444	69.6	15,793
64	36.2	7,842	52.5	11,397	68.2	15,212	36.0	7776	53.5	11,537	71.2	15,875
65	36.8	7,847	53.3	11,352	69.8	15,306	36.7	7,786	54.8	11,627	72.8	15,955
66	37.6	7,870	54.0	11,312	71.4	15,392	37.2	7,762	56.3	11,759	74.1	15,945
67	38.4	7,908	54.7	11,264	72.9	15,467	37.7	7,739	57.9	11,887	75.3	15,933
68	39.3	7,947	55.5	11,242	73.5	15,316	38.2	7,716	59.4	12,009	76.6	15,919
69	40.1	7,977	56.6	11,267	74.3	15,214	38.7	7,694	60.9	12,128	77.8	15,903
70	40.7	7,985	57.9	11,352	75.2	15,127	39.2	7,671	62.5	12,243	79.0	15,884
71	41.4	7,987	59.4	11,473	76.0	15,022	39.8	7,681	63.4	12,243	79.7	15,782
72	42.0	7,997	61.0	11,612	76.8	14,892	40.4	7,691	64.4	12,242	80.4	15,676
73	42.8	8,015	62.6	11,740	77.4	14,746	41.1	7,699	65.3	12,241	81.0	15,567
74	43.5	8,031	64.1	11,847	78.0	14,595	41.7	7,708	66.3	12,240	81.3	15,455
75	44.1	8,038	65.4	11,923	78.5	14,454	42.4	7,716	67.2	12,239	81.3	15,340
76	44.4	7,983	66.0	11,868	79.1	14,360	43.0	7,714	67.9	12,172	81.3	15,161
77	44.7	7,930	66.4	11,771	79.7	14,277	43.6	7,713	68.5	12,107	81.3	14,979
78	45.0	7,884	66.4	11,632	80.3	14,203	44.2	7,711	69.1	12,044	81.3	14,795
79	45.4	7,847	66.5	11,487	81.0	14,139	44.8	7,709	69.7	11,981	81.3	14,608
80	45.8	7,814	66.8	11,392	81.7	14,081	45.5	7,706	70.3	11,920	81.3	14,418
81	46.2	7,785	67.0	11,286	82.3	14,022	46.1	7,720	71.5	11,961	81.3	14,256
82	46.6	7,753	67.4	11,223	82.9	13,957	46.8	7,734	72.6	12,000	81.3	14,091
83	47.0	7,726	67.6	11,121	83.4	13,876	47.4	7,747	73.7	12,038	81.3	13,924
84	47.4	7,703	68.1	11,065	83.7	13,777	48.1	7,759	74.9	12,076	81.3	13,754
85	47.9	7,691	68.4	10,989	84.0	13,657	48.8	7,772	76.0	12,112	81.3	13,582
86	48.4	7,684	68.9	10,939	84.1	13,519	49.5	7,794	76.7	12,073	81.3	13,373
87	48.9	7,677	69.4	10,899	84.1	13,365	50.2	7,815	77.3	12,034	81.3	13,161
88	49.4	7,673	69.7	10,824	83.9	13,196	50.9	7,836	78.0	11,996	83.5	12,947
89	49.9	7,668	70.1	10,764	83.7	13,012	51.7	7,856	78.7	11,960	83.2	12,730
90	50.4	7,661	70.5	10,723	83.3	12,815	52.4	7,875	79.3	11,923	82.8	12,511
91	50.9	7,658	71.2	10,714	82.9	12,607	53.2	7,903	80.0	11,894	82.5	12,304
92	51.5	7,669	72.2	10,747	82.3	12,388	53.9	7,930	80.7	11,865	82.1	12,094

a. Values provided by HDC based on the 1950 Model Test and 2023 WS Index Test on Unit 9 (FPP updated April 2024). Flow (cfs) was calculated based on turbine efficiency, project head, and power output (MW). "Operating Limit" is the maximum safe operating point based on cavitation or generator limit (added Feb 2018).

b. Units 5 and 6 have locked runner blades and a narrower operating range defined below in Table MCN-6-A.

COMMENTS:

11-Apr-2024 FPOM: Lorz asked if this impacts min gen at McNary. Peery said no, min gen will not change.

RECORD OF FINAL ACTION: Finalized at FPOM 11-Apr-2024.