# Fish Passage Plan (FPP) Change Form

**Change Form # & Title**: 21MCN006 – Unit 5 Locked Blades

**Date Submitted**: 23-September-2021; UPDATED 9-November-2021

**Project**: McNary Dam

**Requester Name, Agency**: Chris Peery, Corps, and Lisa Wright, Corps

**Final Action: APPROVED 14-OCT-2021; Re-Coordinated 10-NOV-2021**

**FPP Section**: MCN Section 4.3. “Turbine Operating Range”

**Justification for Change**:

Unit 5 runner blades were hydraulically locked at 22.5⁰ (same as Unit 6) due to leaking blade seals and the unit was returned to service 18-August-2021. The operating range is expected to be the same or similar to Unit 6 in FPP Table MCN-6-A. When Unit 5 index test results are finalized, the FPP will be updated if necessary.

*UPDATE 9-NOV-2021*: Added table with the final Unit 5 operating range. Based on the index test results, the actual Unit 5 blade angle is 22.0°, which results in a slightly lower operating range than Unit 6.

**Proposed Change**: See following pages for edits to existing FPP in “track changes”.

**Comments**:

 14-OCT-2021 FPOM: Wright noted that the full 1% operating range of Unit 5 (before the blades were locked) was approximately 8–16 kcfs. Now it’s restricted to a range of approximately 11–12 kcfs, which is in the lower end of the mid-1% range.

**Record of Final Action**: APPROVED at FPOM 14-OCT-2021.

4.3. Turbine Unit Operating Range

**4.3.1.** Turbine unit flow and power output at the lower and upper limits of the ±1% peak efficiency range, and at the operating limit, are defined in **Table MCN-6**, except Units 5 and 6 with locked blades are in **Table MCN-6-A**. Turbine units will be operated within these ranges according to *BPA’s Load Shaping Guidelines* (**Appendix C**), as summarized below.

Table MCN-6-A. Temporary Operating Ranges for McNary Dam Turbine Units 5, 6 with Locked Runner Blades (Non-Adjustable). a

|  |  |  |
| --- | --- | --- |
| **Project**  | **MCN Unit 5 (Blades Locked at 22.0°) – With ESBS** | **MCN Unit 6 (Blades Locked at 22.0°) – No ESBS** |
| **Head** | **Lower Limit** | **Peak Efficiency**  | **Upper Limit** | **Lower Limit** | **Peak Efficiency**  | **Upper Limit** |
| **(feet)** | **MW** | **cfs** | **MW** | **cfs** | **MW** | **cfs** | **MW** | **cfs** | **MW** | **cfs** | **MW** | **cfs** |
| **62** | 44.9 | 10,245 | 46.7 | 10,585 | 48.6 | 11,084 | 45.8 | 10,236 | 47.6 | 10,570 | 49.5 | 11,059 |
| **63** | 45.7 | 10,239 | 47.6 | 10,610 | 49.7 | 11,143 | 46.6 | 10,230 | 48.5 | 10,595 | 50.6 | 11,117 |
| **64** | 46.4 | 10,232 | 48.5 | 10,633 | 50.8 | 11,198 | 47.3 | 10,224 | 49.4 | 10,618 | 51.7 | 11,173 |
| **65** | 47.2 | 10,226 | 49.4 | 10,656 | 51.9 | 11,252 | 48.1 | 10,217 | 50.3 | 10,641 | 52.8 | 11,227 |
| **66** | 48.0 | 10,228 | 50.3 | 10,654 | 52.8 | 11,247 | 48.9 | 10,220 | 51.2 | 10,640 | 53.7 | 11,222 |
| **67** | 48.8 | 10,229 | 51.1 | 10,652 | 53.6 | 11,240 | 49.7 | 10,222 | 52.1 | 10,638 | 54.6 | 11,216 |
| **68** | 49.6 | 10,230 | 52.0 | 10,650 | 54.5 | 11,234 | 50.6 | 10,223 | 52.9 | 10,636 | 55.5 | 11,210 |
| **69** | 50.5 | 10,230 | 52.8 | 10,647 | 55.4 | 11,227 | 51.4 | 10,224 | 53.8 | 10,633 | 56.4 | 11,204 |
| **70** | 51.3 | 10,230 | 53.7 | 10,643 | 56.2 | 11,220 | 52.3 | 10,224 | 54.7 | 10,630 | 57.2 | 11,197 |
| **71** | 52.3 | 10,275 | 54.7 | 10,673 | 57.2 | 11,233 | 53.3 | 10,269 | 55.7 | 10,660 | 58.2 | 11,210 |
| **72** | 53.4 | 10,319 | 55.7 | 10,701 | 58.2 | 11,245 | 54.4 | 10,313 | 56.7 | 10,689 | 59.2 | 11,223 |
| **73** | 54.4 | 10,360 | 56.7 | 10,728 | 59.1 | 11,256 | 55.5 | 10,355 | 57.7 | 10,716 | 60.2 | 11,234 |
| **74** | 55.5 | 10,400 | 57.7 | 10,754 | 60.1 | 11,266 | 56.5 | 10,395 | 58.8 | 10,742 | 61.2 | 11,245 |
| **75** | 56.5 | 10,438 | 58.7 | 10,778 | 61.0 | 11,276 | 57.6 | 10,433 | 59.8 | 10,767 | 62.1 | 11,255 |
| **76** | 57.4 | 10,459 | 59.7 | 10,810 | 62.1 | 11,320 | 58.5 | 10,454 | 60.8 | 10,799 | 63.2 | 11,299 |
| **77** | 58.3 | 10,479 | 60.7 | 10,841 | 63.2 | 11,363 | 59.4 | 10,475 | 61.8 | 10,830 | 64.4 | 11,342 |
| **78** | 59.2 | 10,499 | 61.6 | 10,871 | 64.3 | 11,405 | 60.3 | 10,494 | 62.8 | 10,860 | 65.5 | 11,384 |
| **79** | 60.1 | 10,518 | 62.6 | 10,900 | 65.4 | 11,446 | 61.3 | 10,513 | 63.8 | 10,889 | 66.6 | 11,425 |
| **80** | 61.0 | 10,536 | 63.6 | 10,928 | 66.5 | 11,485 | 62.2 | 10,531 | 64.8 | 10,917 | 67.7 | 11,464 |
| **81** | 61.9 | 10,558 | 64.5 | 10,944 | 67.4 | 11,495 | 63.1 | 10,553 | 65.7 | 10,933 | 68.6 | 11,474 |
| **82** | 62.8 | 10,579 | 65.4 | 10,960 | 68.3 | 11,504 | 64.0 | 10,575 | 66.6 | 10,949 | 69.5 | 11,483 |
| **83** | 63.7 | 10,600 | 66.3 | 10,975 | 69.2 | 11,513 | 64.9 | 10,596 | 67.6 | 10,964 | 70.4 | 11,492 |
| **84** | 64.6 | 10,620 | 67.2 | 10,990 | 70.1 | 11,522 | 65.9 | 10,616 | 68.5 | 10,979 | 71.3 | 11,501 |
| **85** | 65.5 | 10,640 | 68.1 | 11,004 | 71.0 | 11,531 | 66.8 | 10,635 | 69.4 | 10,993 | 72.3 | 11,510 |
| **86** | 66.5 | 10,679 | 69.1 | 11,027 | 71.9 | 11,537 | 67.8 | 10,675 | 70.4 | 11,028 | 73.3 | 11,541 |
| **87** | 67.5 | 10,718 | 70.0 | 11,050 | 72.7 | 11,543 | 68.8 | 10,714 | 71.5 | 11,063 | 74.3 | 11,571 |
| **Project**  | **MCN Unit 6 (Blades Locked at 22.5°) – With ESBS** | **MCN Unit 6 (Blades Locked at 22.5°) – No ESBS** |
| **Head** | **Lower Limit** | **Peak Efficiency**  | **Upper Limit** | **Lower Limit** | **Peak Efficiency**  | **Upper Limit** |
| **(feet)** | **MW** | **cfs** | **MW** | **cfs** | **MW** | **cfs** | **MW** | **cfs** | **MW** | **cfs** | **MW** | **cfs** |
| **62** | 46.8 | 10,665 | 49.1 | 11,130 | 49.8 | 11,345 | 47.6 | 10,648 | 49.9 | 11,078 | 50.5 | 11,289 |
| **63** | 47.5 | 10,659 | 50.1 | 11,175 | 50.9 | 11,405 | 48.4 | 10,641 | 50.9 | 11,122 | 51.6 | 11,348 |
| **64** | 48.3 | 10,652 | 51.2 | 11,218 | 52.0 | 11,462 | 49.2 | 10,635 | 52.0 | 11,165 | 52.8 | 11,405 |
| **65** | 49.1 | 10,645 | 52.2 | 11,259 | 53.1 | 11,517 | 50.0 | 10,628 | 53.0 | 11,205 | 53.9 | 11,460 |
| **66** | 49.9 | 10,647 | 53.1 | 11,255 | 54.0 | 11,511 | 50.9 | 10,631 | 53.9 | 11,202 | 54.8 | 11,455 |
| **67** | 50.8 | 10,649 | 54.0 | 11,251 | 54.9 | 11,505 | 51.7 | 10,633 | 54.8 | 11,198 | 55.7 | 11,449 |
| **68** | 51.7 | 10,650 | 54.9 | 11,246 | 55.8 | 11,498 | 52.6 | 10,634 | 55.7 | 11,194 | 56.6 | 11,443 |
| **69** | 52.5 | 10,650 | 55.8 | 11,241 | 56.7 | 11,491 | 53.5 | 10,635 | 56.6 | 11,189 | 57.5 | 11,436 |
| **70** | 53.4 | 10,650 | 56.6 | 11,235 | 57.6 | 11,484 | 54.4 | 10,635 | 57.5 | 11,184 | 58.4 | 11,429 |
| **71** | 54.5 | 10,697 | 57.6 | 11,256 | 58.5 | 11,497 | 55.5 | 10,682 | 58.5 | 11,205 | 59.4 | 11,443 |
| **72** | 55.6 | 10,742 | 58.7 | 11,275 | 59.5 | 11,509 | 56.6 | 10,728 | 59.6 | 11,225 | 60.4 | 11,455 |
| **73** | 56.6 | 10,785 | 59.7 | 11,294 | 60.5 | 11,521 | 57.7 | 10,771 | 60.6 | 11,244 | 61.4 | 11,467 |
| **74** | 57.7 | 10,827 | 60.7 | 11,311 | 61.5 | 11,531 | 58.8 | 10,813 | 61.6 | 11,262 | 62.4 | 11,478 |
| **75** | 58.8 | 10,866 | 61.7 | 11,328 | 62.5 | 11,541 | 59.9 | 10,853 | 62.6 | 11,279 | 63.4 | 11,488 |
| **76** | 59.8 | 10,888 | 62.8 | 11,368 | 63.6 | 11,587 | 60.9 | 10,875 | 63.7 | 11,319 | 64.6 | 11,534 |
| **77** | 60.7 | 10,909 | 63.8 | 11,407 | 64.7 | 11,631 | 61.8 | 10,896 | 64.8 | 11,357 | 65.7 | 11,578 |
| **78** | 61.6 | 10,929 | 64.9 | 11,444 | 65.8 | 11,674 | 62.8 | 10,916 | 65.9 | 11,395 | 66.8 | 11,620 |
| **79** | 62.6 | 10,949 | 66.0 | 11,481 | 66.9 | 11,715 | 63.7 | 10,936 | 67.0 | 11,431 | 67.9 | 11,662 |
| **80** | 63.5 | 10,968 | 67.0 | 11,516 | 68.0 | 11,755 | 64.7 | 10,955 | 68.1 | 11,466 | 69.1 | 11,702 |
| **81** | 64.4 | 10,991 | 68.0 | 11,529 | 69.0 | 11,765 | 65.6 | 10,978 | 69.0 | 11,479 | 70.0 | 11,712 |
| **82** | 65.4 | 11,013 | 68.9 | 11,541 | 69.9 | 11,775 | 66.6 | 11,000 | 70.0 | 11,492 | 71.0 | 11,721 |
| **83** | 66.3 | 11,035 | 69.8 | 11,553 | 70.8 | 11,784 | 67.5 | 11,022 | 70.9 | 11,504 | 71.9 | 11,731 |
| **84** | 67.3 | 11,056 | 70.8 | 11,565 | 71.7 | 11,793 | 68.5 | 11,043 | 71.8 | 11,515 | 72.8 | 11,740 |
| **85** | 68.2 | 11,076 | 71.7 | 11,576 | 72.7 | 11,802 | 69.5 | 11,063 | 72.8 | 11,527 | 73.8 | 11,749 |
| **86** | 69.2 | 11,117 | 72.6 | 11,590 | 73.5 | 11,808 | 70.5 | 11,104 | 73.7 | 11,541 | 74.7 | 11,755 |
| **87** | 70.3 | 11,158 | 73.5 | 11,604 | 74.4 | 11,815 | 71.6 | 11,145 | 74.7 | 11,555 | 75.6 | 11,761 |

1. Units 5 and 6 have hydraulically locked (non-adjustable) runner blades to prevent oil leaks and are restricted to a smaller operating range until the units are repaired. Values provided by HDC based on the abbreviated index test of Unit 5 (Aug 2021) and Unit 6 (Jan 2019).