

## **Fish Passage Plan (FPP) Change Form**

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**Change Form # & Title:** 24LMN003 – Turbine Unit 5 Fixed-Blade Range  
**Date Submitted:** 1-NOV-2024  
**Project:** Lower Monumental  
**Requester Name, Agency:** Denise Griffith, USACE  
**Final Action:** **FINALIZED 14-NOV-2024**

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**FPP SECTION:** Chapter 7 (LMN), section 4.1.2 (Unit Priority Order) and 4.2.1 (Unit Operating Range)

**JUSTIFICATION FOR CHANGE:** MU5 is now a hydraulically locked blade unit due to a bad O-ring on the shaft to the hub. The unit needed to be hydraulically locked to prevent oil loss. The blades are fixed at 25 degrees to match the fixed blade operation from when Unit 5 had a blade seal failure in 2019.

**PROPOSED CHANGES:** See pages below for edits in track changes.

**COMMENTS:**

FPOM meeting 14-NOV-2024: Griffith clarified that locking the blades was done to prevent oil leaks, not due to an oil leak that occurred. Unit 5 was previously a fixed-blade, then briefly brought back last year as an adjustable-blade until these issues were identified during maintenance. The unit is back in service but hasn't been run yet.

**RECORD OF FINAL ACTION:** Finalized at the FPOM meeting on 14-NOV-2-24.

4.2.1. Unit 1 provides the best fish passage conditions by eliminating the eddy at the juvenile fish loading dock and providing attraction flow to the North adult fish ladder. Therefore, the default priority order for fish passage starts with Unit 1, then proceeds in order from north to south. However, due to the shaft to hub O-ring seal failure on Unit 5, the runner blades are hydraulically locked at a set angle which restricts the unit to a narrower operating range (Table LMN-6-A). To avoid excessive wear and tear from repeated starts/stops, Unit 5 is operated last-on/first-off in the priority order for all flow conditions until the unit is repaired.

**Table LMN-1. Lower Monumental Dam Turbine Unit Priority Order.**

Season	Unit Priority Order
March 1 – November 30 Fish Passage Season	<u>DEFAULT = 1, 2, 3, 4, 5, 6</u>  <u>MODIFIED ORDER for Unit 5 w/Locked Blades*</u> <u>Start-up: 1, 2, 3, 4, 6, 5*</u> <u>Shutdown: 5*, 6, 4, 3, 2, 1</u>
December 1 – End of February Winter Maintenance Period	Any Order

\*Unit 5 has hydraulically locked blades and is operated in the “MODIFIED ORDER” to minimize starts/stops. When the shaft to hub O-ring seal is replaced, the unit will resume operating in the “DEFAULT” priority order.

## 4.2. Turbine Unit Operating Range

4.2.1. 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 LMN-6**, except Unit 5 with locked-blades in Table LMN-6-A. Turbine units will be operated within these ranges according to *BPA’s Load Shaping Guidelines (Appendix C)*, as summarized below.

**Table LMN-6-A. Temporary Restricted Operating Range for Lower Monumental Unit 5 with Hydraulically Locked Runner Blades (Non-Adjustable).<sup>a</sup>**

Project Head (feet)	<u>LMN Unit 5 (blades locked @ 25°) – with STS</u>						<u>LMN Unit 5 (blades locked @ 25°) – No STS</u>					
	<u>Lower Limit</u>		<u>Peak Efficiency</u>		<u>Upper Limit</u>		<u>Lower Limit</u>		<u>Peak Efficiency</u>		<u>Upper Limit</u>	
	<u>MW</u>	<u>cfs</u>	<u>MW</u>	<u>cfs</u>	<u>MW</u>	<u>cfs</u>	<u>MW</u>	<u>cfs</u>	<u>MW</u>	<u>cfs</u>	<u>MW</u>	<u>cfs</u>
85	<u>110.4</u>	<u>17,810</u>	<u>112.2</u>	<u>18,000</u>	<u>113.8</u>	<u>18,362</u>	<u>110.6</u>	<u>17,761</u>	<u>113.1</u>	<u>18,052</u>	<u>114.2</u>	<u>18,336</u>
86	<u>112.1</u>	<u>17,859</u>	<u>114.3</u>	<u>18,102</u>	<u>115.4</u>	<u>18,391</u>	<u>112.4</u>	<u>17,814</u>	<u>114.7</u>	<u>18,089</u>	<u>115.9</u>	<u>18,376</u>
87	<u>113.8</u>	<u>17,906</u>	<u>115.8</u>	<u>18,125</u>	<u>117.1</u>	<u>18,420</u>	<u>114.1</u>	<u>17,865</u>	<u>116.4</u>	<u>18,123</u>	<u>117.6</u>	<u>18,415</u>
88	<u>115.4</u>	<u>17,943</u>	<u>117.4</u>	<u>18,150</u>	<u>118.7</u>	<u>18,453</u>	<u>115.8</u>	<u>17,907</u>	<u>118.1</u>	<u>18,158</u>	<u>119.3</u>	<u>18,458</u>
89	<u>116.9</u>	<u>17,964</u>	<u>119.0</u>	<u>18,174</u>	<u>120.4</u>	<u>18,488</u>	<u>117.4</u>	<u>17,935</u>	<u>119.7</u>	<u>18,194</u>	<u>121.1</u>	<u>18,503</u>
90	<u>118.3</u>	<u>17,957</u>	<u>120.6</u>	<u>18,197</u>	<u>122.0</u>	<u>18,521</u>	<u>118.8</u>	<u>17,936</u>	<u>121.4</u>	<u>18,227</u>	<u>122.8</u>	<u>18,547</u>
91	<u>120.3</u>	<u>18,047</u>	<u>122.2</u>	<u>18,224</u>	<u>123.7</u>	<u>18,556</u>	<u>120.8</u>	<u>18,026</u>	<u>123.6</u>	<u>18,336</u>	<u>124.6</u>	<u>18,592</u>
92	<u>122.1</u>	<u>18,113</u>	<u>124.2</u>	<u>18,316</u>	<u>125.3</u>	<u>18,582</u>	<u>122.7</u>	<u>18,092</u>	<u>125.3</u>	<u>18,368</u>	<u>126.3</u>	<u>18,629</u>
93	<u>123.9</u>	<u>18,158</u>	<u>125.8</u>	<u>18,341</u>	<u>127.0</u>	<u>18,616</u>	<u>124.4</u>	<u>18,139</u>	<u>126.9</u>	<u>18,404</u>	<u>128.1</u>	<u>18,672</u>
94	<u>125.6</u>	<u>18,200</u>	<u>127.4</u>	<u>18,363</u>	<u>128.6</u>	<u>18,644</u>	<u>126.2</u>	<u>18,185</u>	<u>128.6</u>	<u>18,437</u>	<u>129.8</u>	<u>18,712</u>
95	<u>127.2</u>	<u>18,237</u>	<u>129.0</u>	<u>18,387</u>	<u>130.3</u>	<u>18,676</u>	<u>127.9</u>	<u>18,225</u>	<u>130.3</u>	<u>18,471</u>	<u>131.6</u>	<u>18,754</u>
96	<u>128.6</u>	<u>18,236</u>	<u>130.6</u>	<u>18,415</u>	<u>131.9</u>	<u>18,707</u>	<u>129.3</u>	<u>18,231</u>	<u>132.1</u>	<u>18,511</u>	<u>133.3</u>	<u>18,795</u>
97	<u>130.0</u>	<u>18,240</u>	<u>132.2</u>	<u>18,444</u>	<u>133.6</u>	<u>18,739</u>	<u>130.8</u>	<u>18,241</u>	<u>133.8</u>	<u>18,550</u>	<u>135.1</u>	<u>18,837</u>
98	<u>131.4</u>	<u>18,245</u>	<u>133.8</u>	<u>18,474</u>	<u>135.2</u>	<u>18,771</u>	<u>132.3</u>	<u>18,252</u>	<u>135.5</u>	<u>18,591</u>	<u>136.8</u>	<u>18,880</u>
99	<u>132.9</u>	<u>18,256</u>	<u>135.4</u>	<u>18,501</u>	<u>136.9</u>	<u>18,811</u>	<u>133.8</u>	<u>18,269</u>	<u>137.2</u>	<u>18,629</u>	<u>138.7</u>	<u>18,931</u>

<u>100</u>	<u>134.3</u>	<u>18,265</u>	<u>137.1</u>	<u>18,531</u>	<u>138.8</u>	<u>18,878</u>	<u>135.3</u>	<u>18,284</u>	<u>138.9</u>	<u>18,670</u>	<u>140.7</u>	<u>19,010</u>
<u>101</u>	<u>135.6</u>	<u>18,257</u>	<u>138.3</u>	<u>18,520</u>	<u>140.3</u>	<u>18,884</u>	<u>136.6</u>	<u>18,270</u>	<u>140.6</u>	<u>18,709</u>	<u>142.0</u>	<u>19,001</u>
<u>102</u>	<u>136.9</u>	<u>18,247</u>	<u>140.1</u>	<u>18,572</u>	<u>141.7</u>	<u>18,887</u>	<u>137.8</u>	<u>18,253</u>	<u>141.8</u>	<u>18,682</u>	<u>143.4</u>	<u>18,991</u>
<u>103</u>	<u>138.1</u>	<u>18,234</u>	<u>141.4</u>	<u>18,560</u>	<u>143.1</u>	<u>18,889</u>	<u>139.0</u>	<u>18,234</u>	<u>143.0</u>	<u>18,656</u>	<u>144.7</u>	<u>18,980</u>
<u>104</u>	<u>139.3</u>	<u>18,219</u>	<u>142.7</u>	<u>18,547</u>	<u>144.5</u>	<u>18,889</u>	<u>140.2</u>	<u>18,211</u>	<u>144.2</u>	<u>18,629</u>	<u>146.0</u>	<u>18,966</u>
<u>105</u>	<u>140.5</u>	<u>18,198</u>	<u>143.9</u>	<u>18,534</u>	<u>145.9</u>	<u>18,888</u>	<u>141.4</u>	<u>18,185</u>	<u>145.4</u>	<u>18,602</u>	<u>147.3</u>	<u>18,952</u>

As of November 2024, Unit 5 has hydraulically locked (non-adjustable) runner blades due to leaking blade seals and is restricted to a smaller operating range until the blade seals are repaired or replaced. Values provided by HDC based on the 1962 Model Test and Feb 2020 U5 Index Test, as updated in May 2022.