

APPENDIX C
FORT PECK DAM OPERATIONS

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FORT PECK

HISTORICAL RECORDS

Historical records for Fort Peck pool elevations and releases date back to 1937, when the dam was first closed. It was not until the main stem system filled in June of 1967 that the records reflected normal system operation. During the period of 1967 through 1997, the pool elevation has ranged from a low of 2208.7 ft msl in April of 1991 to a maximum of 2251.6 ft msl in July of 1975, a range of almost 43 feet. The average annual pool elevation since 1967 is 2234.9 ft msl with a standard deviation of the annual means being 9.8 feet. Daily releases from Fort Peck have ranged from a low of zero cfs for one day in April of 1978 to a high of 35,400 cfs in July of 1975. Daily release has averaged 10,100 cfs since 1967 with a standard deviation in the annual mean discharge of 3,900 cfs. Figure 2 shows the observed daily pool elevations and releases from Fort Peck for the period since the main stem system was first filled. Daily maximum, minimum and mean values of pool elevation and releases for each month are listed in Table 2.

Table 2
Fort Peck Pool & Release Historical Records (06/1967-12/1997)

| Month | Pool Elevation (ft msl) | | | Daily Release (cfs) | | |
|--------|-------------------------|---------|--------|---------------------|---------|--------|
| | Maximum | Minimum | Mean | Maximum | Minimum | Mean |
| Jan | 2245.1 | 2209.3 | 2233.0 | 15,600 | 6,500 | 11,600 |
| Feb | 2244.4 | 2208.8 | 2231.9 | 15,500 | 4,800 | 12,200 |
| Mar | 2246.2 | 2208.8 | 2232.0 | 15,600 | 1,000 | 9,000 |
| Apr | 2247.3 | 2208.7 | 2233.2 | 25,100 | 0 | 8,100 |
| May | 2247.7 | 2209.3 | 2234.5 | 28,900 | 2,800 | 9,600 |
| Jun | 2250.0 | 2212.5 | 2236.9 | 35,100 | 3,000 | 10,600 |
| Jul | 2251.6 | 2212.5 | 2238.5 | 35,400 | 3,000 | 10,900 |
| Aug | 2250.1 | 2211.4 | 2237.8 | 35,200 | 3,800 | 10,800 |
| Sep | 2248.5 | 2211.4 | 2236.8 | 20,500 | 2,700 | 9,900 |
| Oct | 2248.0 | 2211.4 | 2236.1 | 21,800 | 2,700 | 9,300 |
| Nov | 2246.3 | 2210.9 | 2235.3 | 22,300 | 2,700 | 9,600 |
| Dec | 2245.4 | 2209.6 | 2234.2 | 16,000 | 4,500 | 10,200 |
| Annual | 2251.6 | 2208.7 | 2234.9 | 35,400 | 0 | 10,100 |

POOL & RELEASE DURATION

Pool duration and release duration relationships were developed using the DRM which used data from 1898 to 1997. Figure 3 shows the pool duration relationship for Fort Peck, while Figure 4 shows the release duration relationship. Both Figure 3 and Figure 4 show the DRM data along with the observed data. Table 3 shows the pool elevation and release for various percentages of time in which the values are equaled or exceeded.

Table 3
Fort Peck Pool & Release Duration Characteristics

| Percent of Time Equaled or Exceeded | Pool Elevation (ft msl) DRM | Release (cfs) DRM |
|-------------------------------------|-----------------------------|-------------------|
| Maximum | 2250.0 | 35,000 |
| 1 | 2245.5 | 22,000 |
| 5 | 2243.2 | 17,500 |
| 10 | 2242.1 | 15,000 |
| 20 | 2238.0 | 12,500 |
| 50 | 2234.9 | 9,500 |
| 80 | 2219.9 | 3,500 |
| 90 | 2201.9 | 3,100 |
| 95 | 2177.6 | 3,000 |
| 99 | 2165.7 | 2,800 |
| 100 | 2160.4 | 2,400 |

POOL PROBABILITY

In 1975, the maximum pool elevation of 2251.6 feet msl was recorded at Fort Peck. Results of the DRM indicate that the peak daily pool for 1975 would be 2248.3 feet msl which would rank as the sixth highest out of the 100 years of simulated record. DRM results also indicate that the maximum daily pool elevation of 2250.0 feet msl during the simulation period would occur during 1997. Extrapolation of the eye-fit curve between the observed and simulated data based on the shape of the curve from the observed data indicates a reasonable pool-probability relationship. Therefore, this curve was adopted for the Fort Peck Pool Probability relationship. Results are shown in Table 4 and on Figure 5.

Table 4
Fort Peck Pool Probability Relationship
Pool Elevations in Feet MSL

| Percent Chance Exceedance | 1976 Study | Observed (1967-1997) | Simulated (1898-1997) | Adopted |
|---------------------------|------------|----------------------|-----------------------|---------|
| 50 | 2240.0 | 2242.0 | 2240.0 | 2241.5 |
| 20 | 2246.5 | 2246.5 | 2244.9 | 2246.5 |
| 10 | 2249.0 | 2249.0 | 2247.5 | 2249.0 |
| 2 | 2251.0 | 2252.7* | 2249.5 | 2251.0 |
| 1 | 2252.0 | 2254.0* | 2250.0 | 2252.0 |
| 0.2 | 2253.0 | 2256.5* | 2251.0* | 2253.0 |

* extrapolated: Max Observed is 2251.6

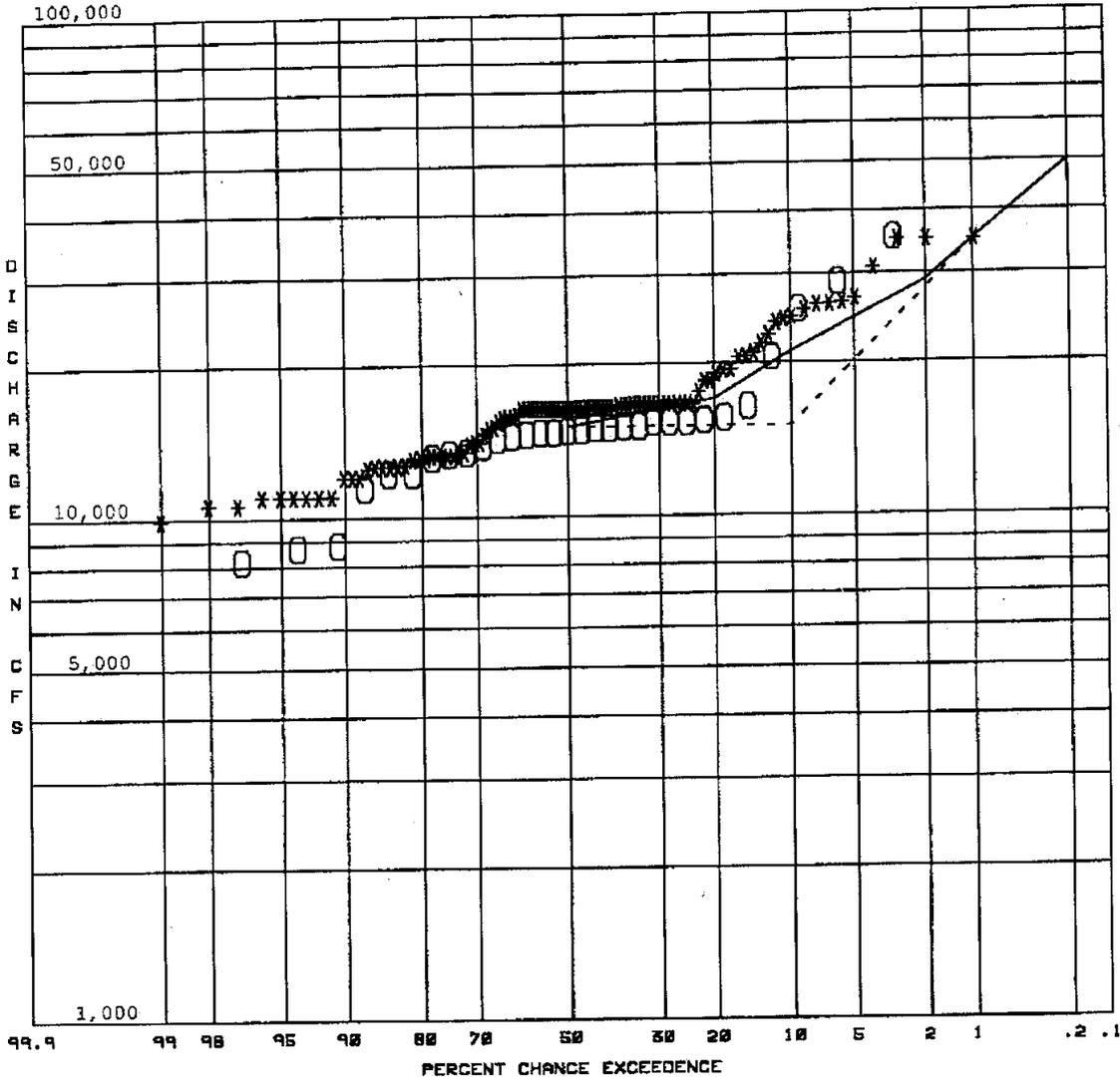
RELEASE PROBABILITY

The maximum observed release from Fort Peck was 35,400 cfs in 1975. Results of the DRM indicate that the maximum daily outflow of 35,000 cfs would be reached during eleven years, 1898, 1908, 1909, 1913, 1916, 1917, 1927, 1948, 1953, 1975, and 1997. The actual maximum for 1997 was 22,300 cfs. The difference stems from the lack of runoff forecasting by the DRM and as a result cannot prerelease water. Both the observed and simulated curves indicated a relatively flat curve with a discharge near 15,000 cfs (near power plant capacity) from the 70 percent chance exceedance to the 20 percent chance exceedance range. The observed remained flat until the 20 percent chance exceedance while the simulated moved to the 30,000 cfs range in a somewhat linear fashion. For events less frequent, both curves showed an abrupt breakpoint at 10 percent value. Values of 35,000 cfs occurred near the 3 percent chance of exceedance for the observed, and 10 percent for the simulated data. A straight line was assumed from the 20 percent to the 0.2 percent and slope steepened between the 2 and 0.2. This curve was used to define the adopted release-probability relationship. Results are shown in Table 5 and on Figure 6.

**Table 5
Fort Peck Release Probability Relationship
Discharges in CFS**

| Percent Chance Exceedance | 1976 Study | Observed (1967-1997) | Simulated (1898-1997) | Adopted |
|----------------------------------|-------------------|-----------------------------|------------------------------|----------------|
| 50 | 15,000 | 14,700 | 16,300 | 15,000 |
| 20 | 15,000 | 15,400 | 18,400 | 17,000 |
| 10 | 15,000 | 24,000 | 24,400 | 22,000 |
| 2 | 28,000 | 40,000* | 34,800 | 29,000 |
| 1 | 35,000 | 50,000* | 34,900 | 35,000 |
| 0.2 | 50,000 | 70,000* | 35,000* | 50,000 |

* extrapolated: Max Observed is 35,200



LEGEND:

- OBSERVED
- * SIMULATED
- ADOPTED
- - - - 1976 STUDY

POWER PLANT CAPACITY - 16,000
 OUTLET CAPACITY - 45,000
 SPILLWAY CAPACITY - 275,000

MISSOURI RIVER MAIN STEM RESERVOIRS
 RELEASE-PROBABILITY RELATIONSHIP

FORT PECK

RESERVOIR CONTROL CENTER

MISSOURI RIVER REGION

U.S. ARMY CORPS OF ENGINEERS

FEBRUARY 1999

FIGURE 6

FORT PECK DAM

RELEASE DURATION RELATIONSHIP

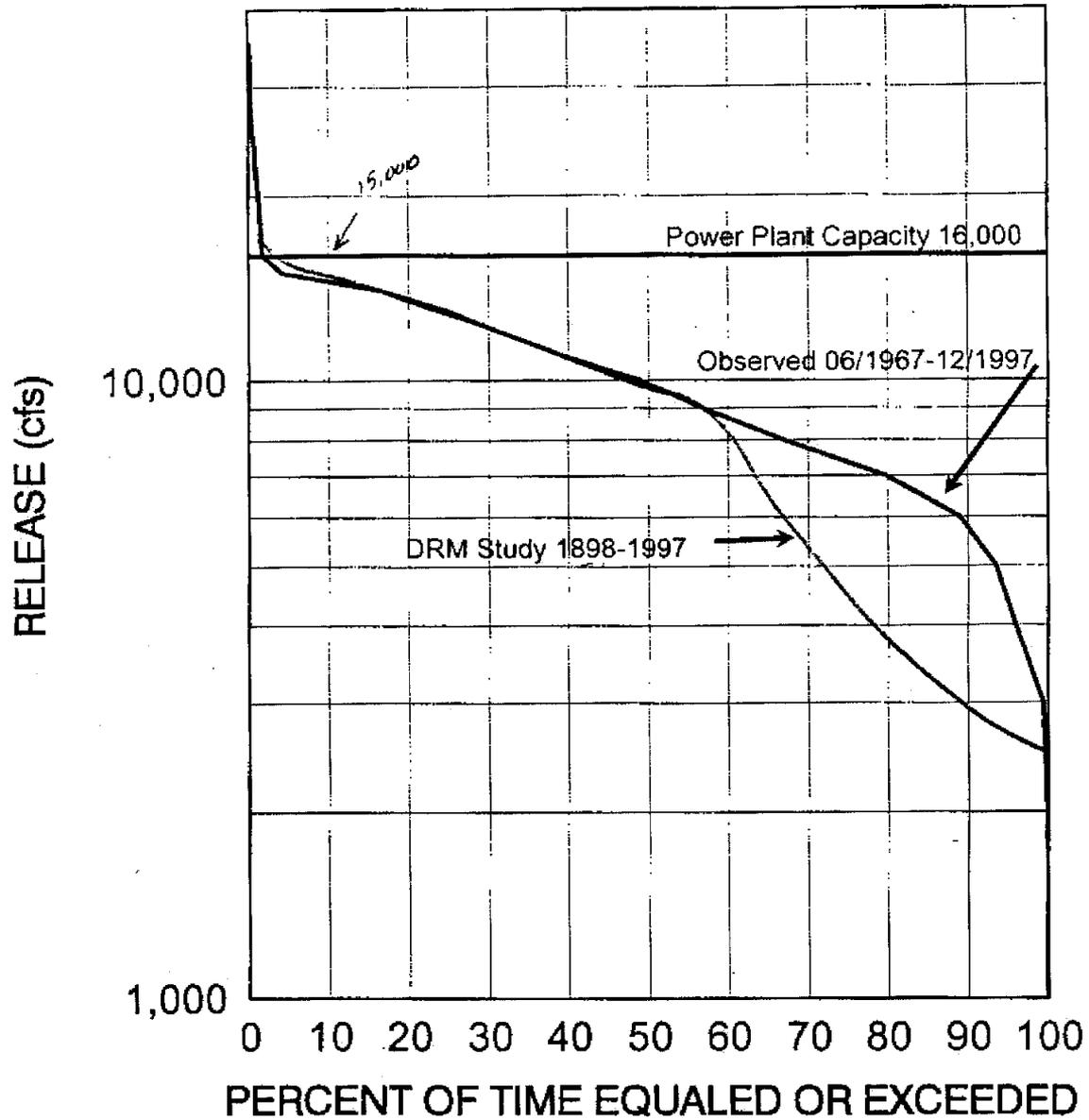
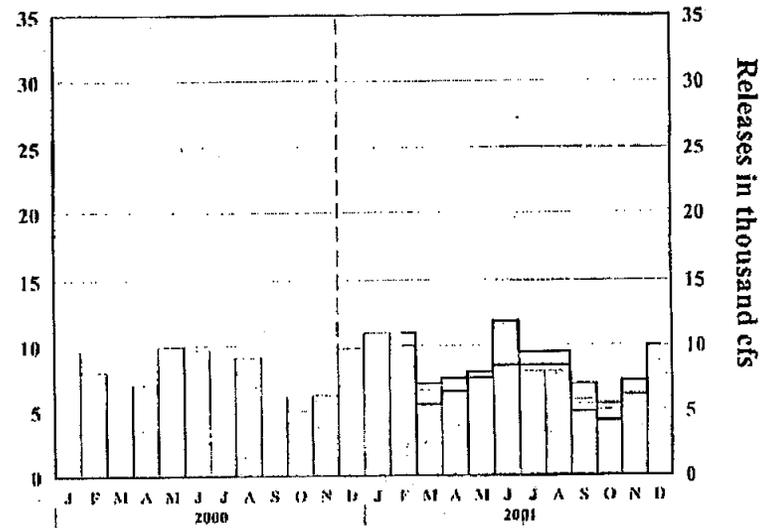
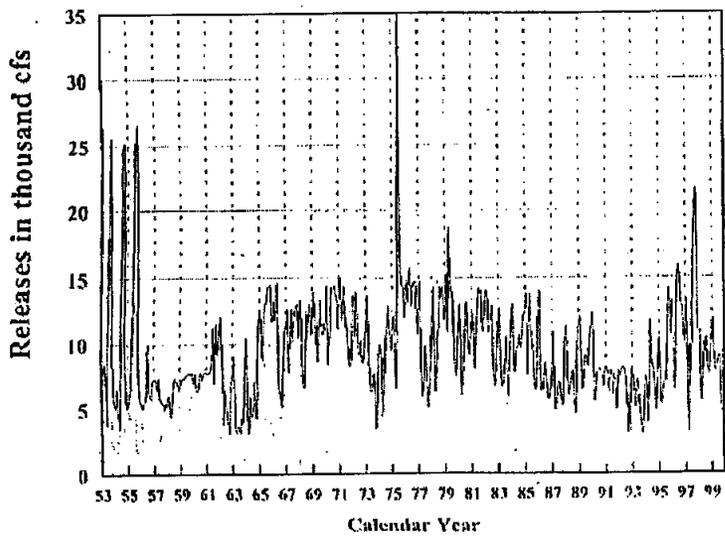
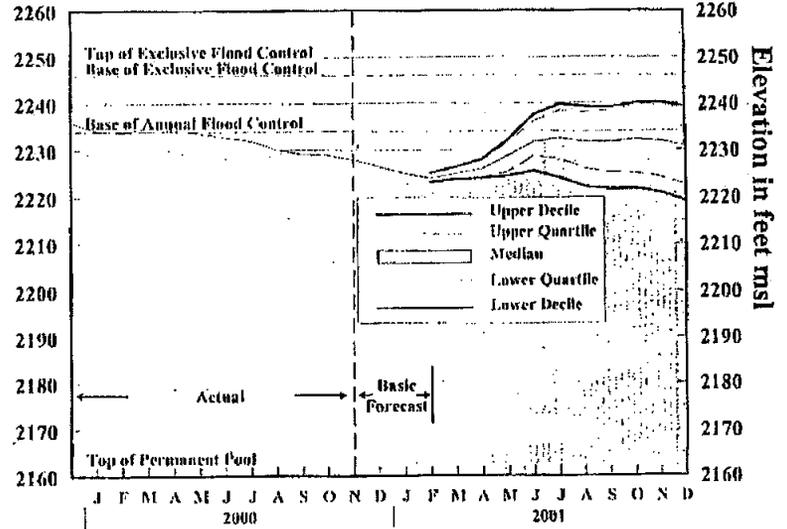
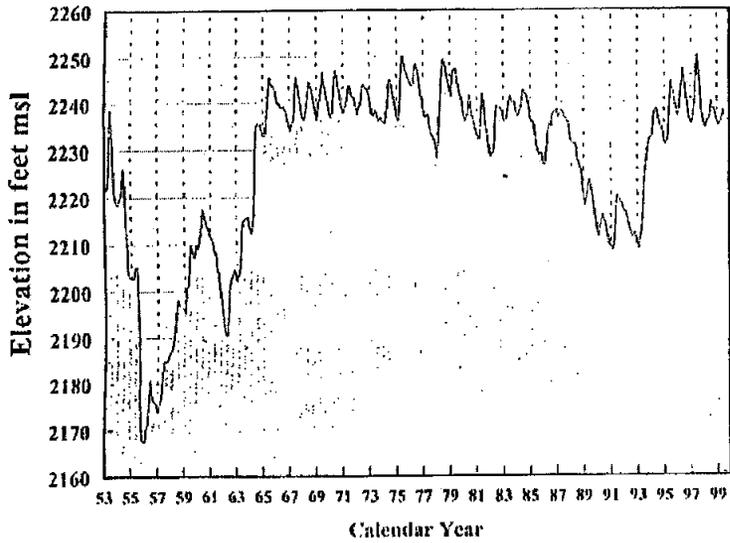


FIGURE 4

Fort Peck Elevations and Releases



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