Operating Requirements & Objectives

• Mandatory /Legal
  – Recognize all Senior Downstream Water Rights
  – Fulfill Compact obligation with Native American Tribes
  – Meet Contract Commitments for Stored Water
  – Dam Safety

• Operating Objectives
  – Maximize Power Generation Benefit
  – Maintain Storage Space for Flood Control
  – Maintain desired Lake levels for Recreation, Reservoir Fishery and Waterfowl
  – Maintain desired River Flow levels for the River Fishery and water quality
Multipurpose Benefits

- **Water Rights**
  - Regulate stream flow and release water for irrigation
- **Compact Commitments with N. Cheyenne and Crow tribes**
- **Industrial water supply**
  - 6,000 AF contract with PPL-MT
- **Flood control**
  - Flood protection = $27.5 million in 1997
- **Hydropower**
  - 260 MW powerplant (8,000 cfs)
  - Peaking power supplied to two grid systems
  - Annual generation = 879.0 million kwhrs (1967-2006)
  - Annual power sales @ .023/kwhr = $20.3 million in annual revenue
  - Montana and Wyoming both benefit from power generated
- **Fish & Wildlife**
  - Lake fishery, river fishery, and waterfowl
- **Recreation**
  - Bighorn Canyon Recreation Area and Bighorn River
- **Water Quality**
  - Reduce high levels of nitrogen supersaturation
  - Sediment retention
Bighorn Lake Inflow Distribution Based on 1967-2006 Data

Annual Total

Bighorn River Accretions less Depletions (Gain)
30%

Boysen Release
42%

Buffalo Bill Release
28%
Archive Data From 1-OCT Through 30-SEP
Plotted 04/10/2007 12:25

Units: INCHES

BHR  Bighorn Lake (Yellowtail), Bighorn River near Fort Smith, MT
     Snow Water Equivalent (inches)
     2007 2006 1981
SE    Snow Water Equivalent Average (inches)
SE_AVG 2006
Drought Management

• 1934-1940: Critical Period used in planning the project, 8 year drought

• 2000-2007: Current drought started in 2000 and has continued to present. We are now in our 8 year of drought
Bighorn Lake Inflow
Average Years vs Drought Periods

1,000 acre-feet

<table>
<thead>
<tr>
<th></th>
<th>1,000 acre-feet</th>
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<tbody>
<tr>
<td>Avg</td>
<td>2604</td>
</tr>
<tr>
<td>1924-1955</td>
<td></td>
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<tr>
<td>2002 Level</td>
<td>2082</td>
</tr>
<tr>
<td>1924-1955</td>
<td>2167</td>
</tr>
<tr>
<td>Avg 1977-2006</td>
<td>1558</td>
</tr>
<tr>
<td>2002 Level</td>
<td>1384</td>
</tr>
<tr>
<td>1934-1940</td>
<td>2000-2006</td>
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</tbody>
</table>

RECLAMATION
Annual Volume of Water Required to Meet River Targets vs Drought Supply

<table>
<thead>
<tr>
<th>Year</th>
<th>2500 cfs</th>
<th>2000 cfs</th>
<th>1500 cfs</th>
<th>Storage</th>
<th>00-06 Avg</th>
<th>2004</th>
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<tbody>
<tr>
<td>1928</td>
<td>1928</td>
<td>1566</td>
<td>1204</td>
<td>311</td>
<td>1384</td>
<td>1030</td>
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<tr>
<td>2004</td>
<td>1463</td>
<td>1204</td>
<td>1204</td>
<td>311</td>
<td>1384</td>
<td>1030</td>
</tr>
</tbody>
</table>

1000 acre-feet
Flood Management

• Flood Runoff Years
  » Peak Inflow
  » Apr-Jul Volume
  - 1967 30,000 cfs 2,271,000 af
  - 1978 23,215 cfs 1,829,000 af
  - 1997 21,006 cfs 1,958,000 af


Largest of Record

1923 43,000 cfs September Rain Event
Flood Runoff vs Flood Control Space

1,000 acre-feet

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>Apr-Jul 1967</td>
<td>2271</td>
</tr>
<tr>
<td>Apr-Jul 1997</td>
<td>1958</td>
</tr>
<tr>
<td>Apr-Jul 1981</td>
<td>1039</td>
</tr>
<tr>
<td>Joint Use Space</td>
<td>240</td>
</tr>
<tr>
<td>Joint Use +Excl Flood</td>
<td>498</td>
</tr>
</tbody>
</table>
DAM SAFETY CONCERNS
1972 Rapid City Flood

- Rain Event – 15 inches in 6 hours
- Peak discharge – 50,000 cfs
- Loss of life – 237 dead, 8 missing
- Injured – 3,057
- Homes Lost – 1,335
- Automobiles destroyed – 5,000
- Estimated Total Damage - $160 million in 1972 dollars about a $500 million in 2007 dollars
DAM SAFETY CONCERNS

- **Inflow Design Flood**
  - Peak Inflow: 126,000 cfs
  - 10 Day Flood Volume: 1,070,000 acre-feet
  - Peak Discharge: 86,000 cfs

- **Maximum Probable Flood**
  - Peak Inflow: 887,000 cfs
  - 20 Day Flood Volume: 4,700,000 acre-feet
  - Peak Discharge: 630,300 cfs
YELLOWTAIL DAM
OPERATING CRITERIA

• REQUIREMENTS

• OBJECTIVES

• MULTIPURPOSE OBJECTIVES
OPERATING REQUIREMENT
SENIOR WATER RIGHTS

- Bypass of inflow during irrigation season Apr-Sept
- River - 1,300 to 1,400 cfs
- Bighorn Canal – 300 to 500 cfs
- Total Discharge Required – 1,600 cfs to 1,900 cfs
OPERATING REQUIREMENT
CONTRACTUAL COMMITMENTS

• Developed
  – PPL Montana
    • 6,000 acre-feet/year as called for

• Future
  – Northern Cheyenne - Undeveloped
    • 30,000 acre-feet/year
  – Crow Tribe’s Compact - Undeveloped
    • 300,000 acre-feet/year 150,000 acre-feet/year reserved for use below fishery reach. Compact has yet to be Ratified and approved
OPERATING REQUIREMENT
DAM SAFETY

• Provide Adequate Storage Space & Release Capacity to Safely pass Large Flood Events

• Inspect, Monitor and Maintain Structure to Insure Safe Operation
OPERATING OBJECTIVES
FLOOD CONTROL

• SPRING RUNOFF - Provide adequate Joint Use Exclusive Flood Space to control flood runoff based on snow conditions and potential spring rain events

• SUMMER & FALL - Maintain Exclusive Flood Pool for regulation of late summer and fall rain events
• Minimize spills or other releases that bypass the power turbines

• Limit power plant discharge to maximum of about 4,500 cfs to retain power peaking capability

• Optimize power plant efficiency

• Provide higher generation levels during the peak seasonal demand periods: July-August and December-February
OPERATING OBJECTIVE
RIVER FISHERY FLOW TARGETS

• 2,500 cfs - Provides good spawning and rearing conditions in all major side channels

• 2,000 cfs - Provides limited spawning and rearing conditions in most side channels

• 1,500 cfs – Provides only main channel habitat and no side channel habitat

• 1,000 cfs – Minimum base flow as identified in Definite Plan Report

• Minimize release reductions after fish spawning activities have occurred
OPERATING OBJECTIVE
LAKE RECREATION

• Desired lake levels to launch boats between Memorial Day and Labor Day weekends

• Horseshoe Bend – At or above elevations 3615 (originally 3593)

• Barry’s Land & Ok-A-Beh – At or above elevation 3580 (originally 3586 & 3596)

• Black Canyon – Limit lake level to elevation 3642 to prevent flooding of campground

• Optimum Lake Level During Recreation Season for Recreation - 3630 to 3640
OPERATING OBJECTIVE
RESEVIOR FISHERY

- Maintain a stable or rising lake level during April and May to enhance walleye and sauger spawning activities
OPERATING OBJECTIVE
WATERFOWL & OTHER INTERESTS

• Maintain the reservoir elevation at or above 3635 during September – October to provide suitable waterfowl habitat at the upper end of the reservoir

• Lake level at or below 3635 before winter freeze up to reduce potential for ice jams near Lovell
MULTIPURPOSE OBJECTIVES

Elevations Targets

- **Sept – Oct**: A Desired Lake Elevation of 3635 provides space for late summer and fall rainstorms, recreation enhancement and wildlife habitat

- **March**: Position Lake Level between 3605 and 3615 to provide good fall and winter generation, prepare reservoir for spring runoff and provide desired fishery flows. This also increases probability of raising pool during Walleye Spawning

- **July**: Fill reservoir to normal full level of 3640 to provide good water supply for all water uses while leaving adequate space to control summer and fall rain events.
MULTIPURPOSE OBJECTIVES
Desired River Operating Range

• 1,500 cfs – Approximate discharge to provide “firm” power generation as identified in DPR and provide minimum target flow for river fishery. Provide more than adequate water for downstream irrigation demands. Protects Reservoir storage in low runoff years except for the period of 2002 - 2004

• 4,500 cfs – Provides optimum power generation (allows full peaking) while providing more than adequate water conditions for river fishery and irrigation needs
COMMON GROUNDS
Where Improvements are Needed

• Communications
• Spring-Summer Runoff Forecasts
• Fall-Winter Forecasts
• Revise Inflow Date to Current Level of Development
• Water Supply Monitoring
  – Streamflow
  – Snowpack
  – Precipitation
  – Soil Moisture Conditions
• Refinement in Needs
  – Fishery Flows
  – Recreation Levels
  – Other
QUESTIONS & COMMENTS