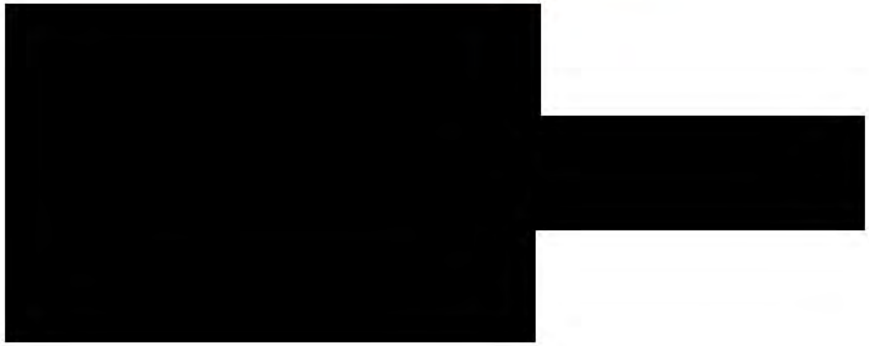
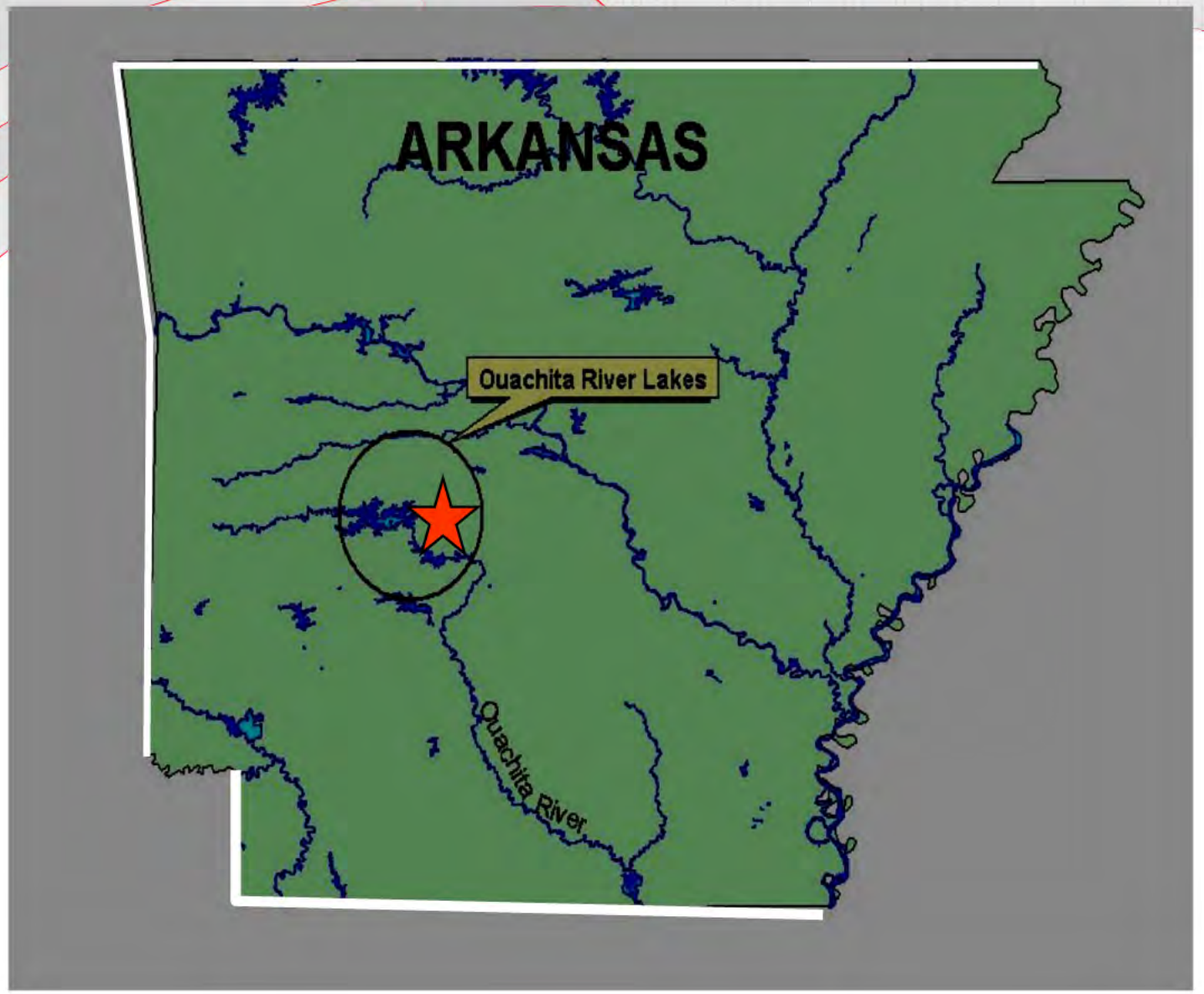
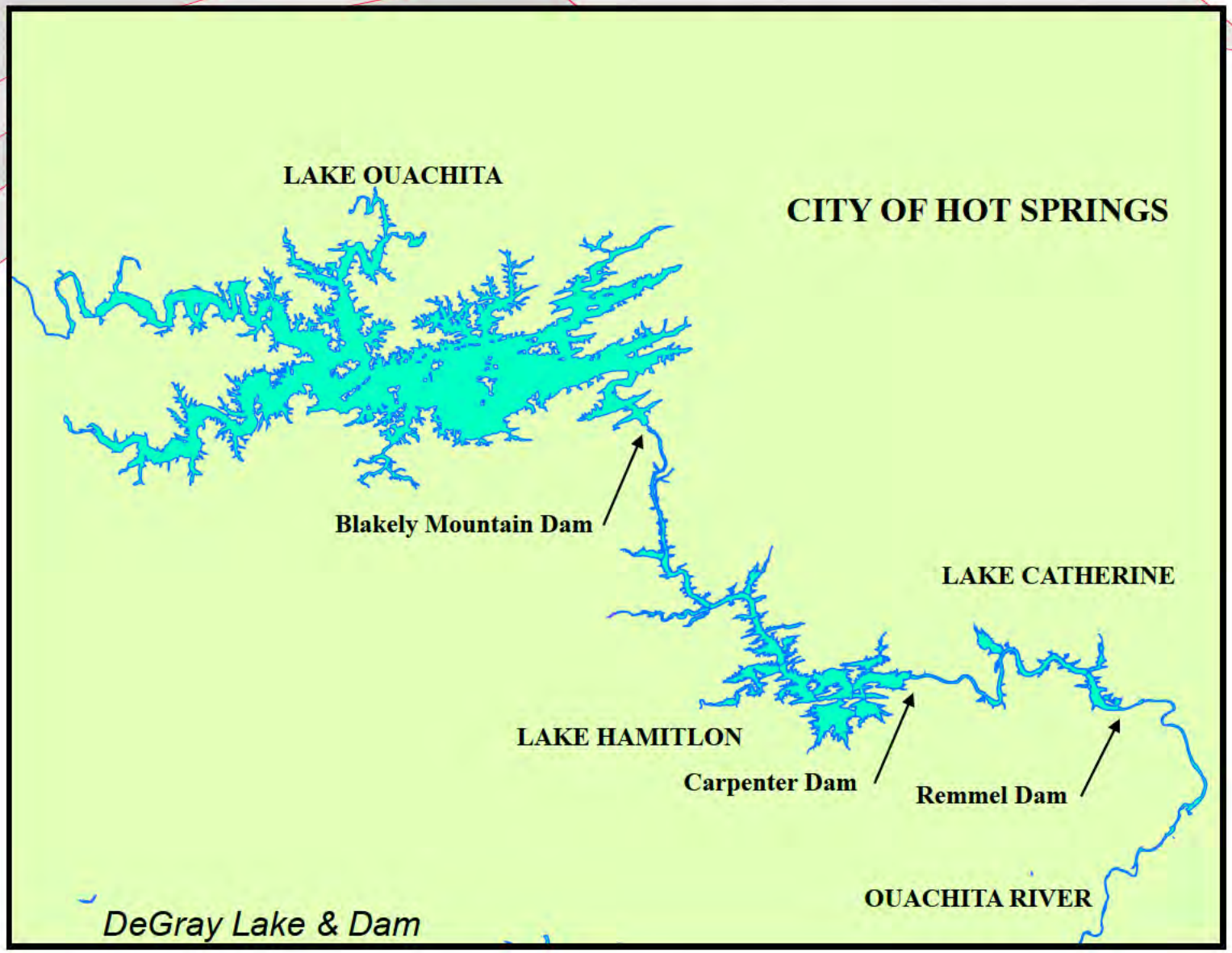
Entergy Hydro Operations



Ouachita River System



Ouachita River System



Who Controls What?

- Entergy's Lake Catherine Plant
  - Carpenter
  - Remmel
- ACOE at Blakely Mountain Dam
  - Blakely
  - DeGray
  - Others

Blakely Mtn. Dam/Lake Ouachita

- Built in 1955
- forms Lake Ouachita
- Owned & Operated by ACOE
- 2 Units – 6600 CFS
- 84 MW @178 ft. Head
- 2.15MAF of water storage at top of Power Pool
- Flood Control is a project purpose

Lake Hamilton / Lake Catherine

- 6,897 acres surface
- 198 miles shoreline
- 70% shoreline developed
- 4,000+ docks
- 10,000+ buildings within 500 ft. of shoreline
- Highly Developed

- 1,642 acres surface
- 56 miles shoreline
- 50% of shoreline developed
- 400+docks
- 1,400+ buildings within 500 ft. of shoreline
- Less Developed

Carpenter Dam/Lake Hamilton

- Built in 1932
- forms Lake Hamilton
- 62 MW @ 89 ft. head
- 2 Units - 9,600 cfs
- Not a flood control project
- Approx. 1ft. freeboard

Remmel Dam/Lake Catherine

- Built in 1923
- forms Lake Catherine
- 12MW @ 42 ft. head
- 3 Units - 3,600 cfs
- Not a flood control project
- Approx. 18 inches freeboard

Blakely, Carpenter, Remmel

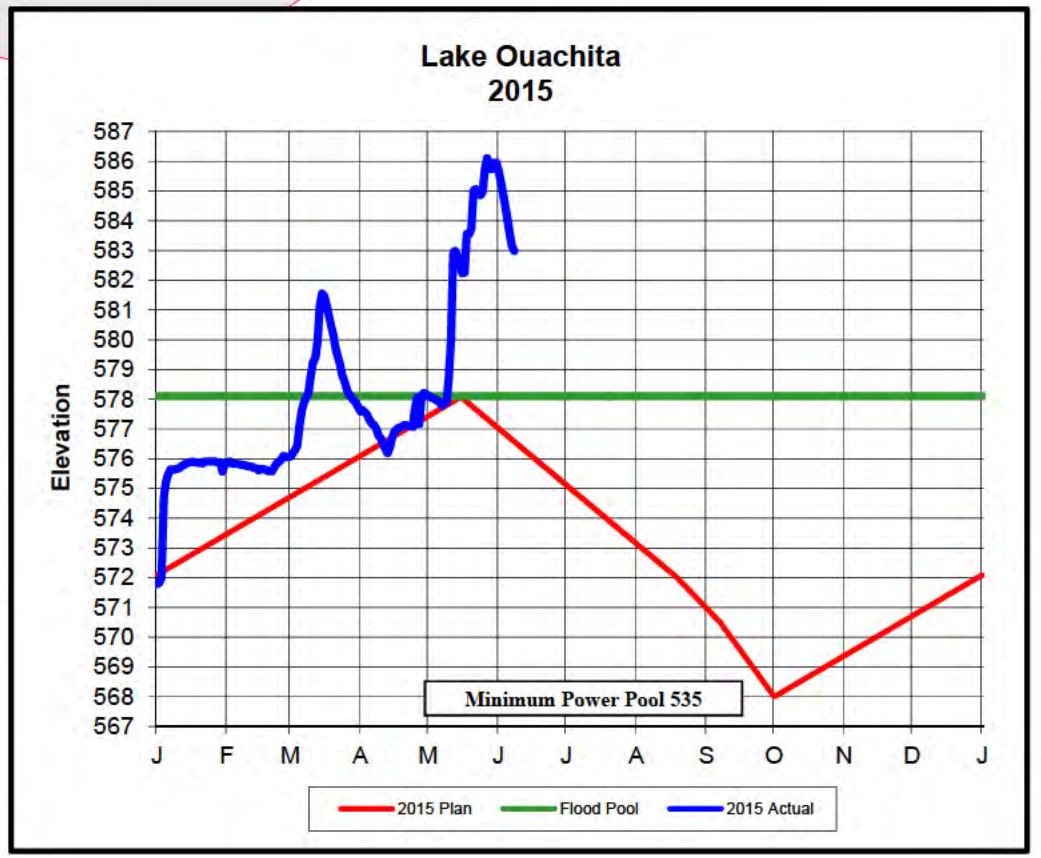
Max Gen	Flow	MW
Blakely	6600	86
Carpenter	9600	62
Remmel	3600	12
DeGray	5400	78

DeGray/Caddo River System

- Storage system like Blakely/Ouachita
- Unit-1 Conventional 46 MW
  - Most efficient at 40 MW
- Unit-2 Pump-Back 32 MW
  - Most efficient at 28 MW
  - Pump 7 Hours get 5 Hours of Generation
  - Corps runs as needed to keep re-reg pool full – minimum flow is 150 CFS
- Excess Hydro Capacity for size of lake
- Caddo River runs into Ouachita River at Arkadelphia

Annual Strategic Plan

- *Top of Power Pool is 578.10*
- *Try to fill up for Summer Run*
- *Target 572 last WE before school starts*
- *Target 570 Labor Day*
- *Target 568 Oct 1*
- *Refill depends on rain*



Storage vs Generation

- *Water Storage*
  - *Summer assumption is that we will not get any more rain until the fall or winter*
  - *Question is: Do we use it now or save it for later?*
  - *Summer assumption is inflow equals evaporation*
- *Lake Elevation reduction is a balance of needs*
  - *By contract we can pull Ouachita and DeGray down to bottom of power pool*
  - *Impact to local economy from past practice prevents large drawdown*

Weekly Hydro Analysis

- [redacted] *prepares analysis*
  - *Standard set of schedules*
  - *MWHrs calculated for each foot of lake - Ouachita*
  - *Recommend a schedule to hit the target lake elevation – i.e. 572 on August 16*
- *EMO bids the schedule into MISO by 11AM*
- *MISO issues Day Ahead Award by 3 PM*
- *Hydro & Corps implement*
  - *Lake Catherine Operators adjust as needed*

Weekly Hydro Analysis

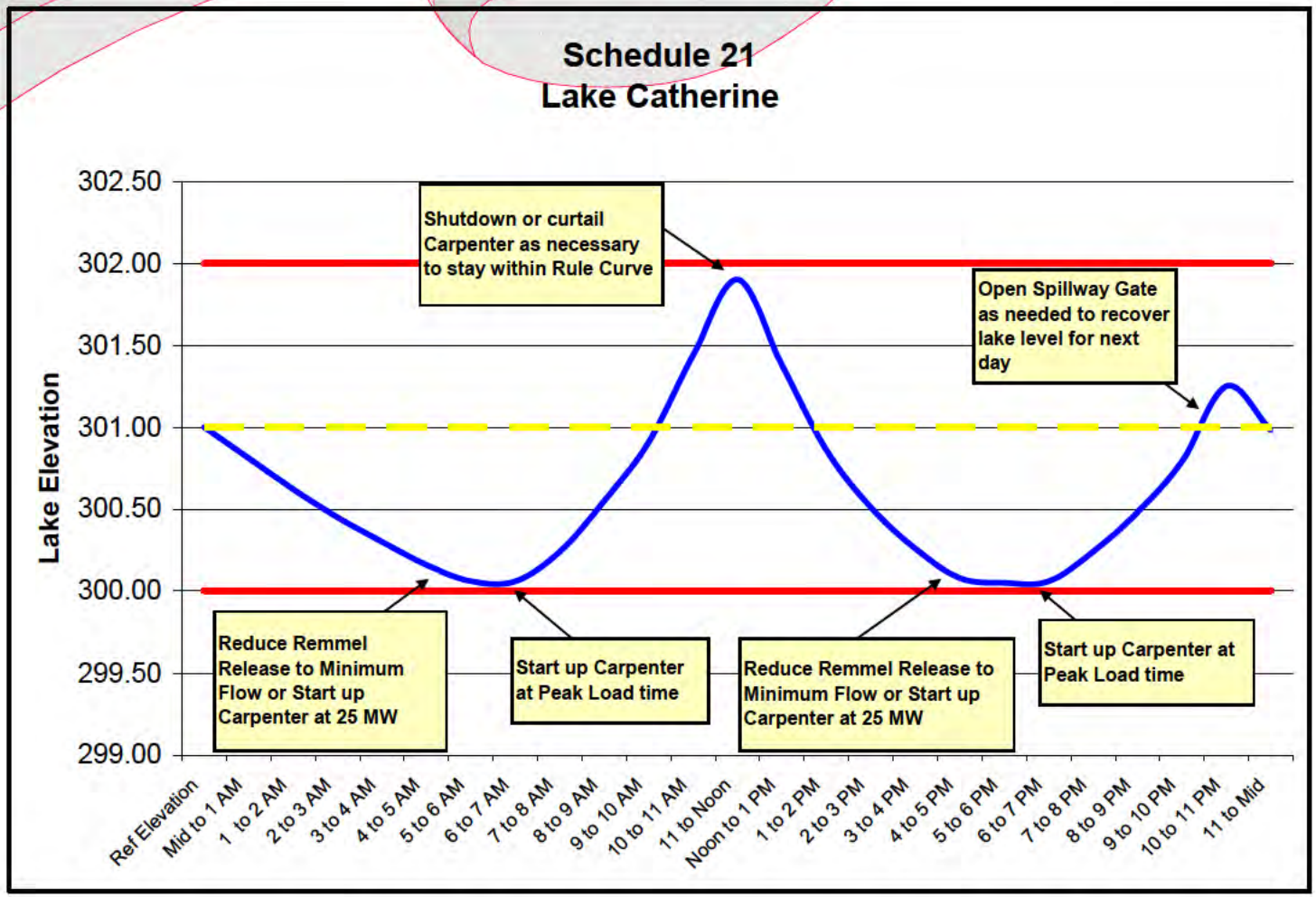
Hydro Analysis	Peak MW	Total MWHr	Blakely MWHrs	Days to Target
Schedule 1 - 10 Hour Max Run, With Spill	158.0	1,916.0	1,204	25.8
Schedule 2 - 8 Hour Run, With Spill	158.0	1,503.2	946	32.9
Schedule 3 - 3 Hour Max Run	158.0	667.1	404	77.0
Schedule 3W - Weekend 4 Hour Max Run	154.0	844.5	492	63.2
Schedule 4 - 8 Hour Balanced Lake Run	87.0	694.8	400	77.7
Schedule 4A - 8 Hr Run One Unit	76.0	536.0	320	97.2
Schedule 5 - 10 Hour Run	87.0	870.2	500	62.2
Schedule 6 - 14 Hour Run	87.0	1,209.3	700	44.4
Schedule 6a - 14 Hour Run	87.0	1,221.0	700	44.4
Schedule 7 - Steady State - 24 Hour Run	87.0	2,088.0	1,200	25.9

Generation Schedule

Schedule 4 - 8 Hour Run

MISO Time Hour Beginning	Rem	Carp-1	Carp-2	Blake-1	Blake-2	Total MW
Mid to 1 AM	0	0	0	0	0	-
1 to 2 AM	0	0	0	0	0	-
2 to 3 AM	0	0	0	0	0	-
3 to 4 AM	0	0	0	0	0	-
4 to 5 AM	0	0	0	0	0	-
5 to 6 AM	0	0	0	0	0	-
6 to 7 AM	0	0	0	0	0	-
7 to 8 AM	0	0	0	0	0	-
8 to 9 AM	0	0	0	0	0	-
9 to 10 AM	0	0	0	0	0	-
10 to 11 AM	0	0	0	0	0	-
11 to Noon	0	0	0	0	0	-
Noon to 1 PM	**12**	**0**	**25**	**30**	**20**	**87.0**
1 to 2 PM	**12**	**0**	**25**	**30**	**20**	**87.0**
2 to 3 PM	**12**	**0**	**25**	**30**	**20**	**87.0**
3 to 4 PM	**12**	**0**	**25**	**30**	**20**	**87.0**
4 to 5 PM	**12**	**0**	**25**	**30**	**20**	**87.0**
5 to 6 PM	**12**	**0**	**25**	**30**	**20**	**87.0**
6 to 7 PM	**12**	**0**	**25**	**30**	**20**	**87.0**
7 to 8 PM	**12**	**0**	**25**	**30**	**20**	**87.0**
8 to 9 PM	0	0	0	0	0	-
9 to 10 PM	0	0	0	0	0	-
10 to 11 PM	0	0	0	0	0	-
11 to Mid	0	0	0	0	0	-
Totals	**96**	**0**	**200**	**240**	**160**	**696**

What it does to the lake



Daily Operating Considerations

Hydro Operations Priorities

1. Safety – Public & Personnel
2. FERC & NERC Compliance
3. Equipment Protection
4. Lake Level Management
5. MISO Day Ahead Compliance
6. Generation Production

Lake Levels & Generation

- Schedules are designed for no inflow
  - Due to tributary inflow adjustments may be needed to keep lakes within limits
- Schedules are designed to start with lakes at normal levels at Midnight
  - If lakes are not at the right level to begin the schedule, adjustments may be needed

Working with MISO

- *Entergy EMO talks to MISO, not us*
- *MISO is operating a market*
- *Day Ahead Market and Real Time Market – different pricing*
- *Independent Market Monitor is checking for price manipulation*

Lake Levels & Generation

- *Adjustments – MISO Real Time Market*
  - *Operators call to request change from Day Ahead. Use the words, "For Lake Level Control"*
  - *Change unit generation amount – up or down*
  - *Change duration of generation – longer or shorter*
  - *Open or close a spillway gate – No MISO contact*
- *Which adjustment depends on conditions*
  - *If system load demands or electricity prices are high – Spill water, if necessary*
  - *If system load demand or electricity prices are low – back off generation*

Making Changes

- *Day Ahead award is a commitment to provide the scheduled MW's on the required hour*
  - *We either produce it or buy it to replace it*
- *Real Time Market can override the Day Ahead*
- *To avoid purchasing replacement power we may not bid into Day Ahead before a rain event.*
  - *Need Operators to request run in Real Time*
  - *Before bottom of the hour for the next hour*

Blackstart

- *Remmel Dam exciter uses permanent magnets – Can generate without off-site power*
- *Remmel can be used to start Carpenter*
  - *Blakely also Blackstart capable*
  - *Then White Bluff and rest of system*

Hydro Condensing Operation

- *Carpenter & Remmel do not open/close breakers when going from generation mode to condensing mode*
- *Always synchronized to the system*
- *2 minute delay imposed by Hydro Operations to provide downstream fishermen time to move*
- *Can go to full load within minutes*

Blakely Condensing

- Blakely and DeGray Units are taken off-line when not generating
  - Entergy is paying for Aux Power
- Transmission declares RMR when Arkansas load exceeds 5300 MW
  - One Blakely unit needed to condense (motor) or generate
  - When load exceeds 5600 MW both units needed

FERC License Requirements

- Continuous Minimum Flow
  - Varies monthly from 200 to 400 CFS
- Lake level fluctuations
  - 12 inches on Hamilton
  - 24 inches on Catherine except in Spring when it is only 6 inches
- Public Notification of Release Plans
- Special Releases