

# Nantahala River Project



## CHEOPS™

*Operations and Planning Model*

**Developed By:**



**FRAMATOME ANP**

FRAMATOME ANP DE&S

**Developed For:**



*A Duke Energy Company*

# Meeting Agenda



- Introduction
- CHEOPS Model – Wet/Norm/Dry Years
- Nantahala River Project CHEOPS Model
  - **Scenarios & Output**
    - Base Case w/ Current Runner
    - Base Case w/ New Runner (NR)
    - Scenario 2 - Duke Power Trial Balloon w/NR
    - Scenario 3 - Duke TB w/NR & Bunny's Mod Rec Flows
    - Scenario 4 - Duke TB w/NR & Bunny's Mod Rec Flows & Nant HOA Rule Curve
    - Scenario 5 - Duke TB w/NR & Bunny's Mod Rec Flows & USFWS Minimum Bypass Flows
    - Scenario 6 - Duke TB w/NR & Bunny's Mod Rec Flows & NCWRC Rule Curve
- Questions & Answers

# CHEOPS Model

## Wet / Normal / Dry Years



- Estimate (based on complete hydrology data ranked by year for each location)

**Wet = 1996**

**Normal = 1983**

**Dry = 1970**



# CHEOPS Model

## Scenarios



- **Current Scenario** - Base Case w/ Current Runner
- **Scenario 1** - Base Case w/ New Runner (NR)
- **Scenario 2** - Duke Power Trial Balloon w/NR
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# Current Scenario

## Base Case Components

- Existing Runner
- Minimum Instantaneous Flows
  - White Oak to Dicks Creek Tailrace (8cfs)
  - Dicks Creek (No flow used for generation)
- Target Elevations
  - Current Target Elevations
- Recreational Flows
  - Pass approx. 525cfs via generation at Nantahala  
April 1 – October 31 to support 606cfs downstream

# CHEOPS Model

## Scenarios



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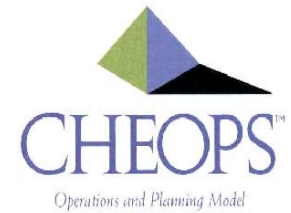
# Scenario 1

## Base Case w/ New Runner Components

- ➔ • New Runner
- Minimum Instantaneous Flows
  - White Oak to Dicks Creek Tailrace (8cfs)
  - Dicks Creek (No flow used for generation)
- Target Elevations
  - Current Target Elevations
- Recreational Flows
  - Pass approx. 525cfs via generation at Nantahala  
April 1 – October 31 to support 606cfs downstream

# CHEOPS Model

## Scenarios



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# Scenario 2

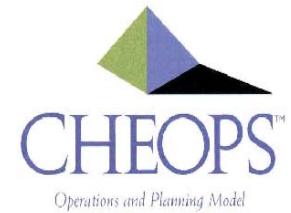
## Duke Trial Balloon w/ New Runner Components



- **Minimum Instantaneous Flows**
  - White Oak to Dicks Creek Tailrace (13cfs Jul 1-Nov 15)
- **Bypass Flows**
  - White Oak Dam Bypass (5cfs all year)
  - Dicks Creek Bypass (no flow used for generation)
  - Nantahala Bypass (425cfs for 1 weekend and 350cfs for 1 Fall weekend & 1 Spring weekend)
- **Target Elevations**
  - New Target Elevations
- **Recreational Flows**
  - Various times, durations for 606cfs at downstream node

# CHEOPS Model

## Scenarios



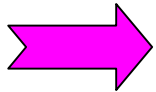
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# Scenario 3



## Modified Duke Trial Balloon w/ New Runner Compon

- Minimum Instantaneous Flows
  - White Oak to Dicks Creek Tailrace (13cfs Jul 1-Nov 15)
- Bypass Flows
  - White Oak Dam Bypass (5cfs all year)
  - Dicks Creek Bypass (no flow used for generation)
  - **Nantahala Bypass (350cfs for 1 wknd 7hrs/day Sept., 300cfs for 1 evening/wk 4hrs/day mid-Jul. – Aug., 300cfs for 2 evenings/wk 4hrs/day for 3wks Sept.)**
- Target Elevations
  - New Target Elevations
- Recreational Flows
  - Various times, durations for 606cfs at downstream node



# CHEOPS Model

## Scenarios



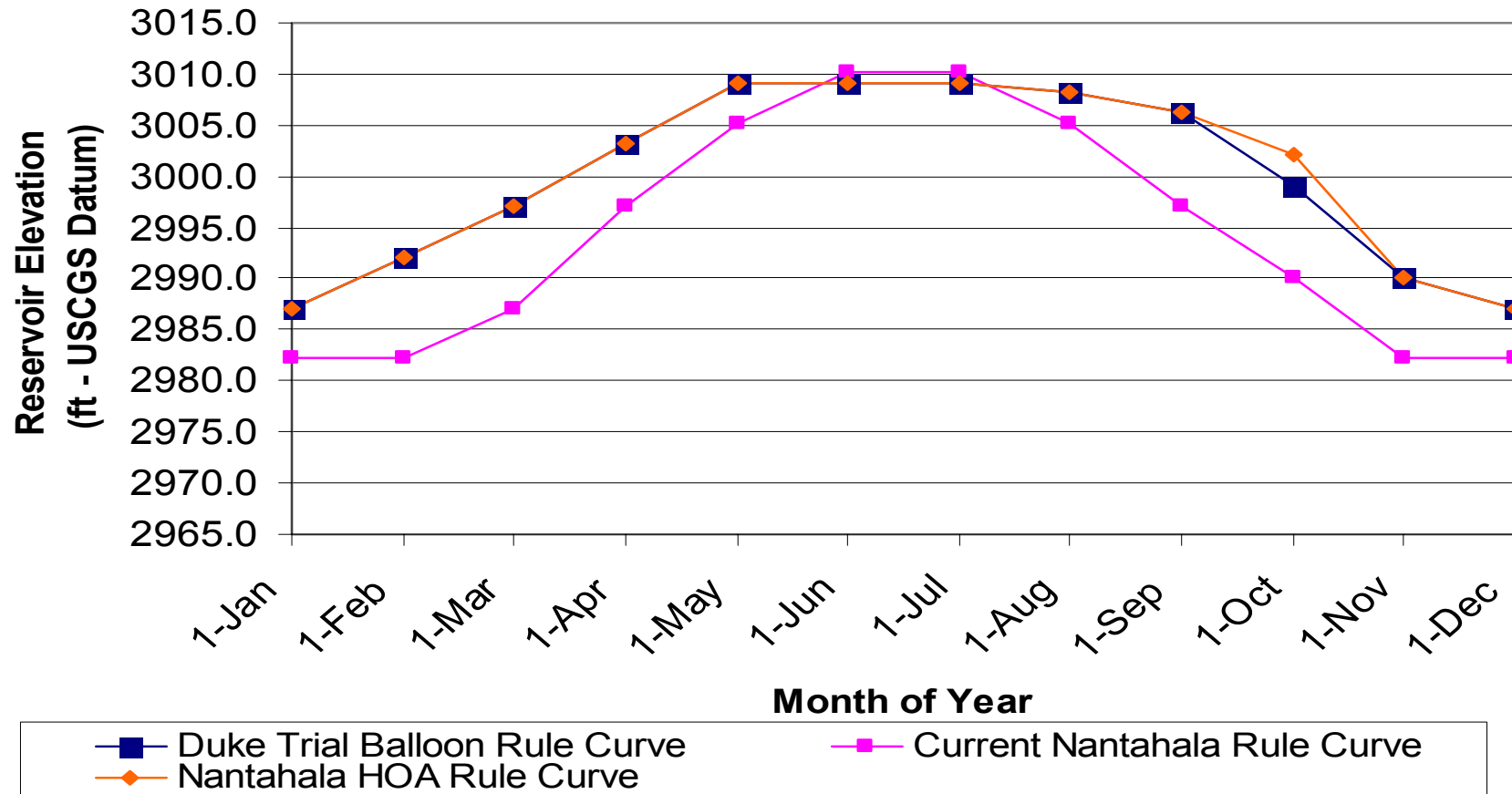
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# Scenario 4

## Nantahala HOA Target Elevations vs. Duke Trial Balloon & Current Target Elevations



Comparison of all Nantahala Rule Curves



# CHEOPS Model

## Scenarios



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# Scenario 5

## USFWS Min. Bypass Flow Components



<b>MONTH</b>	<b>ESTIMATED 20% Flows</b>	<b>NANTAHALA (cfs)</b>	<b>WHITE OAK (cfs)</b>	<b>DICKS CREEK (cfs)</b>
January	20%	74	11.3	2.3
February	20%	82	12.4	2.6
March	20%	88	13.4	2.8
April	20%	71	10.8	2.3
May	20%	55	8.3	1.7
June	20%	42	6.4	1.3
July	20%	38	5.8	1.2
August	20%	33	5	1
September	20%	26	4	0.8
October	20%	26	3.9	0.8
November	20%	35	5.3	1.1
December	20%	57	8.7	1.8

# CHEOPS Model

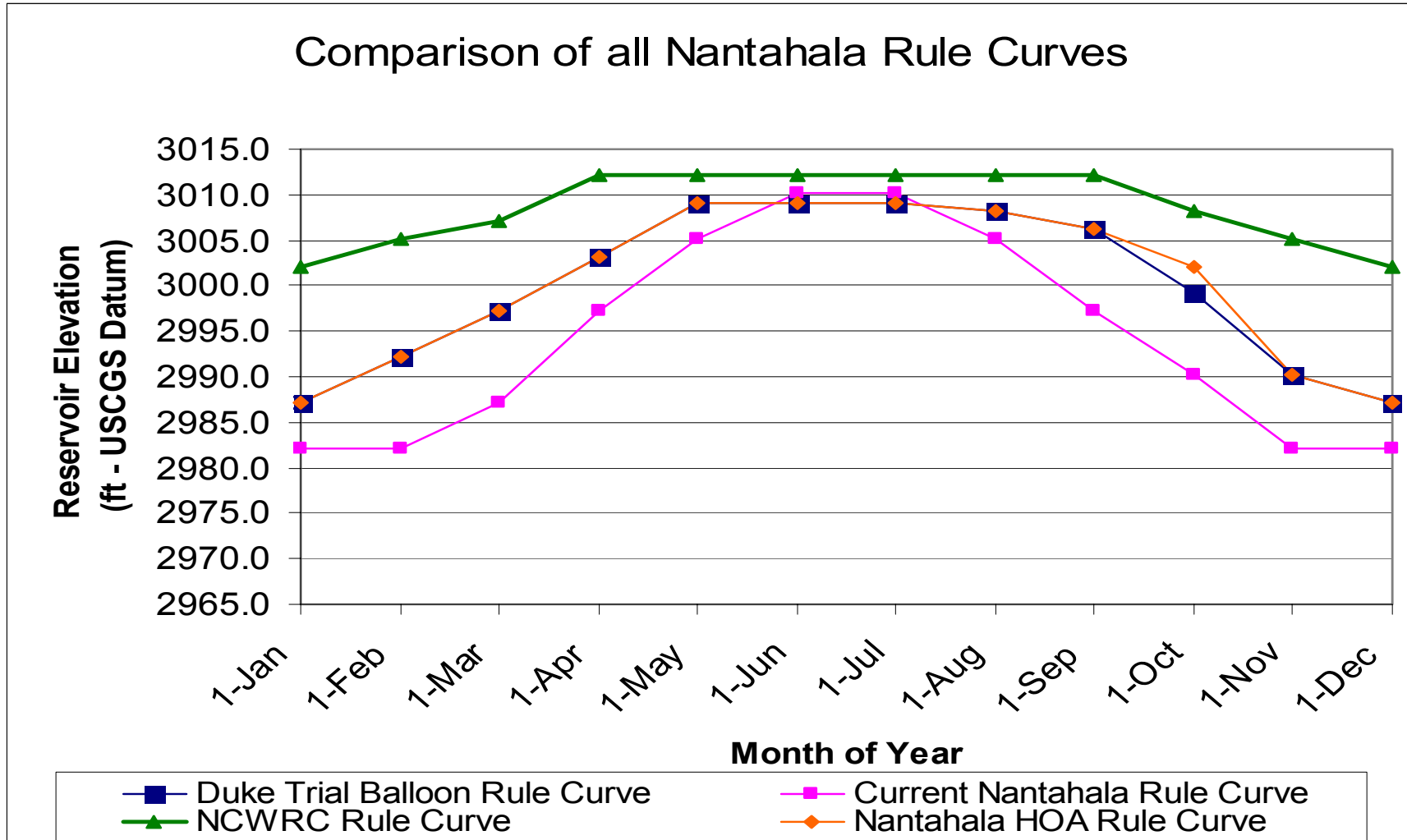
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# Scenario 6

## NCWRC Nantahala Target Elevations vs. All other Nantahala Target Elevations



# CHEOPS Model



## Scenario Output



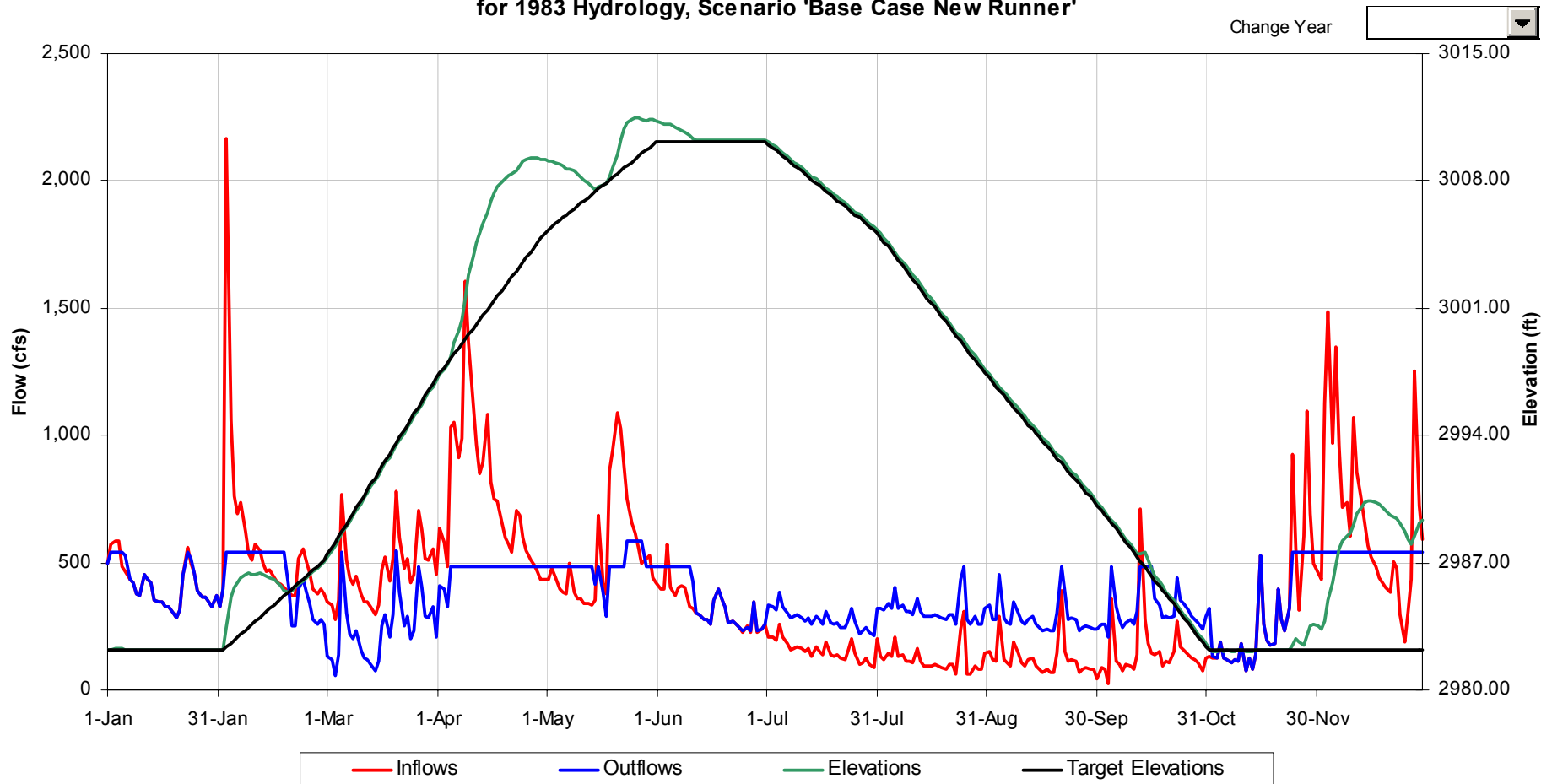
# Nantahala

## Base Case New Runner

(Normal 1983)



Nantahala Reservoir Operational Details  
for 1983 Hydrology, Scenario 'Base Case New Runner'



# Nantahala

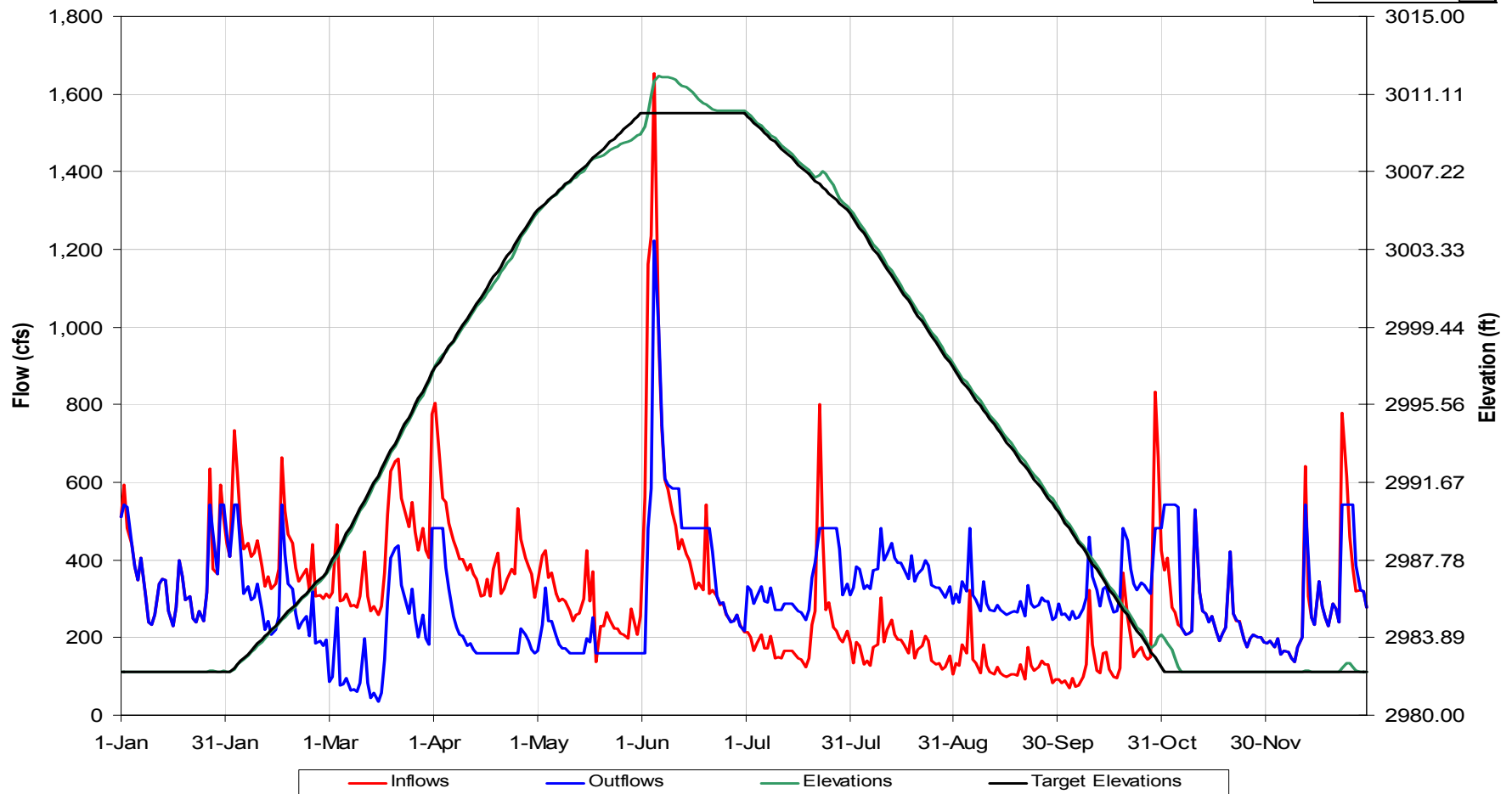
## Base Case New Runner

(Dry 1970)



Nantahala Reservoir Operational Details  
for 1970 Hydrology, Scenario 'Base Case New Runner'

Change Year



# Nantahala

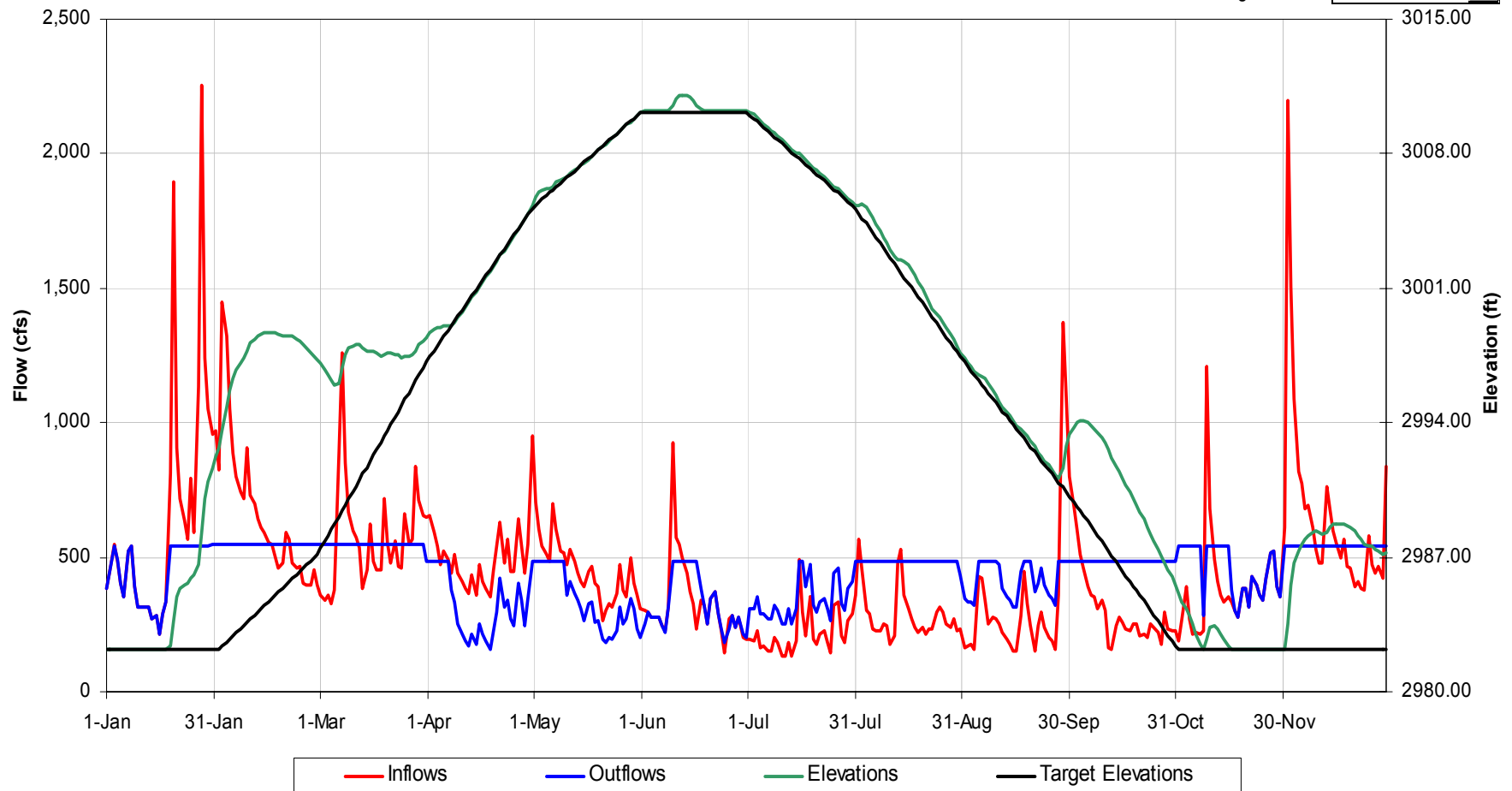
## Base Case New Runner

(Wet 1996)



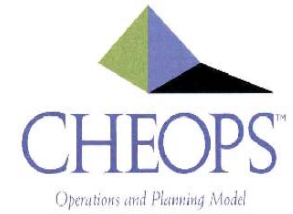
Nantahala Reservoir Operational Details  
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Change Year



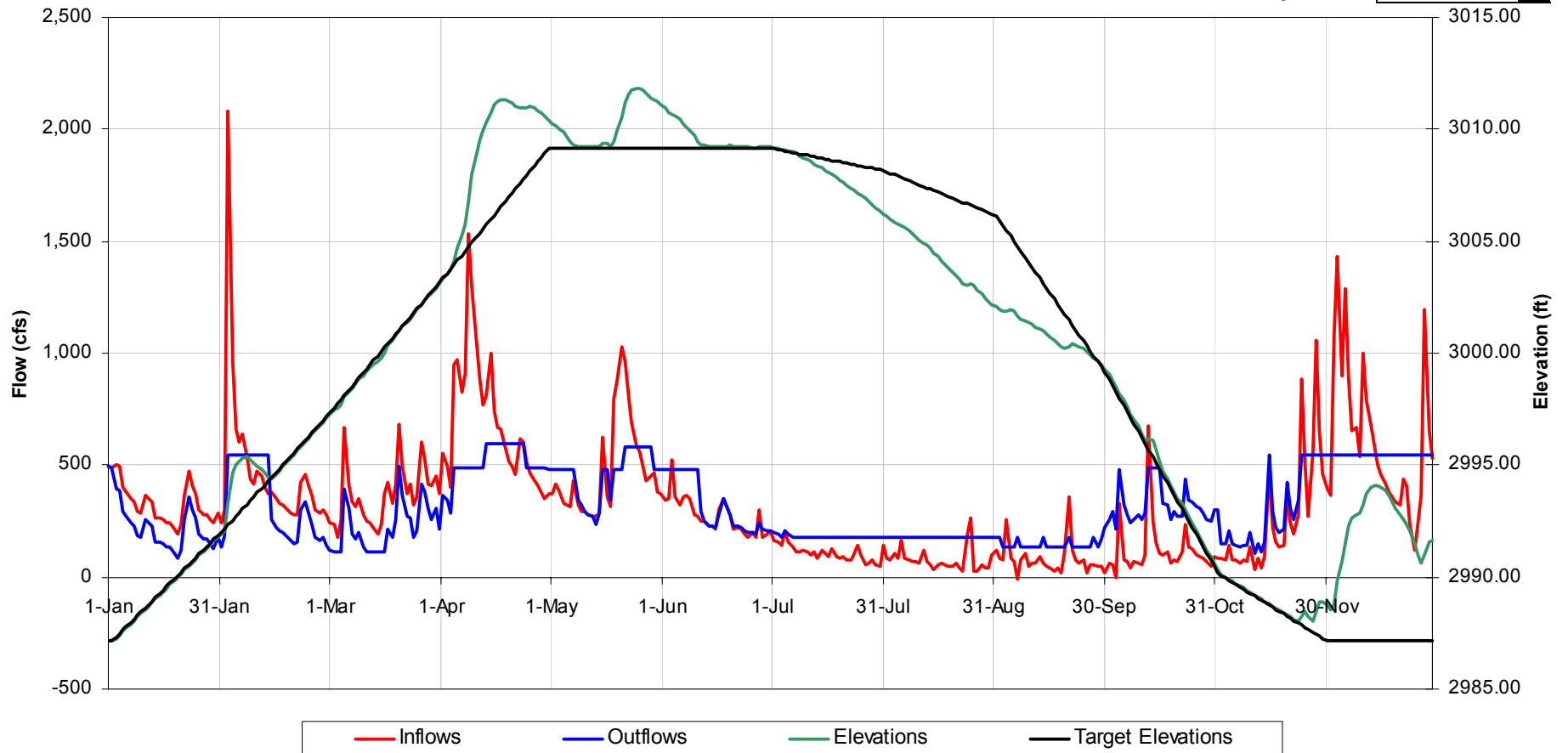
# Nantahala - Scenario 5

## (Normal 1983)



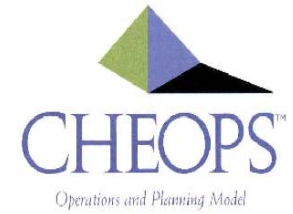
Nantahala Reservoir Operational Details  
for 1983 Hydrology, Scenario 'Scn 5 Usfws Bpf & Mod Tb'

Change Year



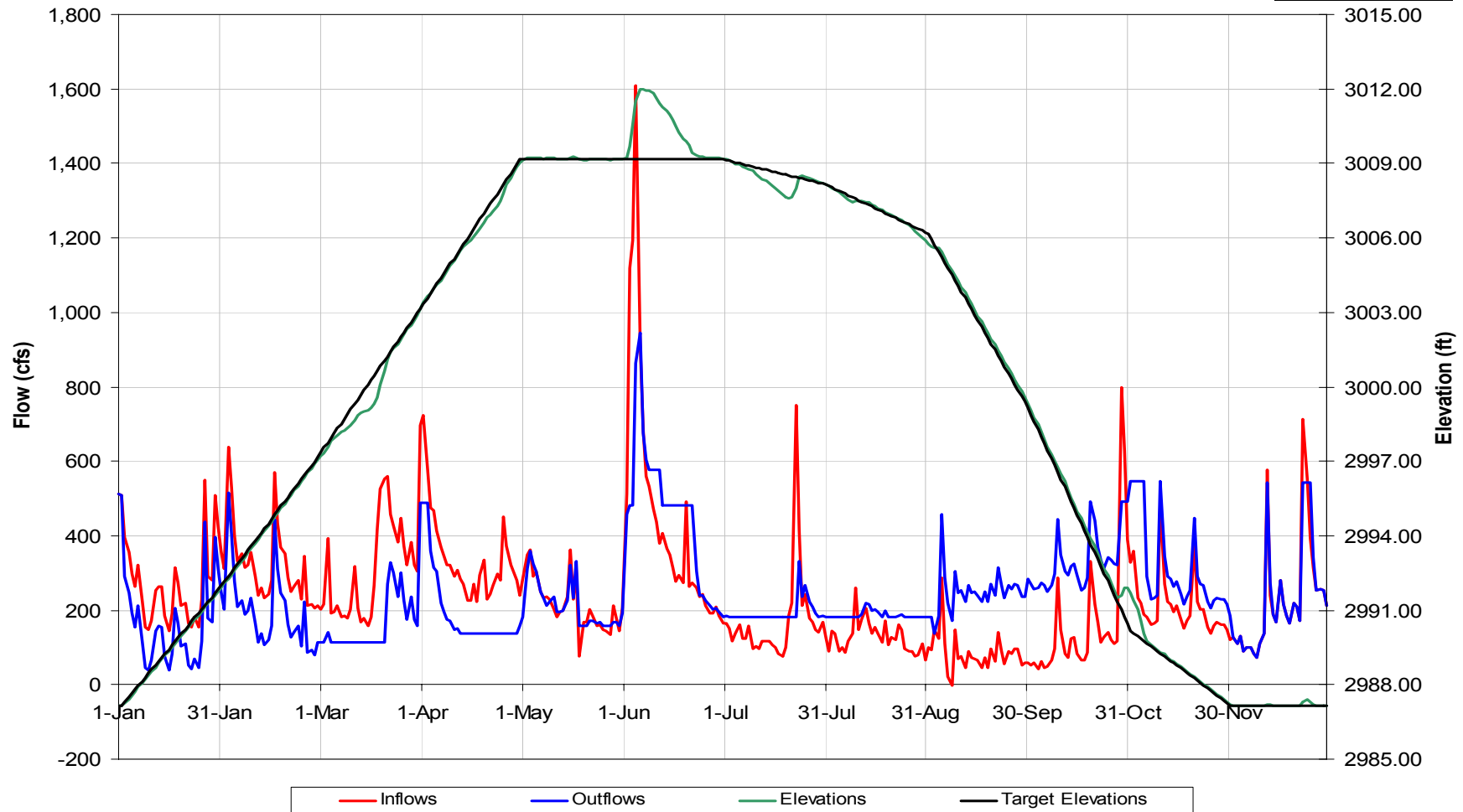
# Nantahala - Scenario 5

## (Dry 1970)



Nantahala Reservoir Operational Details  
for 1970 Hydrology, Scenario 'Scn 5 Usfws Bpf & Mod Tb'

Change Year



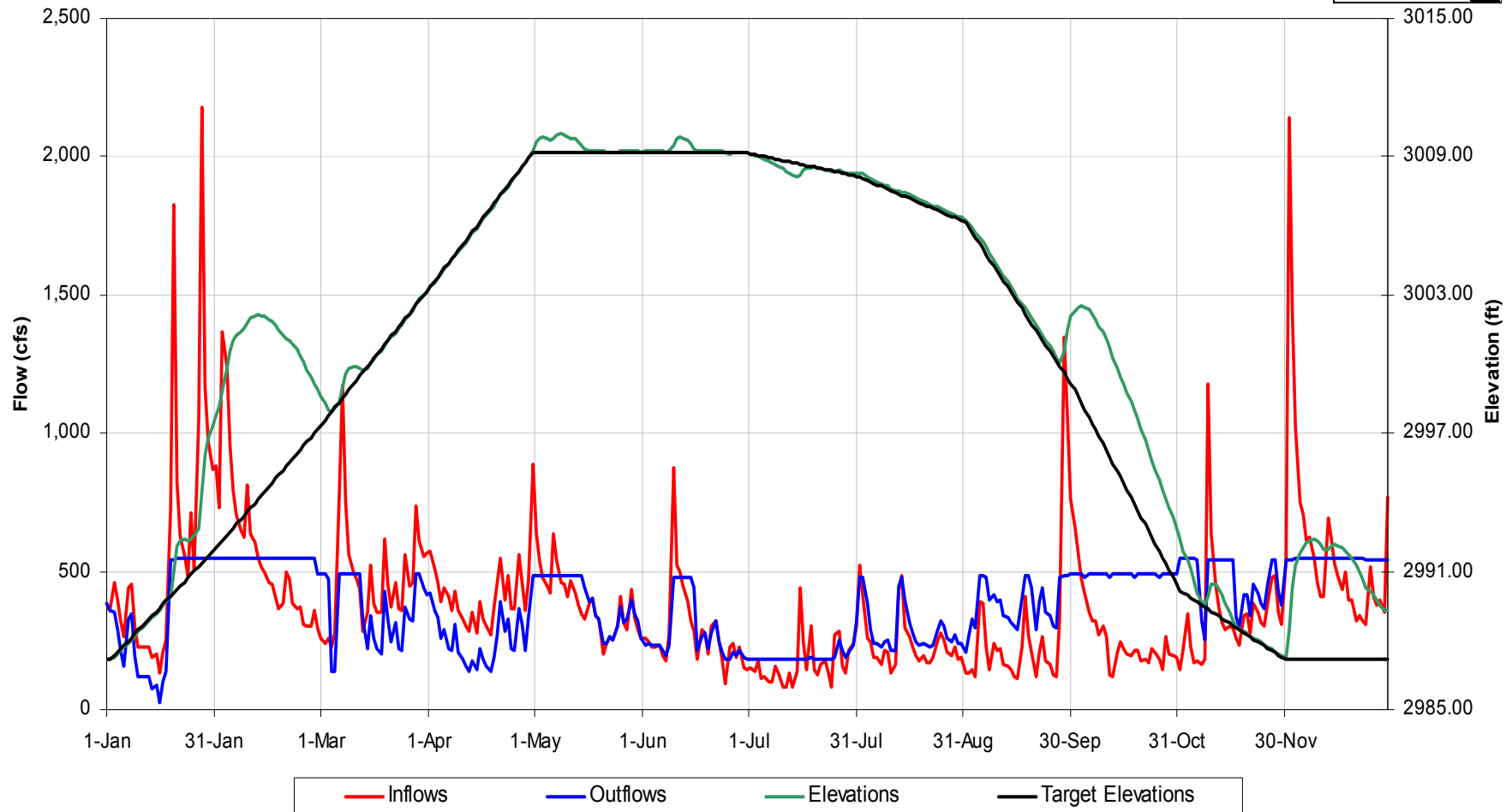
# Nantahala - Scenario 5

## (Wet 1996)



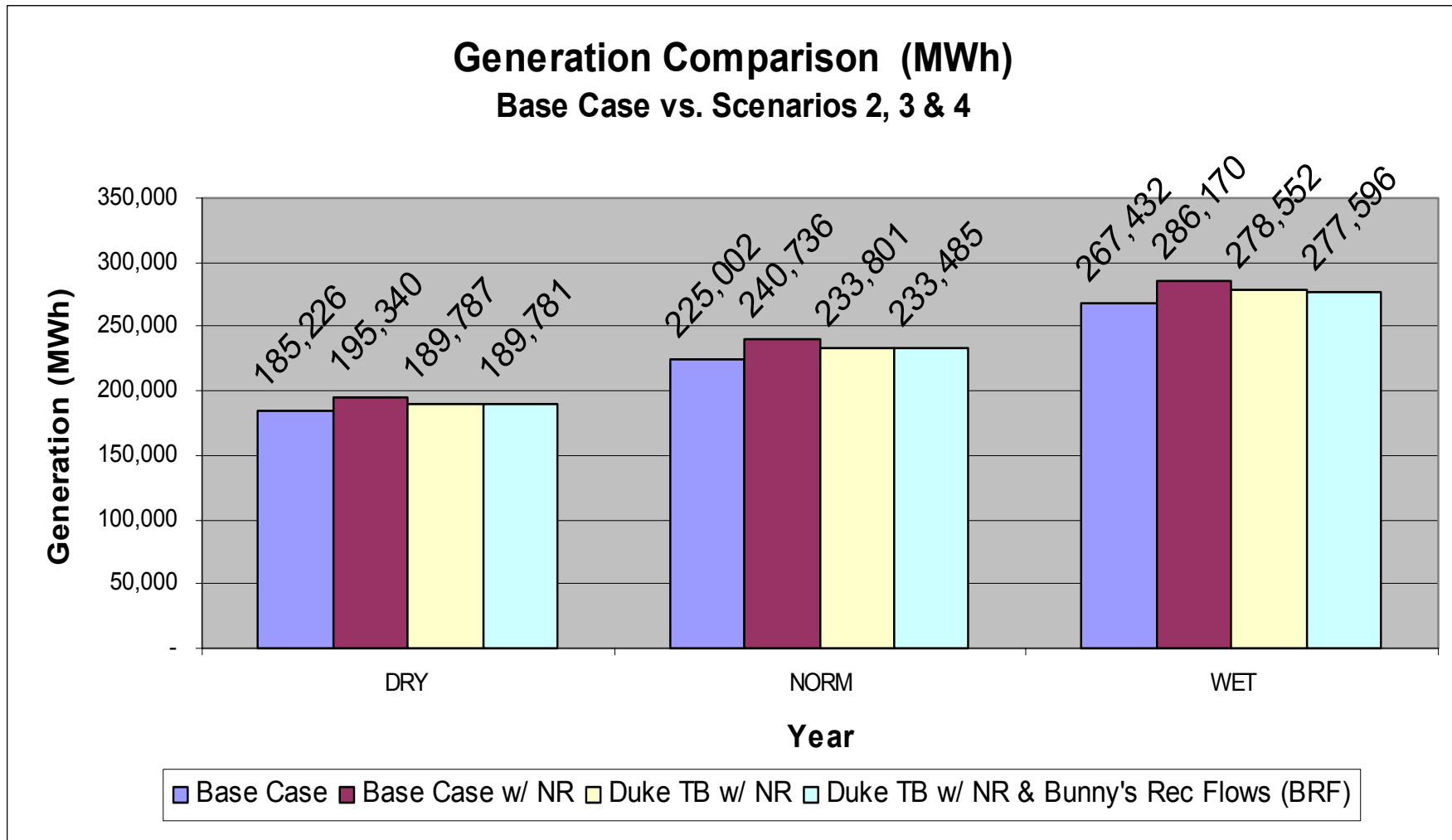
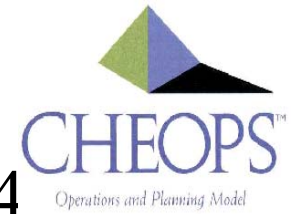
Nantahala Reservoir Operational Details  
for 1996 Hydrology, Scenario 'Scn 5 Usfws Bpf & Mod Tb'

Change Year



# Generation (MWh)

Base w/New Runner vs. Scenarios 2, 3 & 4

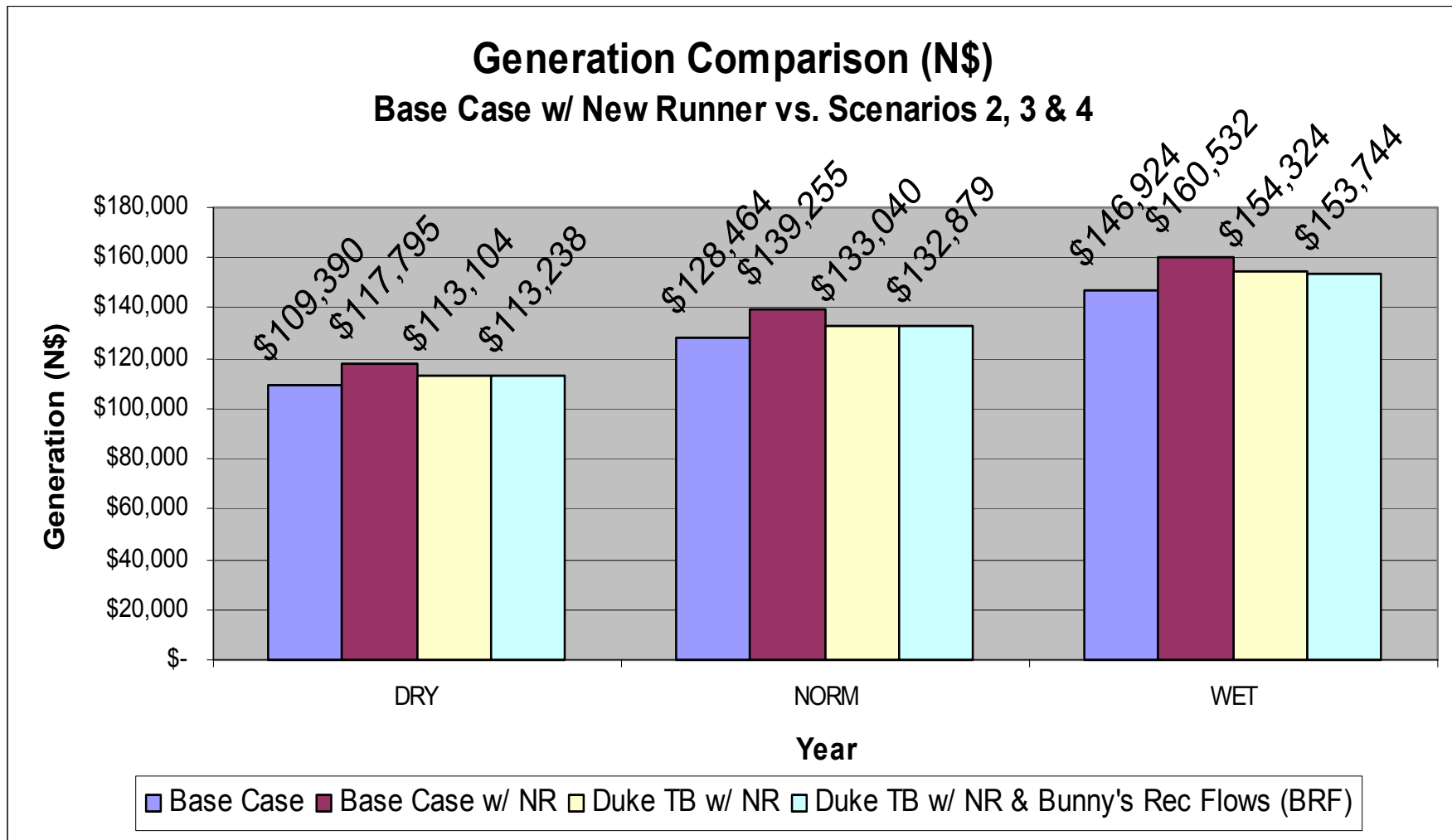


NR = New Runner    TB = Trial Balloon    BPF = Bypass Flows    BRF = Bunny's Rec. Flows    RC = Rule Curve

# Generation (N\$)



Base w/New Runner vs. Scenarios 2, 3 & 4

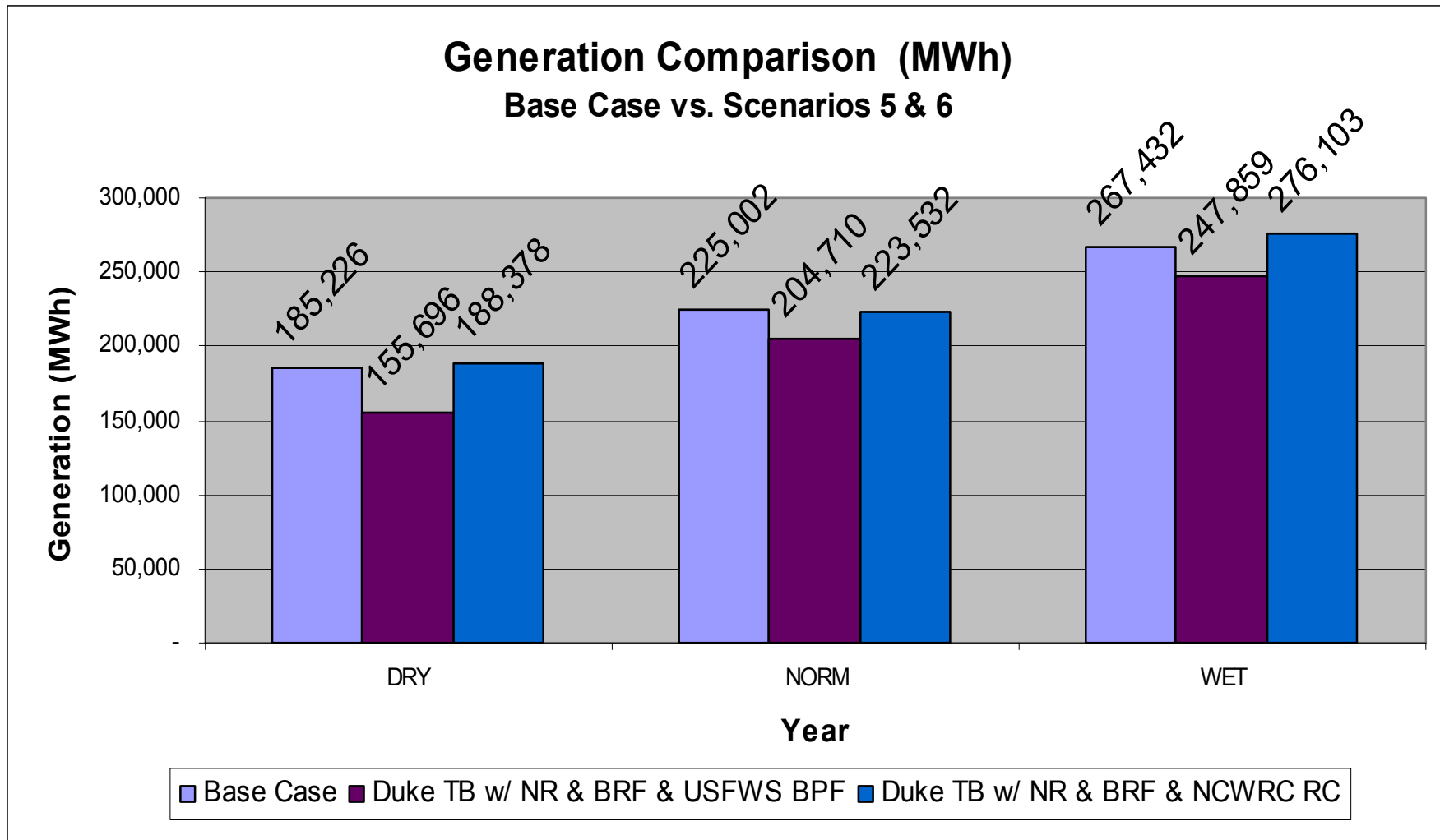


NR = New Runner    TB = Trial Balloon    BPF = Bypass Flows    BRF = Bunny's Rec. Flows    RC = Rule Curve

# Generation (MWh)



Base w/ New Runner vs. Scenarios 5 & 6

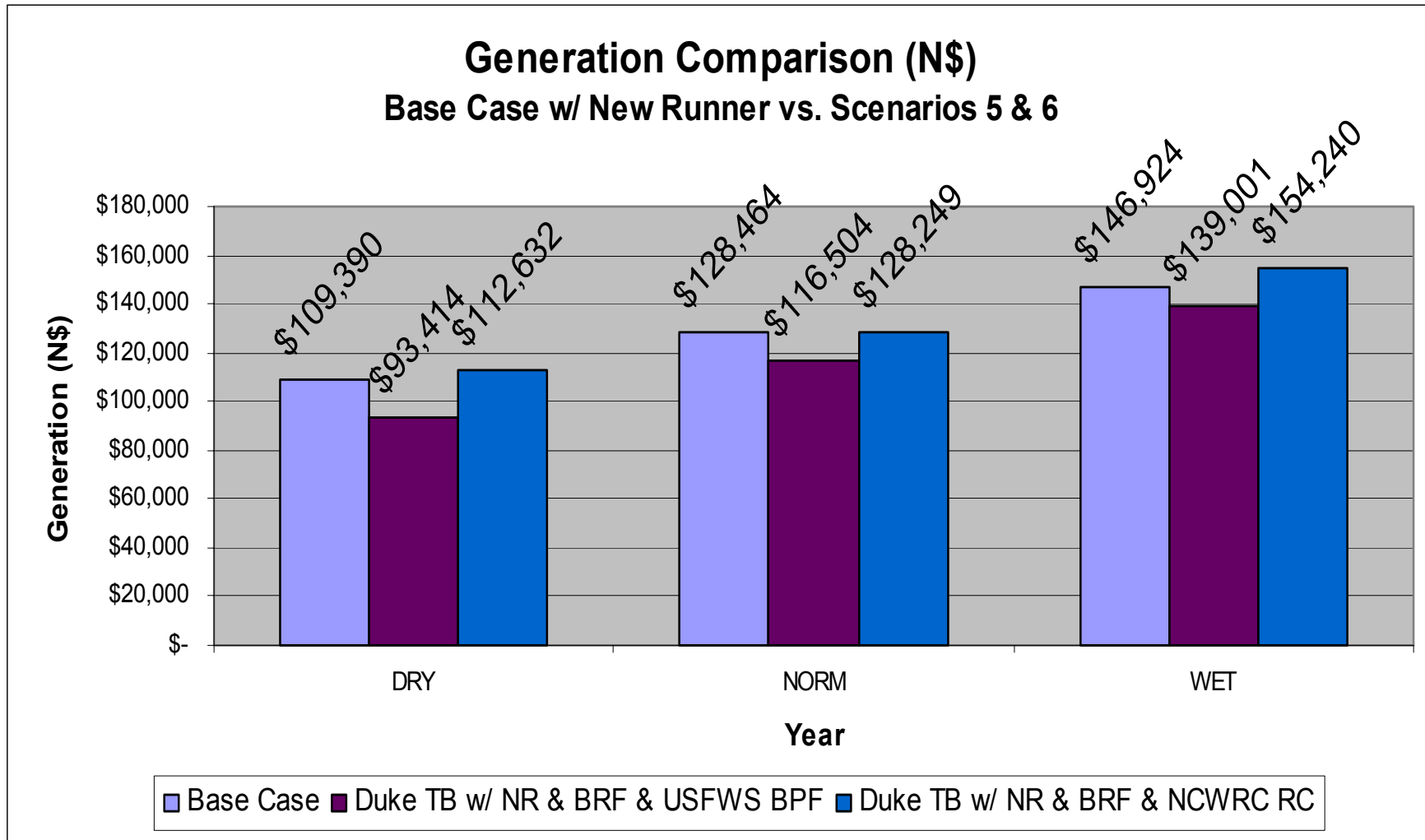


NR = New Runner    TB = Trial Balloon    BPF = Bypass Flows    BRF = Bunny's Rec. Flows    RC = Rule Curve

# Generation (N\$)



## Base w/ New Runner vs. Scenarios 5 & 6



NR = New Runner    TB = Trial Balloon    BPF = Bypass Flows    BRF = Bunny's Rec. Flows    RC = Rule Curve

# Generation Comparison (N\$)

## Base Case w/ New Runner vs. Scenarios



SCENARIO	DRY	NORM	WET
Base Case	\$ 109,390	\$ 128,464	\$ 146,924
Base Case w/ NR	\$ 117,795	\$ 139,255	\$ 160,532
Duke TB w/ NR	\$ 113,104	\$ 133,040	\$ 154,324
Duke TB w/ NR & Bunny's Rec Flows (BRF)	\$ 113,238	\$ 132,879	\$ 153,744
Duke TB w/ NR & BRF & HOA RC	\$ 112,193	\$ 131,914	\$ 152,542
Duke TB w/ NR & BRF & USFWS BPF	\$ 93,414	\$ 116,504	\$ 139,001
Duke TB w/ NR & BRF & NCWRC RC	\$ 112,632	\$ 128,249	\$ 154,240

PERCENT DIFFERENCE IN GENERATION \$\$ (w/ New Runner)			
SCENARIO	DRY	NORM	WET
Base Case (BC)	-	-	-
BC w/ NR	-	-	-
BCNR vs Duke TB w/NR	-4.0%	-4.5%	-3.9%
BCNR vs Duke TB w/NR & BRF	-3.9%	-4.6%	-4.2%
BCNR vs Duke TB w/ NR & BRF & HOA RC	-4.8%	-5.3%	-5.0%
BCNR vs Duke TB w/ NR & BRF & USFWS BPF	-20.7%	-16.3%	-13.4%
BCNR vs Duke TB w/ NR & BRF & NCWRC RC	-4.4%	-7.9%	-3.9%

# Generation Comparison (MWh)

## Base Case w/ New Runner vs. Scenarios



SCENARIO	DRY	NORM	WET
Base Case	185,226	225,002	267,432
Base Case w/ NR	195,340	240,736	286,170
Duke TB w/ NR	189,787	233,801	278,552
Duke TB w/ NR & Bunny's Rec Flows (BRF)	189,781	233,485	277,596
Duke TB w/ NR & BRF & HOA RC	189,636	233,565	275,495
Duke TB w/ NR & BRF & USFWS BPF	155,696	204,710	247,859
Duke TB w/ NR & BRF & NCWRC RC	188,378	223,532	276,103

PERCENT DIFFERENCE IN GENERATION MWh (w/ New Runner)			
SCENARIO	DRY	NORM	WET
Base Case (BC)	-	-	-
BC w/ NR	-	-	-
BCNR vs Duke TB w/NR	-2.8%	-2.9%	-2.7%
BCNR vs Duke TB w/NR & BRF	-2.8%	-3.0%	-3.0%
BCNR vs Duke TB w/ NR & BRF & HOA RC	-2.9%	-3.0%	-3.7%
BCNR vs Duke TB w/ NR & BRF & USFWS BPF	-20.3%	-15.0%	-13.4%
BCNR vs Duke TB w/ NR & BRF & NCWRC RC	-3.6%	-7.1%	-3.5%

# Questions & Answers

