



# Eastern Nevada Development Plan

**Presentation to the STEP Meeting**

**Nevada Power Company & Sierra Pacific  
Power Company**

**November 17, 2006, San Diego**



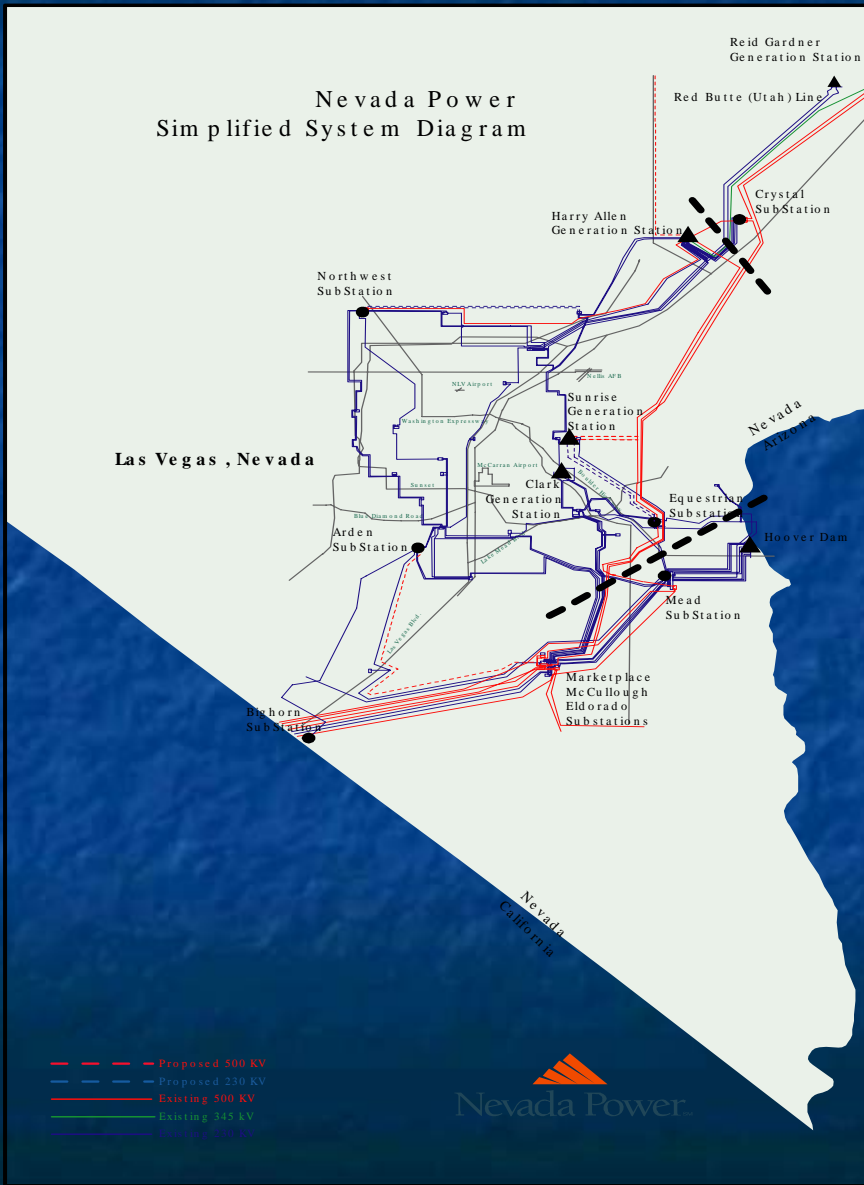
2006 IRP



# Transmission Plans



# Nevada Power System Overview



- Transmission System Composed of Three Major Sections
  - Uncongested Grid
  - Southern Cut Plane
  - Northern Cut Plane



# Major NPC Projects Revealed in 2006 IRP

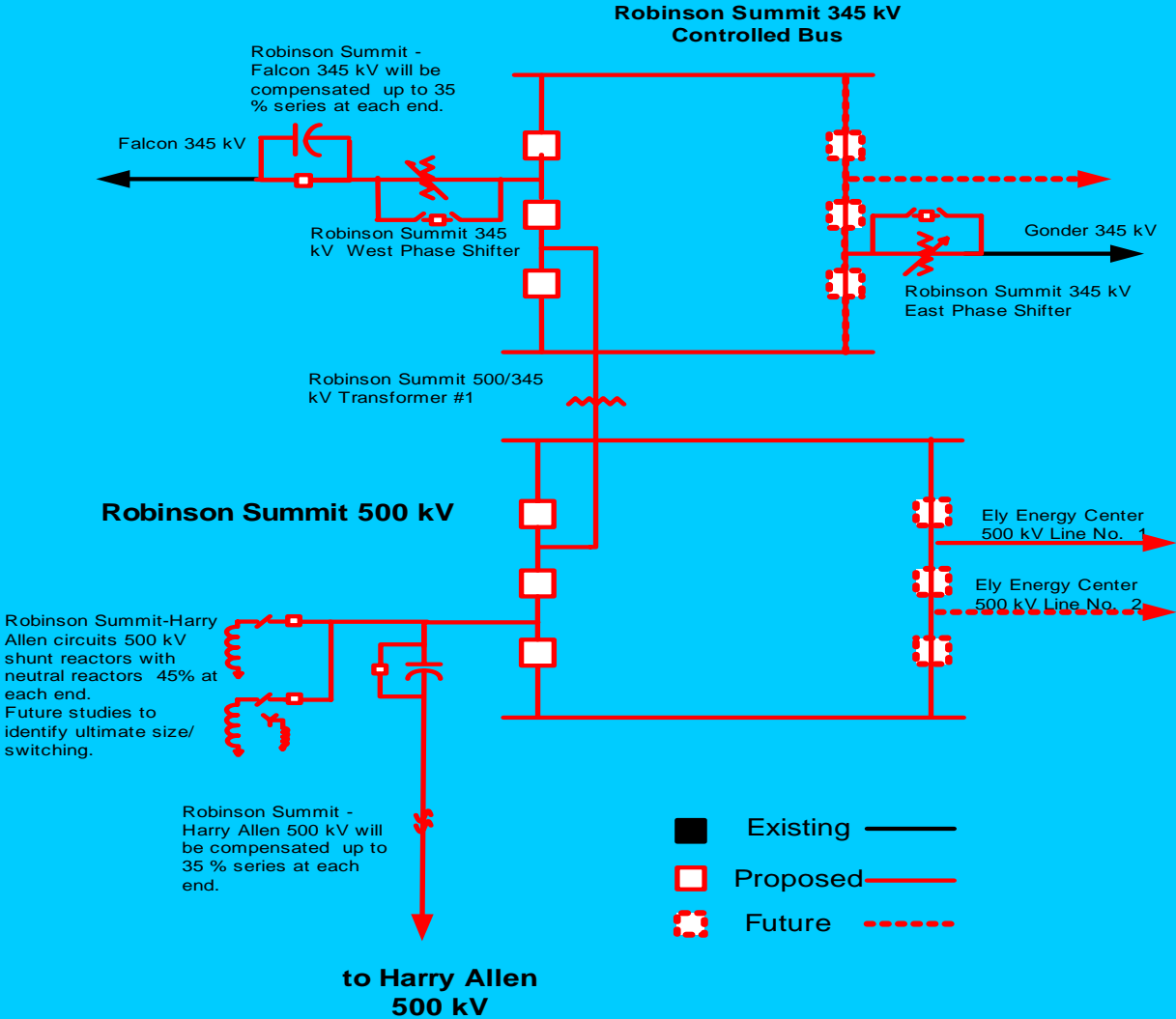
- Ely Energy Center (EEC), Including Eastern Nevada Transmission Intertie (ENTI) - **NPUC APPROVED**
- White Pine Energy Associates (WPEA) and Great Basin Transmission Company (GBT)
- East Valley Area Master Plan (EVAMP) - **NPUC APPROVED**
- Northwest Las Vegas Area Routing and Siting Master Plan (VARs) - **NPUC APPROVED**
- Other Projects : Sinatra, LV Core Service, etc. - **NPUC APPROVED**
- Also Addressed: Import / Export Capabilities, Centennial Project Status



# Ely Energy Center & EN-ti Projects

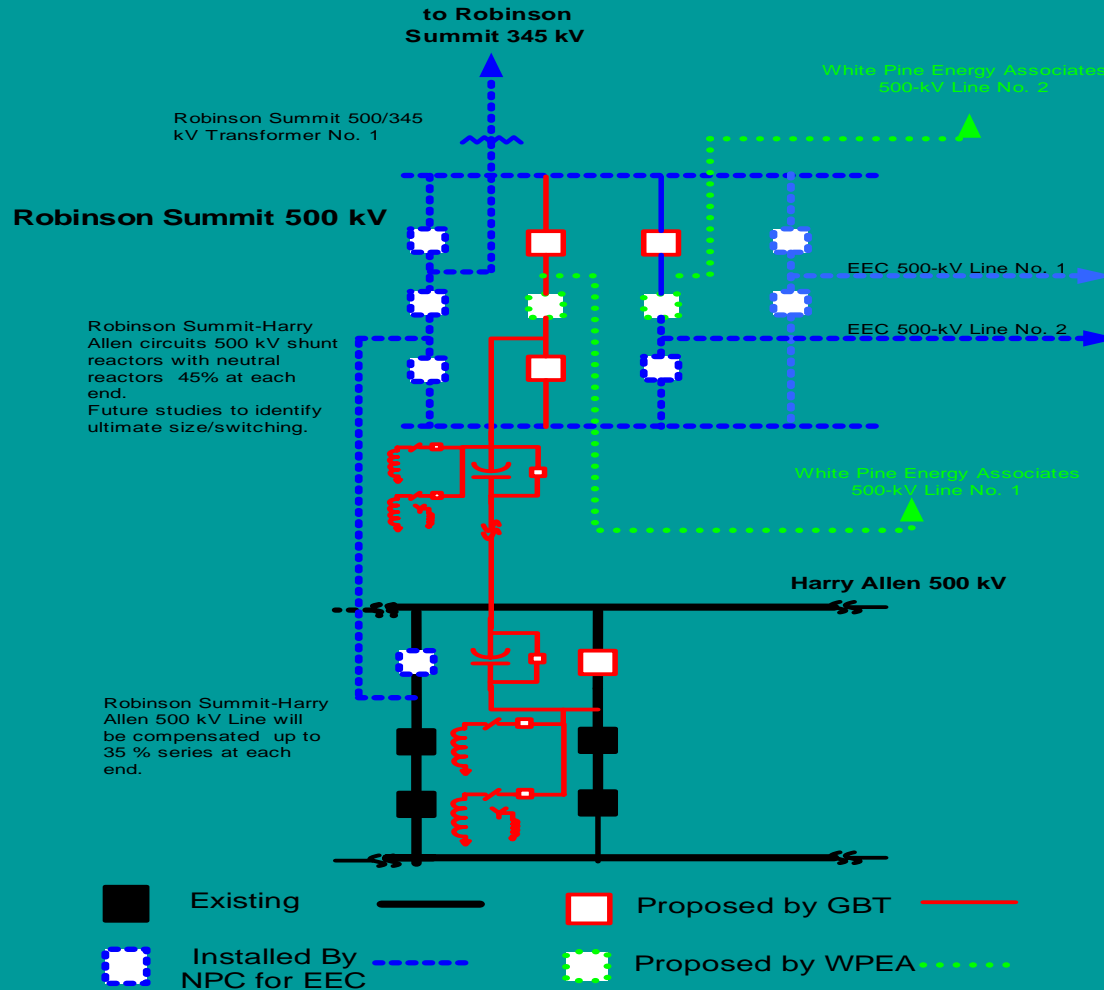
- EEC 500 kV Switching Station
- EEC – Robinson Summit 500 kV No. 1 Transmission Line
- Robinson Summit 500/345 kV Switching Station
- Fold of Falcon – Gonder 345 kV Line Into Robinson Summit Substation
- Harry Allen – Robinson Summit 500 kV No. 1 Transmission Line (ENTI)
- Harry Allen 500 kV Improvements for EEC (ENTI)

# Robinson Summit Substation One-line Diagram



# White Pine Energy Center / Great Basin Transmission Interconnection

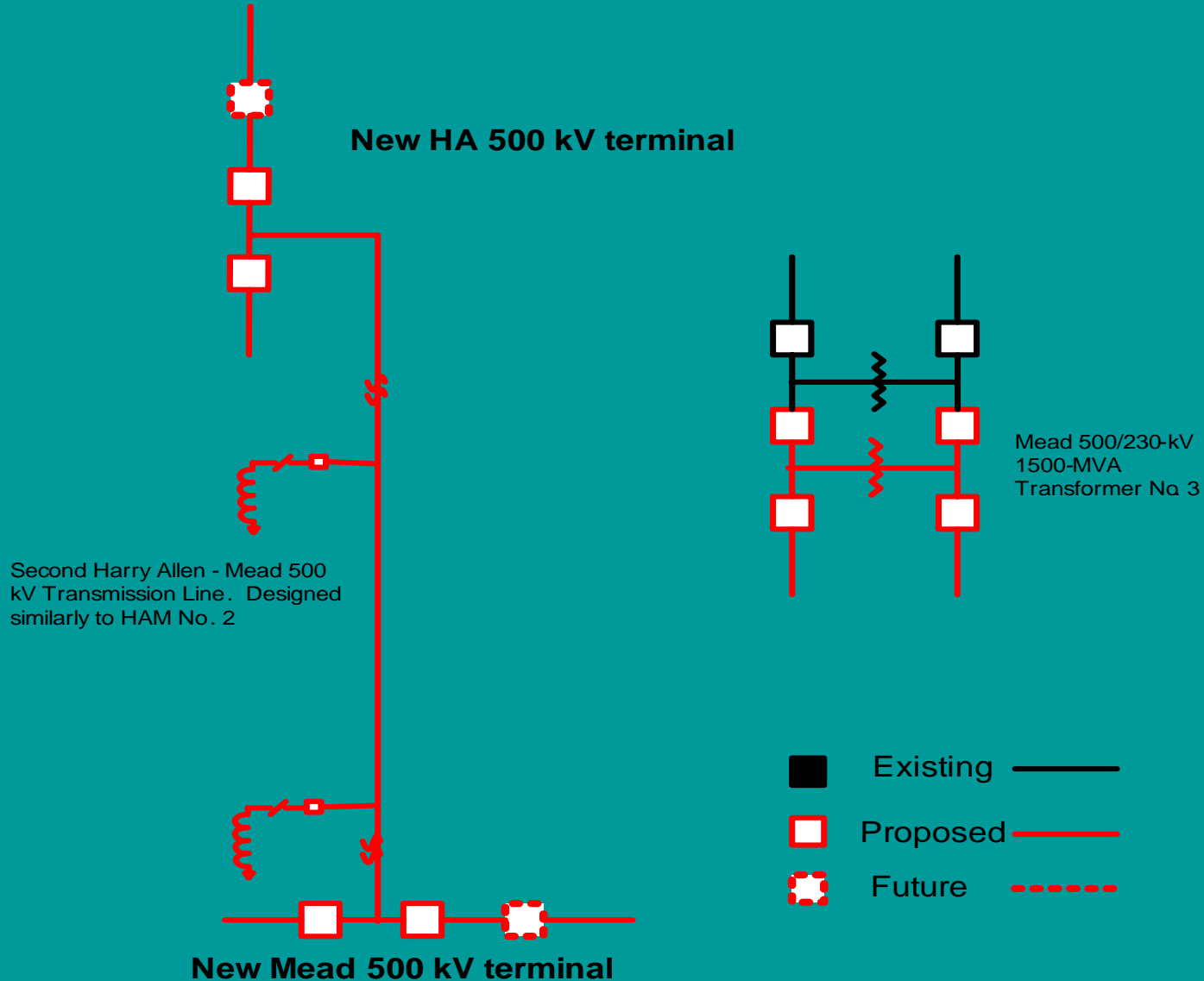
## Great Basin Transmission, LLC Robinson Summit - Harry Allen 500 kV Line



# Justification of EEC & EN-ti Projects

- 1,550 MW new resources to Nevada Power loads
- 300 MW new resources to Sierra Pacific loads
- Deliver IGCC plants at EEC
- Interconnect White Pine Energy Center
- Point-to-point transmission service for Great Basin Transmission additions

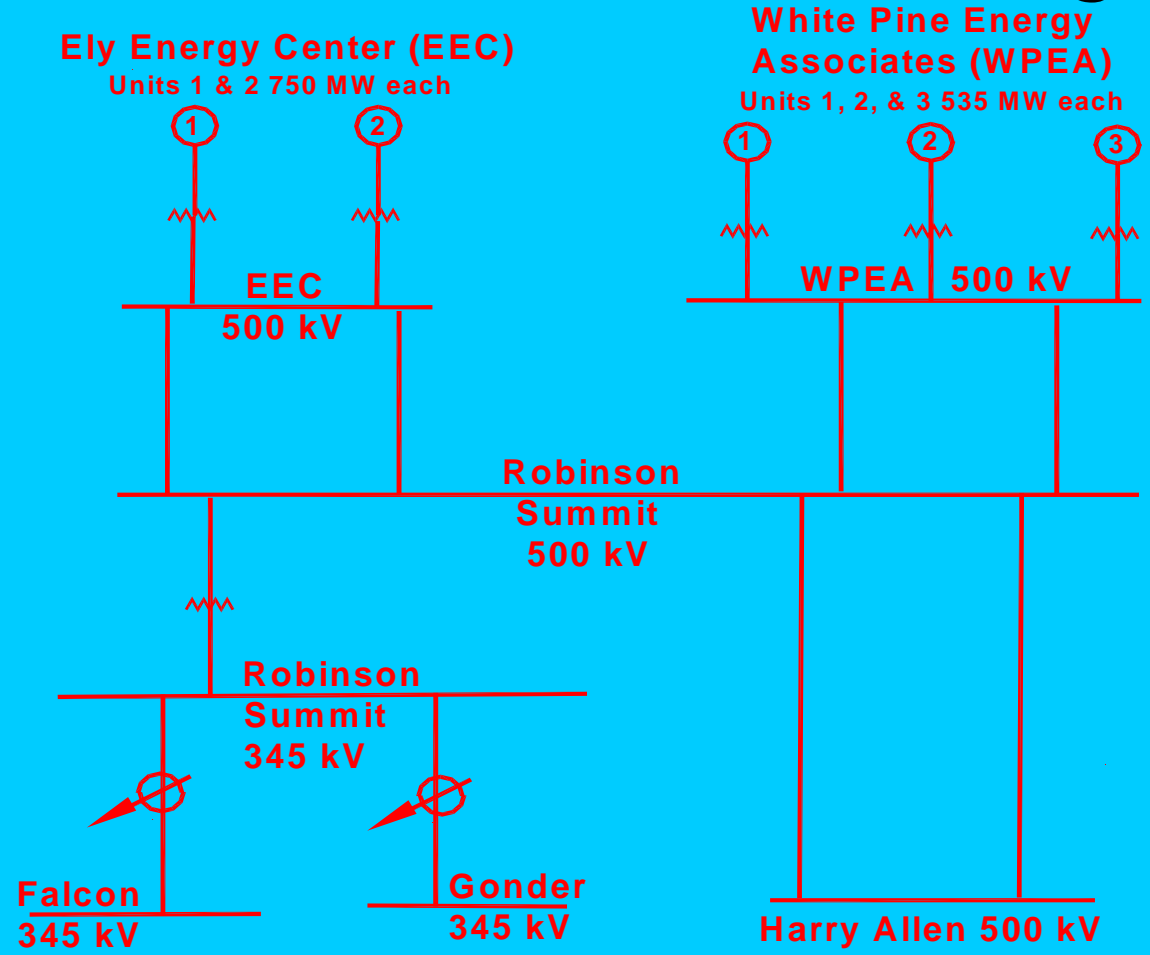
# White Pine Energy Associates Transmission Service Request



# White Pine (WPEA) and Great Basin (GBT) Project

- Robinson Summit 500 kV terminals for connection of White Pine Energy Center
- Robinson Summit and Harry Allen Substation for GBT (LS Power) Transmission Interconnection of its Robinson Summit – Harry Allen 500 kV line
- Harry Allen – Mead 500 kV line No. 2, substation work for the WPEA (LS Power) point-to-point Transmission Service Request, and transformer # 3 at Mead

# EEC & White Pine Interconnection, Final Diagram

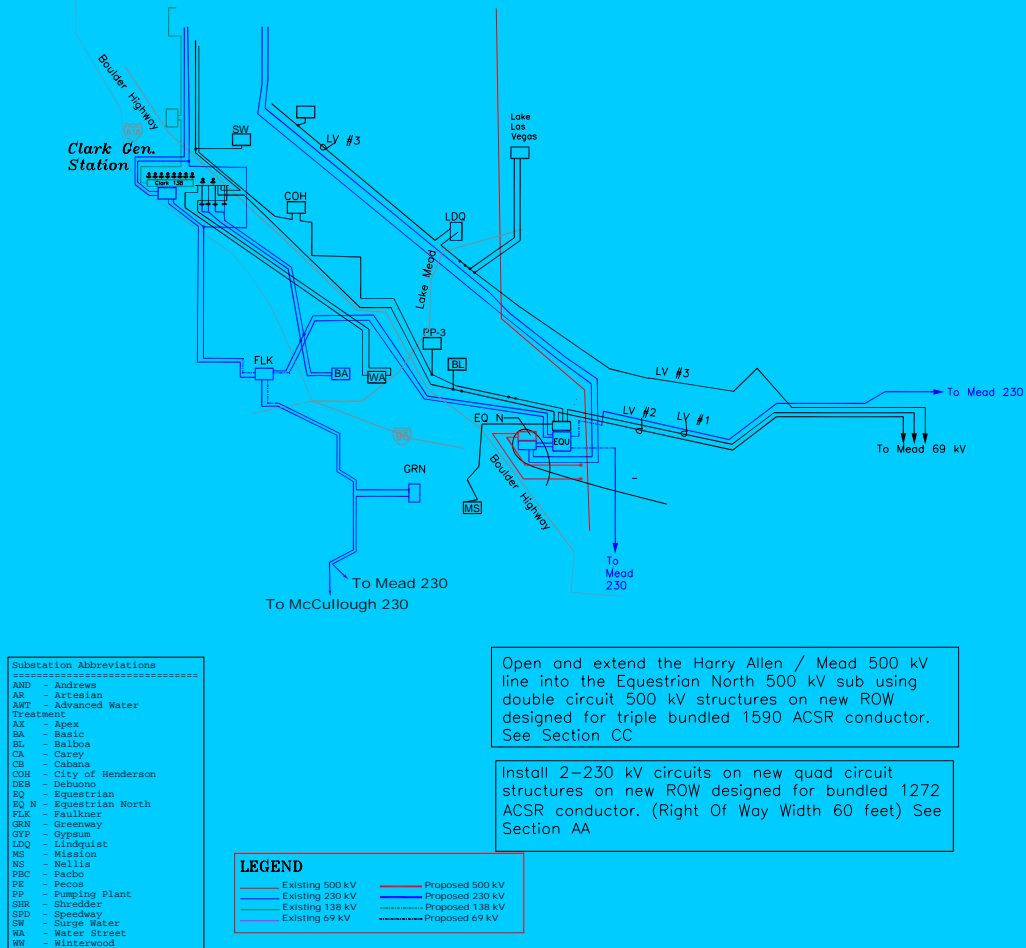


# East Valley Area Master Plan (EVAMP) Projects

- Northwest Substation 500/230 kV No. 2 Transformer - **NPUC APPROVED**
- Sunrise 500/230/138 kV Substation, The 'Sunrise' Option - **NPUC APPROVED (2 yr deferred)**
- Equestrian North 500/230 kV Substation, The 'Equestrian' Option



# EVAMP: Equestrian Option Oneline Diagram



# Justification of EVAMP Projects

## ■ Northwest #2 Transformer

- Northwest valley
- Crystal Sub
- Crystal – McCullough 500 kV line
- NW 500/230 kV No. 1 transformer

## ■ Sunrise 500/230/138 kV Substation

- Load service to Las Vegas valley
- Bulk power transfer or EEC 600 MW block into Harry Allen
- Close to load center and other transmission subs

## ■ Equestrian 500/230 kV Substation - Bulk power transfer Capability

1. New generation at Harry Allen
2. Change in Transmission at Crystal – McCullough 500 kV line
3. Crystal – McCullough 500 kV line / South of the Harry Allen 230 kV cut plane

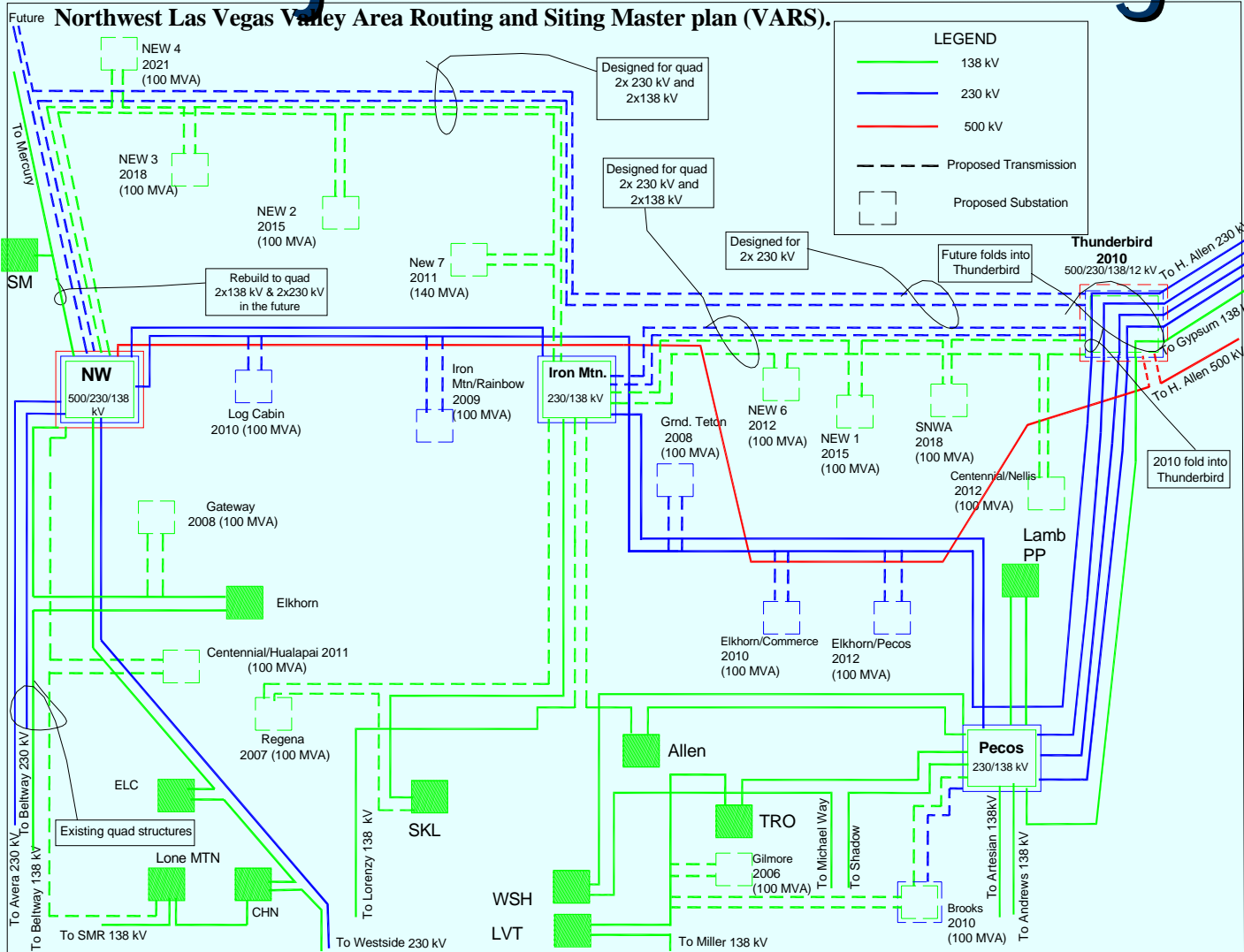
## ■ Beyond 2014

- Further development of 500/230 kV sources into the LV valley
- Participate in Federal Corridor Study
- Investigate feasibility of a 500 kV loop around LV

# Northwest Las Vegas Area Routing and Siting Master Plan (VARs)

- New 230/12 kV Substations - **NPUC APPROVED**
  - Grand Teton
  - Iron Mountain/Rainbow
  - Log Cabin
  - Elkhorn/Commerce
  - Elkhorn/Pecos
  - Mobile 230/12 kV substation
- Thunderbird Sub and VARs Transmission System Additions
- Iron Mountain 230/138 kV, 336 MVA Transformer
- Northwest 230/138 kV, 336 MVA Transformer
- Brooks 230/138/12 kV Substation & Pecos – Brooks 230 kV line

# VARS Projects One-line Diagram



# Justification of VARS Projects

- New 230/12 kV Subs
- Thunderbird Sub and VARS Transmission Additions
- Iron Mountain 230/138 kV, 336 MVA Transformer
- Northwest 230/138 kV, 336 MVA Transformer
- Brooks 230/138/12 kV Substation and Pecos – Brooks 230 kV line

# Additional Projects Proposed

- Sinatra Substation
- Strategic Plan for Las Vegas Core Service
- McDonald 230/138 kV Transformer
- Arden 230/138 kV Transformer
- Clark 230/138 kV Bank No. 6 Change out
- Valley Electric Association Interconnection
- Clark Generating Station Peakers
- Solar One Interconnection
- Import/Export Capability

# SPR Transmission Projects

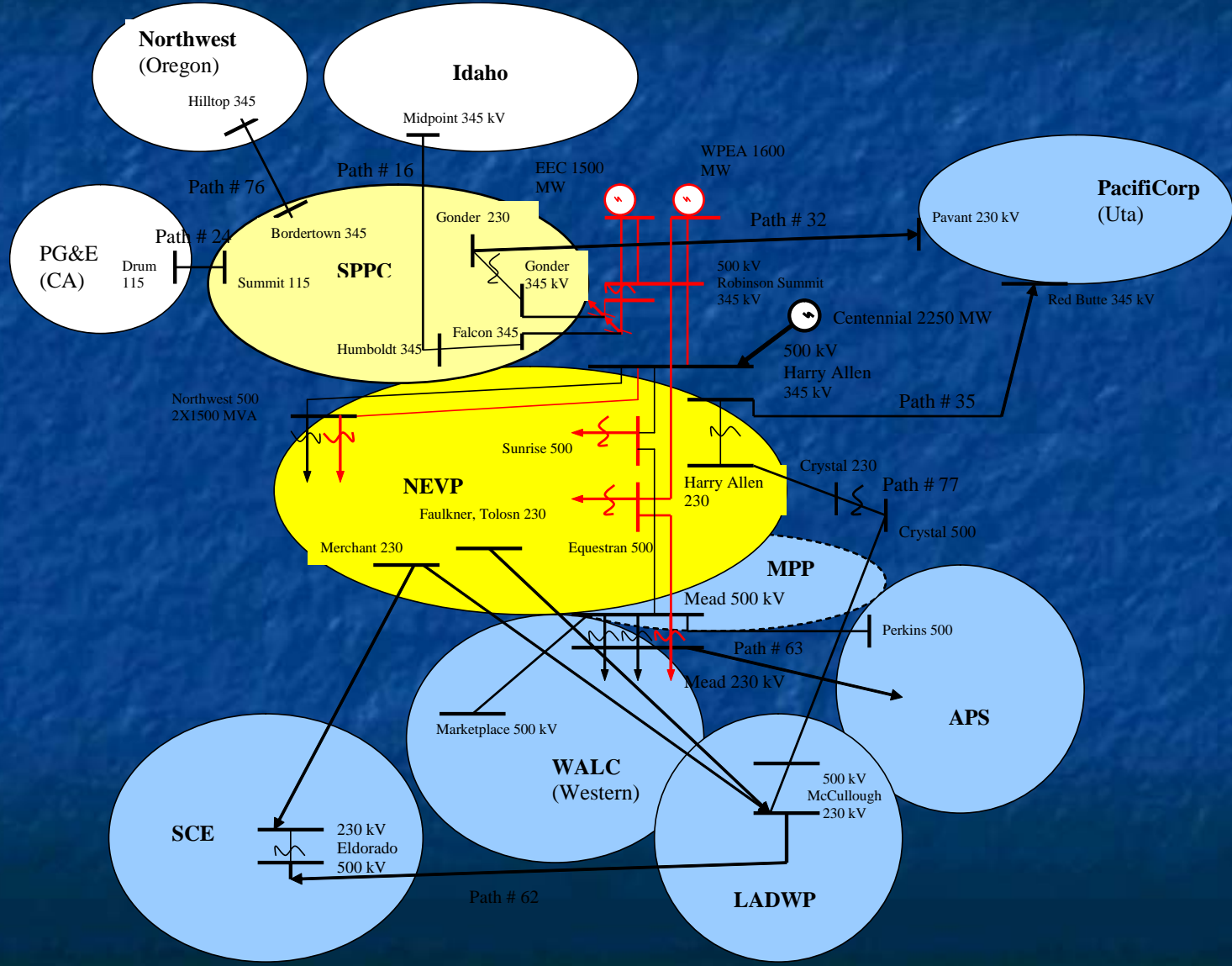


- \$785 Million completed since 1998 or currently under construction
- \$ 740 Million proposed in-service through 2014 not including EEC transmission
- Total \$ 1.5 Billion completed since 1998, under construction, or proposed through 2014

# 2006 NEVP/SPPC IRP Transmission Plans through 2014 Include:

- 3100 MW of new generation
- More than 700 miles of new 500 kV Lines
- 4 new 500 kV substations
- 6 to 10 new 230 kV substations

# NEVP and SPPC Development Plan in 2008 - 2014: EN-ti, WPEA/GBT and EVAMP



# Table 1: Major Phases and Milestones of EVAMP, EN-ti & WPEA/GBT Interconnection Facilities

#	Facility	In service	Project	Comment
1	Northwest xfmr # 2 500/230 1500MVA	2010	EVAMP	Load growth
2	Sunrise substation 500/230 kV	2010-2011	EVAMP	Load growth
3	White Pine 1600MW, Robinson 500/345, lines EEC-Robinson-HA-500, Robinson- Falcon - Gonder 345	2010-2011	WPEA/GBT	WPEA Network Intercon./Transm. Service
4	HAM Line # 2	2011	WPEA/GBT	WPEA Transm. Service
5	Mead xfmr # 3 500/230 1500MVA	2011	WPEA/GBT	WPEA Transm. Service
6	Mead xfmr # 3 230/69 1500MVA	2011	WPEA/GBT	WPEA Network Intercon.
7	Line HA-Northwest # 2 500 Kv	2011-2013	EN-ti/WPEA	WPEA Network Intercon.
8	EEC 1500MW, Robinson 500/345, Lines: EEC-Robinson-HA-500, Robinson- Falcon&Gonder 345	2011-2013	EN-ti	Load growth
9	Equestrian subst. 500/230 kV	2014-2015	EVAMP	Load growth

# Studies Performed

## ■ Nevada Power IRP 2006:

- Power Flow and Import/Export Limits Study
- Power Flow and Stability Study For East Valley Area Master Plan Cases, Years 2011- 2014 (before and after Sunrise and Equestrian)
- Stability Assessment for "EEC/EN-ti" Project, Years 2011- 2014

## ■ Obtaining WECC Rating for EEC/EN-ti

- Initiated Regional Planning Process, Regional Review Group Formed
- Initiated Phase I
- Comprehensive Progress Report (- at WECC REVIEW)
- Regional Project Report (in progress)

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## ■ System Impact for WPEA/GBT interconnection Requests

- SIS for Network Interconnection of WPEA 1600 MW + GBT line RS-HA 500 kV
- SIS for Point-to-Point Transmission of WPEA 1200 MW from HA 500 kV - Mead 230 kV

# Power Flow and Import/Export Limits Study

- Congested: Northern and Southern Cut planes
- NEVP Import Limits:
  - 2011: 5,200 MW (with NW xfmr #2 & Sunrise)
  - 2014: 5,700 (with Sunrise & Equestrian)
- NEVP Export Limits:
  - 2011: 5,200 MW w/o EEC, 4,500 with EEC # 1
  - 2014: 5,000 MW w/o EEC, 3,500 with EEC # 1,2

# Power Flow and Stability Study for EVAMP, Years 2011- 2014

- Four major cases studied:
  1. 2011HS, with 750 MW at EEC, one xfmr 500/230 kV at Northwest, before Sunrise and Equestrian
  2. 2011HS, with 750 MW at EEC, two xfmr 500/230 kV at Northwest, before Sunrise and Equestrian
  3. 2014HS, with 1500 MW at EEC, two xfmr 500/230 kV at Northwest, with Sunrise, before Equestrian
  4. 2014HS, with 2250 MW at EEC, two xfmr 500/230 kV at Northwest, with Sunrise and Equestrian
- The steady state analysis for pre- and post-contingency states, has not revealed any substantial problems. The possible overloads (that occur under major contingencies), will be addressed by transmission planning in the near future.
- The transient stability analysis included NEVP list of major disturbances, showed no violations of the NERC/WECC specified system stability requirements.
- The worst condition analysis has not determined any violations of the NERC/WECC specified requirements.

# Stability Assessment for “EEC/EN-ti” Project, Years 2011- 2014

- Transient stability study for SPPC and NEVP in connection with EN-ti project facilities. The major reason for study: angular instability detected at the first phase of the EN-ti implementation. Two cases: a) 2011 750 MW at EEC + one line RS-HA 500 kV b) 2014 1500 MW at EEC + one line RS-HA 500 kV
- The summary of the stability analysis is presented in table 2. The table includes 11 alternatives, which mitigate detected angular instability.
- Installation of series capacitors on line Robinson – Falcon 345 kV at 70% compensation is judged to be the most effective “static” measure enhancing CCT to 6cycles. Additional benefits: enhancement of the Sierra’s TTC and reduction of losses. A disadvantage of this alternative is its relatively high cost \$16.8M.
- Auto-transformer 500/345 and a phase-shifter 345 kV at Robinson with the smaller impedances is an effective and not expensive supplemental measure to the series compensation on line Robinson - Falcon.
- Optimization of the phase-shifting transformers configuration at Robinson also is attractive supplemental measure. Requires re-design of transmission in Robinson – Falcon – Gonder area and in a wider Sierra’s 345 kV network. Additional studies required.
- Fast valving according to the performed simulations solves the stability problem within CCT=5 cycles. Pros: low expected cost. Cons: a) possible adverse effects on the turbine (valves), and boiler/steam generator b) no experience in SPR and WECC utilities. Requires additional considerations and efforts in both theoretical and implementation aspects.
- Fast-speed excitation (successful at Colstrip, Montana Power Co.) further studies required
- Installation of SVD. Five locations examined. The most effective: 300 Mvar cap banks at Robinson 500 kV. Other alternatives, including SVC, require further studies and considerations.

# TABLE 2: COMPARISON OF THE SYSTEM STABILITY ENHANCEMENTS

#	Description	Z reduction n <sup>1</sup>	CC T <sup>2</sup>	COST, \$M	Other	Comments
		%	cycles	Capital	benefits	
	Case: 2011 750 MW at EEC					
1	SC on Robinson - Falcon (no bypassing and reinsertion for external faults)	39.99	6.0	16.8	Increases TTC, reduces loss	Can be a supplement to # 1
2	Two Xfmrs Robinson + 2 PS -Falcon	14.22	5.0	17.05	Increases TTC, reduces loss	
3	Reduced impedances: Xfmr Robinson (from 8.9% to 5%); PS - Falcon (from 15% to 8%)	13.25	5.0	f/m	- " -	
4	No Phase-Shifters at Robinson -Falcon 345 kV	20.09	3.5	-11.0	- " -	
5	Fast Valving	n/a	5.0	f/m		Has a potential for CCT improvement. Further study required
6	SVD (+300Mvar) at ECG1, 22 kV	n/a	5.0	4.0		Further study/tuning of ON/OFF time required
7	Cap Bank 200 Mvar at Robinson 500 kV	n/a	4.5	4.33 <sup>3</sup>		- " -
8	Cap Bank 300 Mvar at Robinson 500 kV	n/a	6.0	6.0 <sup>3</sup>		- " -
9	Cap Bank 300 Mvar at Robinson 345 kV	n/a	5.5	6.0 <sup>3</sup>		- " -
10	Reactor 300 Mvar at ECG1, 22 kV	n/a	4.5	14		Disadvantage: reduces reactive reserve of the generator
11	SVC (+300/-100 Mvar) at Robinson 500 or 345 kV	n/a	-	10.0 <sup>3</sup>		Study is required
12	Fast Excitation	n/a	-	f/m		Further study is required
	Case: 2014 2X750 MW at EEC					
13	SC on Robinson - Falcon (no bypassing and reinsertion for external faults)	39.99	6.5	16.8	Increases TTC, reduces loss	

# Obtaining WECC Rating for EEC/EN-ti

- Initiated WECC Regional Planning Process, Regional Review Group Formed in Jan-2006
- Initiated Phase I in Oct-2006
- Comprehensive Progress Report (**at WECC Review**)
- Regional Project Report (in progress)

# Path Rating Study

- North-to-South 2000 MW: 1500 MW from EEC+500 MW from SPPC
- South-to-North 1000 MW : 1000 MW from NEVP into SPPC
- Power Flow Studies
- Stability Studies
- Short Circuit Studies
- Impact on WECC paths

# System Impact from WPEA/GBT Interconnection

- Power Flow Study Revealed a number of system operational limit violations in NEVP and SPPC 500/345/230 kV. Upgrades or construction of additional facilities are required. Sensitivity of the level of system loading to the amount of power transmitted from the new facilities into NEVP have been performed.
- Stability Study
  - Case1: 1600 MW at White Pine and a single line 500 kV RS – HA. Angular instability for a three-phase fault at RS 500 kV bus. A transfer trip of two 575 MW White Pine units is necessary (CCT=7.5 cycles). The respective RAS is needed at White Pine plant; all units must be equipped with OOS protection. Line RS – HA 500 kV needs high-performance protection and breakers, with the fault clearing within 3 cycles.
  - Case2: 1600 MW at White Pine, 1500 MW at EEC, and two lines 500 kV RS – HA. System is stable (CCT=5.5 cycles). To improve stability margin a transfer trip of one 575 MW White Pine generation unit is necessary (increase CCT=7.0 cycles).
- Fault Duty Assessment

No violations of switch breaking capabilities in SPPC/NPC facilities, as a result of WPEA additions. Violation of breaker's duty at Mead and McCullough 500 and 230 kV. Will be addressed jointly by NPC, WPEA and other facility owners (WAPA). Regional "EN-Short Circuit Study Group" will study and address the issues.

# Reason for Short Circuit Study Group

- Need to evaluate and address regional impacts of the EN Development Plan on the fault duty
- Preliminary studies identified potential need in breaker upgrades at some 500/230 kV substation (Mead, McCullough)
- Breaker duties at other substations are not known
- More detailed case needed to evaluate all impacts

# Short Circuit Study Group Plan

- Solicit membership from utilities in affected areas
- Build case to analyze impacts of IRP
- Perform analysis of impacts
- Generate report with results and recommendations

# TABLE 2: SCSG STUDY CASES

Case		Facilities & Projects <sup>1</sup>	Participants
#	Name		
1	Before WP	1,2	SPPC/NEVP
2	WP_NETWRK	1,2,3,7,9	SPPC/NEVP/WPEA
3	WP_TRANSM	1,2,3,4,5,6,9	SPPC/NEVP/WPEA/GBT
4	EEC_NETWRK	1,2,8	SPPC/NEVP
5	EEC_WP_NETWRK	1,2,3,7,8,9	SPPC/NEVP/WPEA/GBT
6	EEC_WP_TRANSM	1,2,3,4,5,6,8,9	SPPC/NEVP/WPEA/GBT/WAPA/ LADWP
7	EEC_WP_NETRANSM	1 - 9	SPPC/NEVP/WPEA/GBT/WAPA/ LADWP

<sup>1</sup> Numbers refer to cases in table 1

Thank you For  
Listening and  
Participating!