

## Appendix I Transmission System

### I.1 Overview

This appendix provides general information on LADWP’s transmission resources and then presents brief descriptions of the individual transmission systems.

### I.2 Transmission Resources

LADWP owns and operates an extensive network of Alternating Current (AC) and Direct Current (DC) transmission lines. Its internal grid is made up of a network of 115-kilovolt (kV), 138-kV, and 230-kV overhead and underground AC transmission lines. LADWP’s long distance bulk power system consists of 230-kV, 287-kV, 345-kV, and 500-kV AC lines and 500 kV DC lines. In terms of circuit-miles, Table I-1 illustrates LADWP’s transmission resources:

**Table I-1: Breakdown of Transmission Resources**

Voltage Level	AC/DC Current	Location	Circuit-Miles
±500-kV	DC	Out-of-Basin	1068
500-kV	AC	Out-of-Basin	1068
345-kV	AC	Out-of-Basin	189
287-kV	AC	Out-of-Basin	351
230-kV	AC	Out-of-Basin	341
Bulk Transmission Circuit-Miles		81%	3017
230-kV	AC	In-Basin	504
138-kV	AC	In-Basin	152
115-kV	AC	In-Basin	44
Basin Transmission Circuit-Miles		19%	700
Total Transmission Circuit-Miles		100%	3717

As Table I-1 shows, the majority of LADWP’s transmission assets are located outside of the Los Angeles basin. These resources, its “bulk transmission assets,” extend LADWP’s reach so that energy from low-cost generation resources located out of its service territory may be transmitted to LADWP customers. While its customers consume approximately 10 percent of all the electricity within California, LADWP’s transmission capacity is approximately 25 percent of California’s total transmission capacity, thus ensuring its customers are provided with a reliable supply of energy from the lowest cost resources. The reach and capacity of LADWP’s transmission portfolio also enables LADWP to purchase and sell energy in wholesale electricity markets using short and long-term agreements. Excess transmission capacity, or capacity not used at any given time to serve LADWP customers, is sold through a wholesale market that had its genesis when the Federal Energy Regulatory Commission (FERC) ruled in 1996 that all utilities under its jurisdiction must establish open-access transmission tariffs (OATTs) and

implement open-access same-time information systems (OASIS). Although municipal utilities, including LADWP, are not subject to FERC’s regulations, LADWP voluntarily meets these new industry standards.

LADWP is an active participant in the Western Systems Power Pool (WSPP) and the Western Electricity Coordinating Council (WECC) which work cooperatively to conform to North American Electric Reliability Corporation (NERC) standards and practices. In addition, it is LADWP’s policy to coordinate bulk transmission planning activities with other utilities and transmission service providers, encouraging partnership and cooperation in these activities. LADWP has differentiated itself from many of its counterparts by maintaining ownership and operation of its electric generation, transmission, and distribution assets.

A one-line diagram showing some of the key bulk power transmission lines is presented on Figure I-1. The transmission capabilities of the different systems are summarized in Table I-2.

**Table I-2: Import Capability of LADWP Bulk Power Transmission Resources**

Transmission System	Transfer Rating (MW)	LADWP Share (MW) <sup>5</sup>
East to LA Basin	4,000	3,566
West-of-the-River	10,623	3,373
East-of-the-River	9,300 <sup>1</sup>	1,109 <sup>1,2</sup>
Pacific DC Intertie (N-S at NOB)	2,990 <sup>1,3</sup>	1,196 <sup>1,3</sup>
Owens Valley Transmission Line	300	300
Southern Transmission System	1,920 <sup>1</sup>	1,143 <sup>1</sup>
Northern Transmission System, Mona to Intermountain	1,200 <sup>4</sup>	343 <sup>4</sup>
Northern Transmission System, Gonder to Intermountain	200 <sup>4</sup>	33

Notes: 1 = The total transfer capability into Southern California and the interdependence of these systems is determined by seasonal nomograms called SCIT.

2 = LADWP’s share may be increased up to 1,521 MW depending on the result of on going discussions with the other path owners.

3 = the total transfer capability into Northern California and the interdependence of these systems is determined by seasonal nomograms.

4 = LADWP shares on the NTS depend on the IPP Excess Power recalls. Capacities shown are transmission available for winter 2010 season (9/25/10 to 3/24/11). The summer 2010 shares maybe lower, depending on Excess Power Sales Recall by the Utah participants.

5 = these are import capacities of the paths. Export capabilities are discussed individually as needed in the following subsections.

Changes that are possible in the planning horizon include:

1. STS upgrade will be in service in December 2010, and will add 480 MW for LADWP.
2. Owen’s Valley Transmission Lines will add new transmission in 2014 for LADWP.

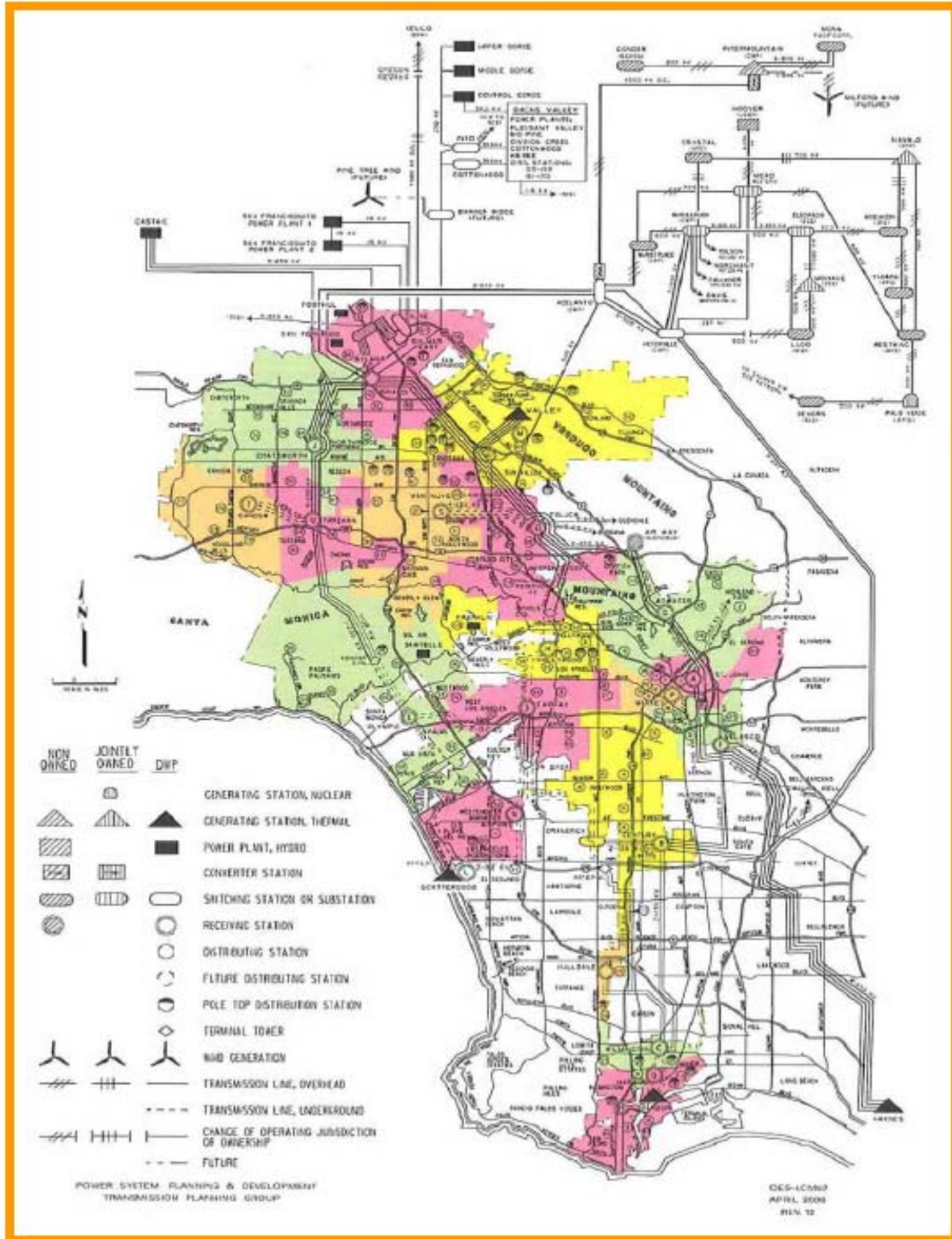


Figure I-1: LADWP Transmission Resources

### **I-3 Basin Transmission System**

This system consists of a network of 115-, 138-, and 230-kV overhead lines and underground cables interconnecting 20 receiving stations, 5 switching stations, 4 basin thermal generating stations, 2 small hydro power plants, and 1 pumped storage hydro power plant.

The present basin transmission system is capable of handling expected system peak loads for the next four years. To support long-term growth, LADWP is exploring increased utilization of the basin transmission system, or “beltlines,” by dynamically rating these transmission lines to take advantage of their higher current-carrying capacity during cooler weather. This technique to upgrade capacity is currently being studied on the Valley-Toluca and Rinaldi-Toluca lines.

Improvements already in development for the basin transmission system include the Scattergood-Olympic second line. This new cable circuit is 15 miles long and will operate at 230-kV. This cable project allows for transmission of power from Scattergood generating station to Receiving Station K. This project will involve building 15 circuit miles of PVC conduit, in a duct bank and Maintenance hole system. Once the civil work is complete, 15 miles of 230 kV XLPE cables will be installed. The new cables will have cross-linked polyethylene insulation versus the majority of existing underground transmission cables which have paper impregnated with oil insulation. Additionally, the new cable system will be eliminating the environmental hazards of oil and will require less maintenance. The circuit is planned for commercial operation in May 2014.

### **I.4 East-to-LA Basin Transmission System**

This system consists of three 500-kV and two 287-kV lines that transmit power from the Adelanto/Victorville area to the Los Angeles basin (see Table I-3). These assets are contained entirely within the LADWP control area and are LADWP-owned and operated. At the present time, LADWP is studying possible upgrades to the 287-kV lines to increase the power transfer capability into the basin and increase LADWP’s access to renewable energy sources. The improvement projects include: Victorville-Century Lines overhead transmission improvement project to reconductor the 82-miles long, 287-kilovolt(kV) Victorville-Century Lines 1&2 with 1351 kcmil, ACSS/AW (Dipper) and will result in increasing the continuous rating of this line from 420 MVA to 545 MVA in the future.

**Table I-3: East to LA Basin Transmission System**

Transmission Line	Voltage Class (kV)	Circuit Miles	Transfer Limit (MW)	LADWP Ownership (%)	LADWP Scheduling (%)
Victorville-Century Lines 1&2	287	168	4000	100	June 2011
Victorville-Rinaldi	500	85			
Adelanto-Toluca	500	69			
Adelanto-Rinaldi	500	78			

## I.5 West-of-the-River System

LADWP’s West of River (WOR) system transmits power from the McCullough/Marketplace area to the Adelanto/Victorville area along the WECC WOR path 46. The WOR path consists of several Extra-High Voltage (EHV) transmission systems that interconnect the Nevada/Arizona areas to Southern California along the western side of the Colorado River. The WOR system is summarized on Table I-4 and shown on Figure I-2.

**Table I-4: WOR Transmission System**

	Transmission Line	Voltage Class (kV)	Allocation (MW)	LADWP Entitlement (MW)
North	McCullough-Victorville Lines 1&2	500	2592	2592
	Hoover-Victorville	287		
	Marketplace-Adelanto	500	1291	313
	Eldorado-Lugo Eldorado-Cima-Pisgah & Eldorado-Pisgah Mohave-Lugo Julian Hinds-Mirage	500 230 500 230	2754	0
	North Subtotal		6637	2905
South	Palo Verde-Devers	500	1802	468
	Ramon-Mirage	230	600	0
	Coachella-Devers	230		
	North Gila-Imperial Valley El Centro-Imperial Valley	500 230	1584	0
	South Subtotal		3986	0
WOR	WOR Total		10623	6278

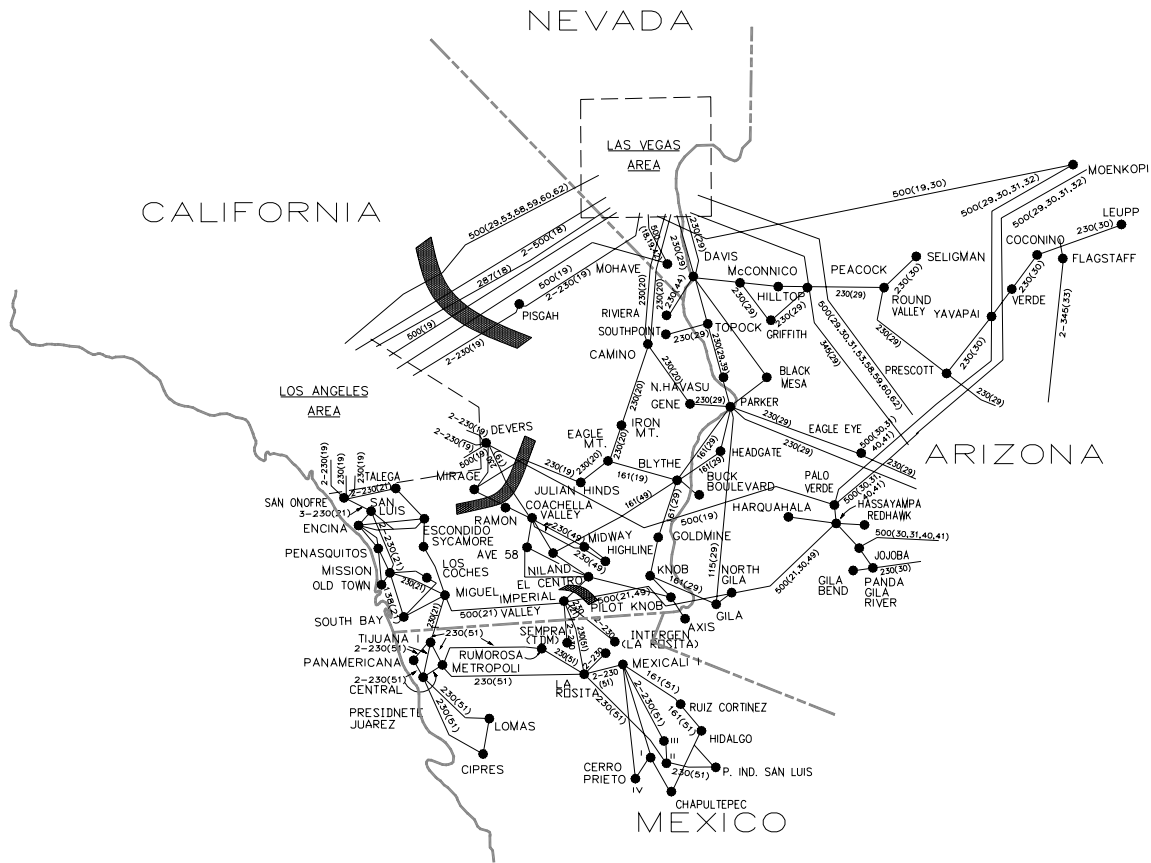


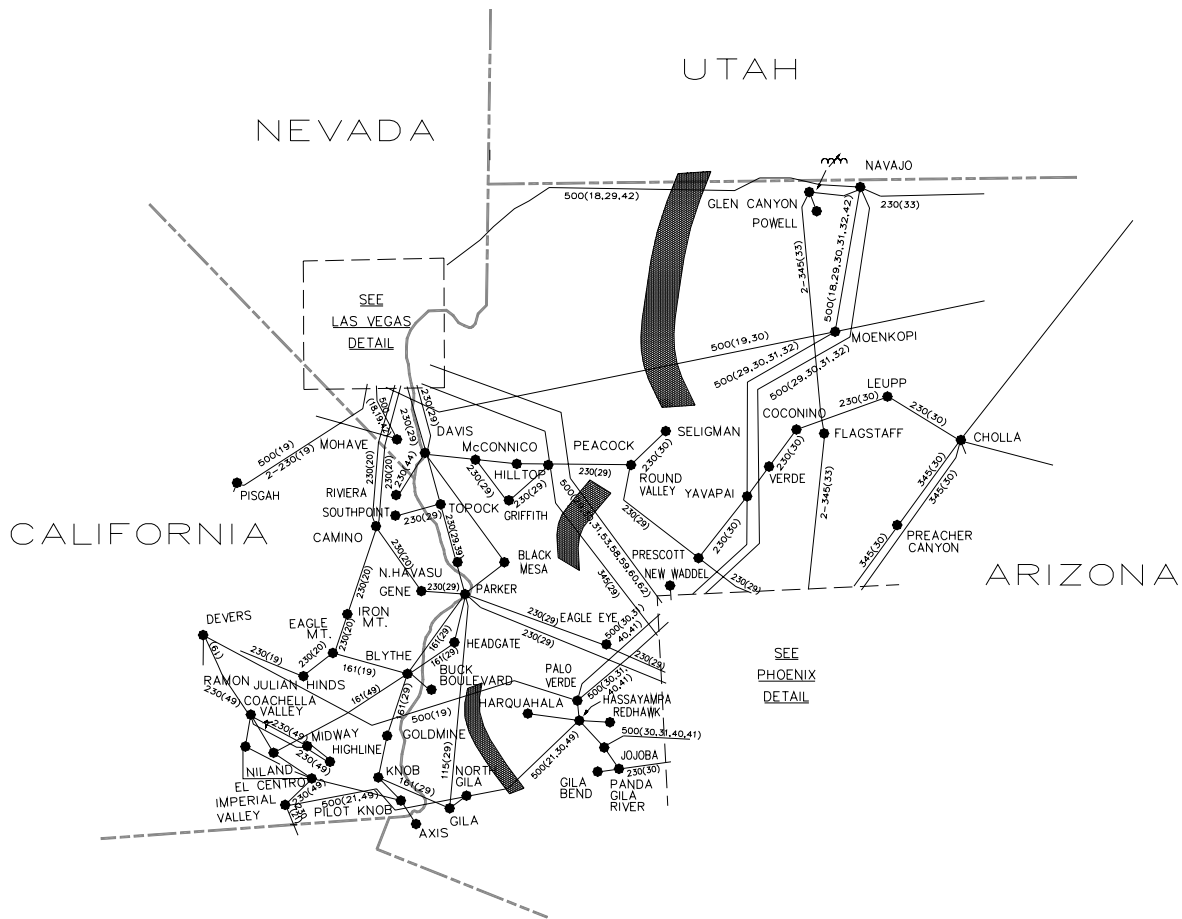
Figure I-2: LADWP Transmission Resources: West-of-Colorado River

## I-6 East-of-the-River (EOR) System

LADWP’s East of the River (EOR) system transmits power from the Navajo and Palo Verde areas to the McCullough/Marketplace/Mead area along the WECC EOR path 49. The EOR path consists of several EHV transmission systems that interconnect the Arizona/New Mexico area to Nevada/Arizona area along the eastern side of the Colorado River. The EOR system is summarized on table I-5 and shown on Figure I-3.

**Table I-5: EOR Transmission System**

Transmission Line	Voltage Class (kV)	Allocation (MW)	LADWP Entitlement (MW)
Navajo-Crystal	500	9,300, east to west non-simultaneous	1,556
Moenkopi-Eldorado	500		
Liberty-Peacock-Mead	345		
Palo Verde-Devers	500		
Hassayampa-North Gila	500		
Perkins-Mead	500		



**Figure I-3: LADWP Transmission Resources: East-of-Colorado River**

Both of LADWP's WOR and EOR shares include 468 megawatts (MW) of contractual rights on Southern California Edison's (SCE's) Palo Verde-Devers system.

Because of the interdependencies among the WOR path, the EOR path, and other competing paths bringing power to Southern California, the capacity ratings of the WOR and EOR paths are typically operationally determined and seasonally adjusted by the use of operating nomograms.

The construction of PVD2 would potentially increase the import capability into Southern California and reduce current restrictions on these paths.

The Mohave coal-fired power plant, of which LADWP has a 10 percent ownership share, was shut down on December 31, 2005, due to a variety of emission and water supply issues. Options for this site include converting the plant to a “clean coal” technology such as the integrated gasification combined cycle (IGCC), or possibly developing solar or wind power sources in the area. In the interim, the surplus transmission capacity will be marketed on LADWP’s OASIS and will be utilized to transport power purchased in the wholesale market.

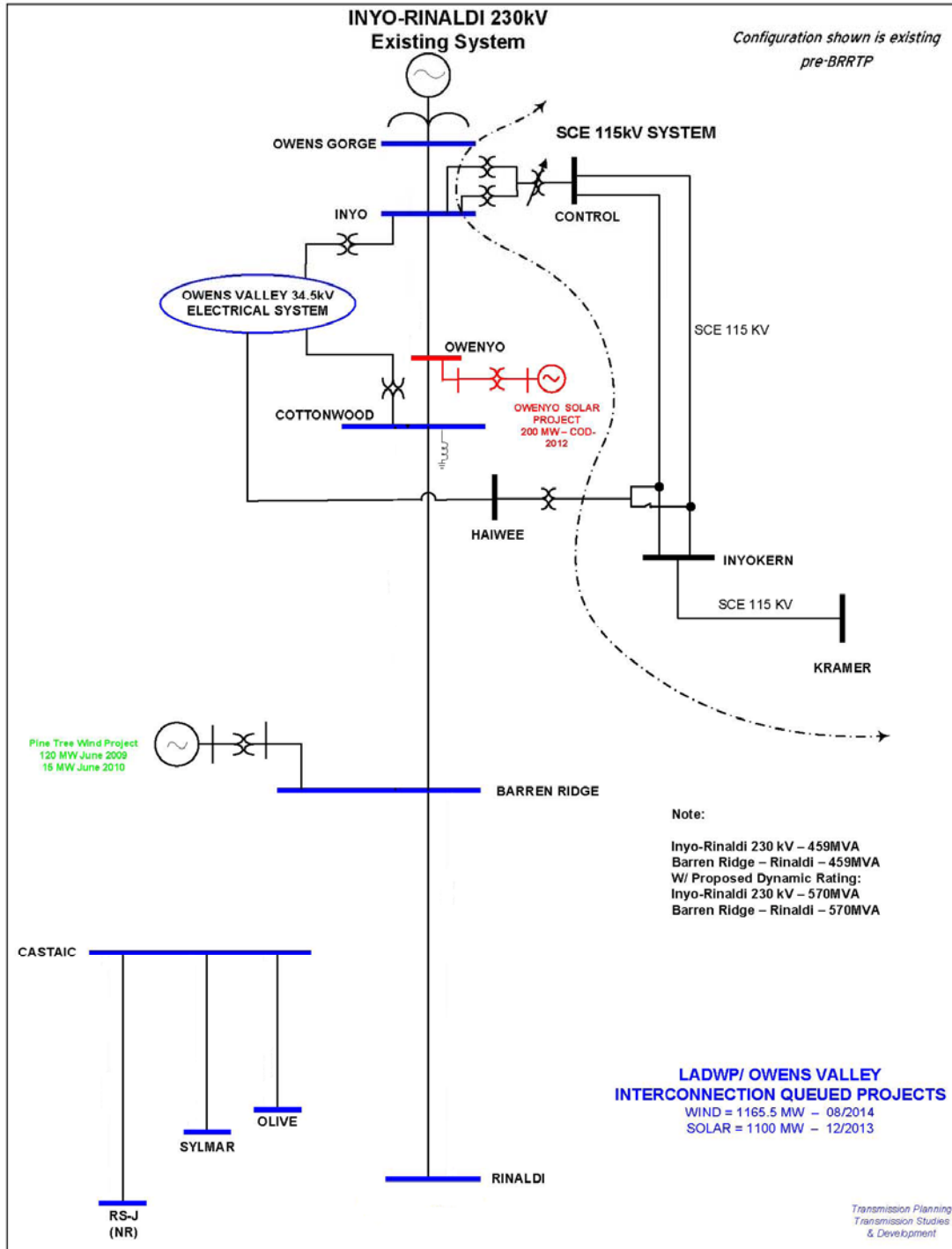
## I-7 Owens Valley Transmission Line

This is a 230-kV line and imports electricity generated primarily from renewable resources in the Owens Valley and the High Desert areas in the vicinity of the transmission line. System upgrades to increase the transmission capacity of this corridor are being planned and implemented to interconnect with the many wind and solar projects proposed and being planned for the next decade. The Owens Valley transmission system is summarized on Table I-6.

**Table I-6: Owens Valley Transmission System**

Transmission Line	Voltage Class (kV)	Approximated Allocation (MW)	LADWP Expiration	LADWP Entitlement (MW)
Owens Control-Inyo	230	300 <sup>9</sup>	Owned Asset	300
Inyo-Cottonwood	230			
Cottonwood-Barren Ridge	230			

<sup>9</sup> The normal rating of the line is 459 MVA,



**LADWP Transmission Resources: Owens Valley**

## I-8 Intermountain Transmission System

This system consists of the Southern Transmission System (STS) and the Northern Transmission System (NTS). The STS is a 500-kV DC line transmitting power from the Intermountain Generating Station (IGS) in Utah to the Adelanto Switching Station in Southern California. The NTS consists of two 345-kV AC lines connecting the IGS to PacifiCorp’s Mona Substation, and one 230-kV line connecting IGS to Sierra Pacific’s Gonder Substation.

The STS was built to bring IGS power to LADWP and other municipal utilities in Southern California, and is used primarily to serve native loads. The excess transmission capacities on the NTS and STS have always been in high demand, and there is continuous interest in these paths in both directions. The STS will be upgraded from 1920 MW to 2400 MW in December 2010.

### I.8.1 Intermountain Power Project DC Line

WECC Path 27 is ±500kV Direct Current Transmission System from Intermountain Station (near Delta, Utah) to Adelanto Station (Adelanto, California). It is shown in Table I-7 and on Figure I-5

**Table I-7: Intermountain DC Transmission System**

Transmission Line	Allocation (MW)	LADWP Expiration	LADWP Share (%)	LADWP Scheduling (%)
Intermountain- Adelanto	1920	15Jun2027	59.5	59.5
Adelanto- Intermountain	1400			

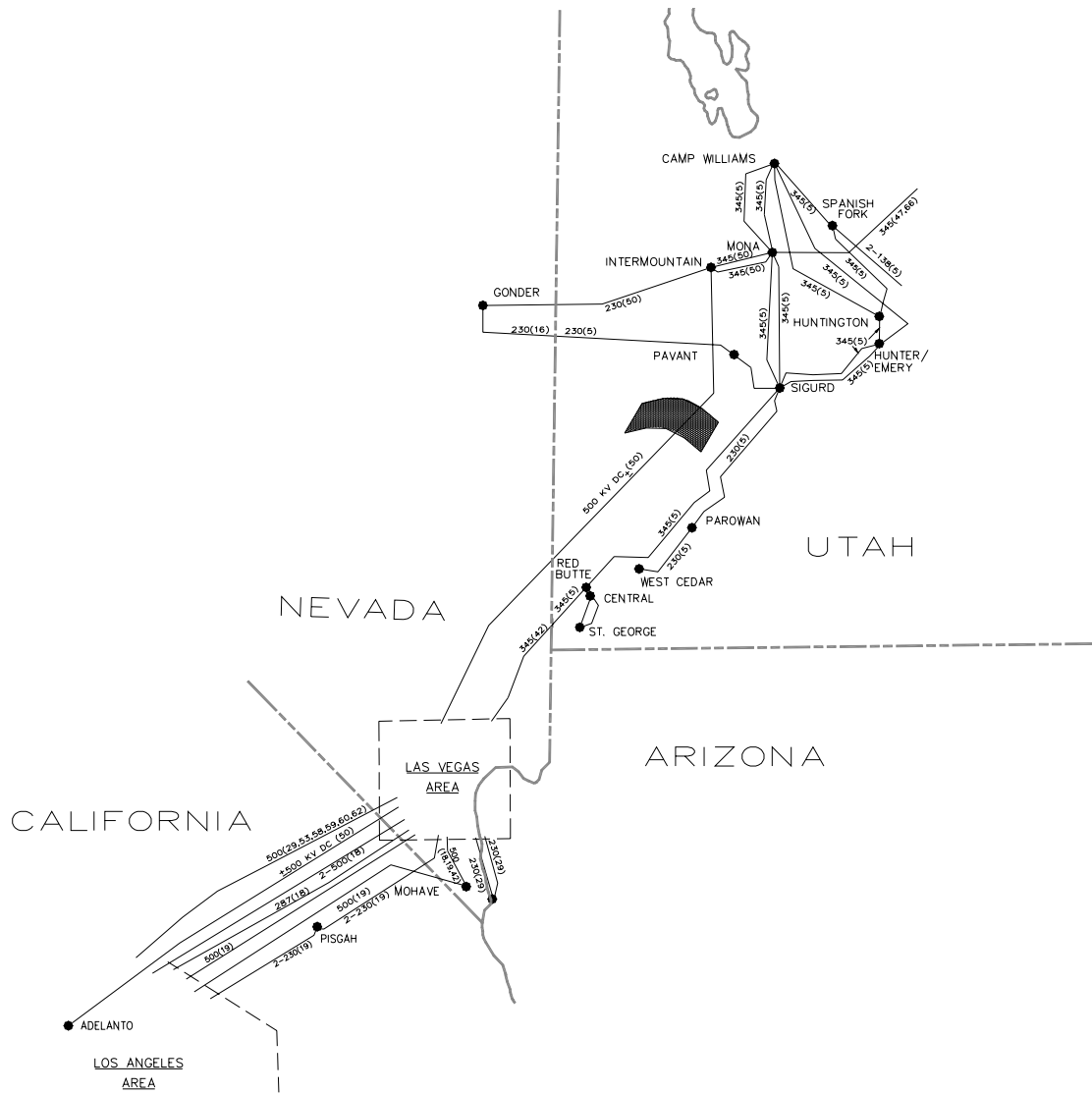


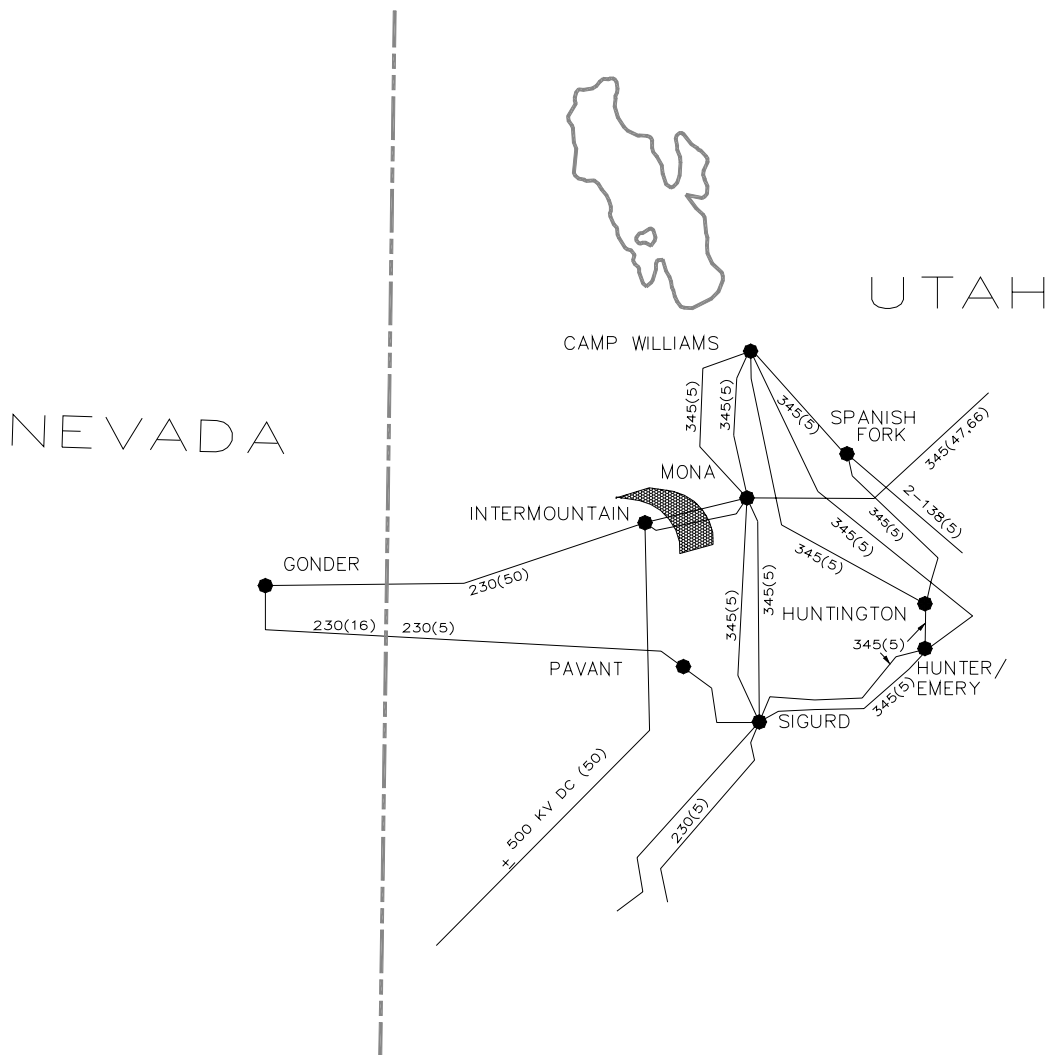
Figure I-5: LADWP Transmission Resources: Intermountain DC Lines

I.8.2 Intermountain-Mona 345kV Line

WECC Path 28, summarized in table I-8 and shown on Figure I-6, is a 50-mile double-circuit interconnection between Pacificorp (at Mona) and LADWP (near Delta) in Utah.

**Table I-8: Intermountain-Mona Transmission System**

Transmission Line	Allocation (MW)	LADWP Expiration	LADWP Share (%)	LADWP Entitlement (MW)
Intermountain-Mona	1200	15Jun2027	0	0
Mona-Intermountain	1400			



**Figure I-6: LADWP Transmission Resources: Intermountain-Mona**



## I-9 Pacific DC Intertie Transmission System

The Pacific Direct Current Intertie (PDCI) is the  $\pm 500$  kV DC transmission line which connects Celilo, Oregon to Sylmar, California. LADWP, cities of Burbank, Glendale, Pasadena, and SCE jointly own the PDCI south of the Nevada-Oregon border; therefore the PDCI is sometimes referred to as the NOB. Refer to Table I-10 and Figure I-8.

**Table I-10: NW Intertie Transmission System**

Transmission Line	Voltage Class (kV)	Allocation (MW)	LADWP Ownership (%)	LADWP Scheduling (%)
Sylmar-Celilo	+/- 500 kV DC	3100 both directions	40	23.28



**Figure I-8: LADWP Transmission Resources: Northwest Intertie**

This system is beneficial to both southern California (including LADWP) and the Pacific Northwest. Many areas of the Pacific Northwest have colder winters and experience higher electrical loads in the winter and lower electrical demands during summer months. California generally experiences hotter summers and accompanying higher electrical loads in the summer months and lower electrical loads in non-summer months. Accordingly, southern California can export power to Pacific Northwest during their times of need, and can import energy from the Pacific Northwest during the summer season, utilizing the PDCI. In addition to this synergy, southern California uses this line to access the large hydroelectric and renewable resources of the Pacific Northwest, including Canadian electrical generation.

As mentioned, the PDCI is used extensively to access economic hydroelectricity from the north. Adequate capacity is reserved on these lines for the energy needs of LADWP customers and to provide reliability reserves.

Maintenance of transmission facilities is an ongoing effort involving the participation of all owners, with the actual work managed by the facility operator. As operator of the southern PDCI station located at Sylmar, LADWP has recently refurbished the facility, including replacing mercury-arc converters with modern thyristor converters and adding new control and protection systems.

## **I-10 Interconnections with Other Utilities**

LADWP also has a number of transmission system interconnections with other utilities as shown on Table I-11.

**Table I-11: Interconnection with Other Utilities**

Utility	Regional Transmission Organization	Location	Voltage Class (kV)
Arizona Public Service	--	Marketplace Switching Station	500
Bonneville Power Administration	--	Pacific DC Intertie @ North of Nevada-Oregon Border	500
City of Anaheim	California ISO	Marketplace Switching Station	500
City of Azusa	California ISO	Marketplace Switching Station	500
City of Banning	California ISO	Marketplace Switching Station	500
City of Burbank	--	Marketplace Switching Station Toluca Receiving Station	500 69
City of Colton	California ISO	Marketplace Switching Station	500
City of Glendale	--	Marketplace Switching Station Airway Receiving Station	500 230
City of Pasadena	California ISO	Marketplace Switching Station St. John Receiving Station (emergency)	500 34.5
Cities of Modesto Redding Santa Clara	California ISO	Marketplace Switching Station	500
City of Riverside	California ISO	Marketplace Switching Station	500
City of Vernon	California ISO	Marketplace Switching Station	500
Intermountain Power Agency	--	Adelanto Switching Station, after 15Jun2027	500
NV Energy	--	McCullough Switching Station Gonder, until 15Jun2027	500 and 230 230
Pacificorp	--	Mona, until 15Jun2027	345
Salt River Project	--	Marketplace Switching Station	500
Southern California Edison	California ISO	Eldorado Substation Victorville-Lugo midpoint Velasco Receiving Station-Laguna Bell (emergency) Sylmar Switching Station Inyo Substation Haiwee (emergency)	500 500 230 220 115 115
Western Area Power Administration	--	Marketplace Switching Station McCullough Switching Station Mead Substation	500 500 and 230 287