



An Electric Utility's Power Transmission Modernization Needs

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Presentation Outline

■ Existing System

- Electric System Components, Basic Power System, Voltage Classifications, Grid Operations, Western Interconnected System (WSCC), California Power Grid Operations

■ Present Day Challenges

- Transmission, Sub-transmission, and Distribution lines are stressed beyond their design limits. New transmission lines construction challenges

■ New Technology

- Increased capacity on existing right-of-ways, tower structures. Enhanced reliability



Electric System Components

■ **Generation Plants**

- Produce electricity from various sources, including chemical energy, fossil fuels, nuclear fission energy, and the kinetic energy of water

■ **Electric Grid (Wires)**

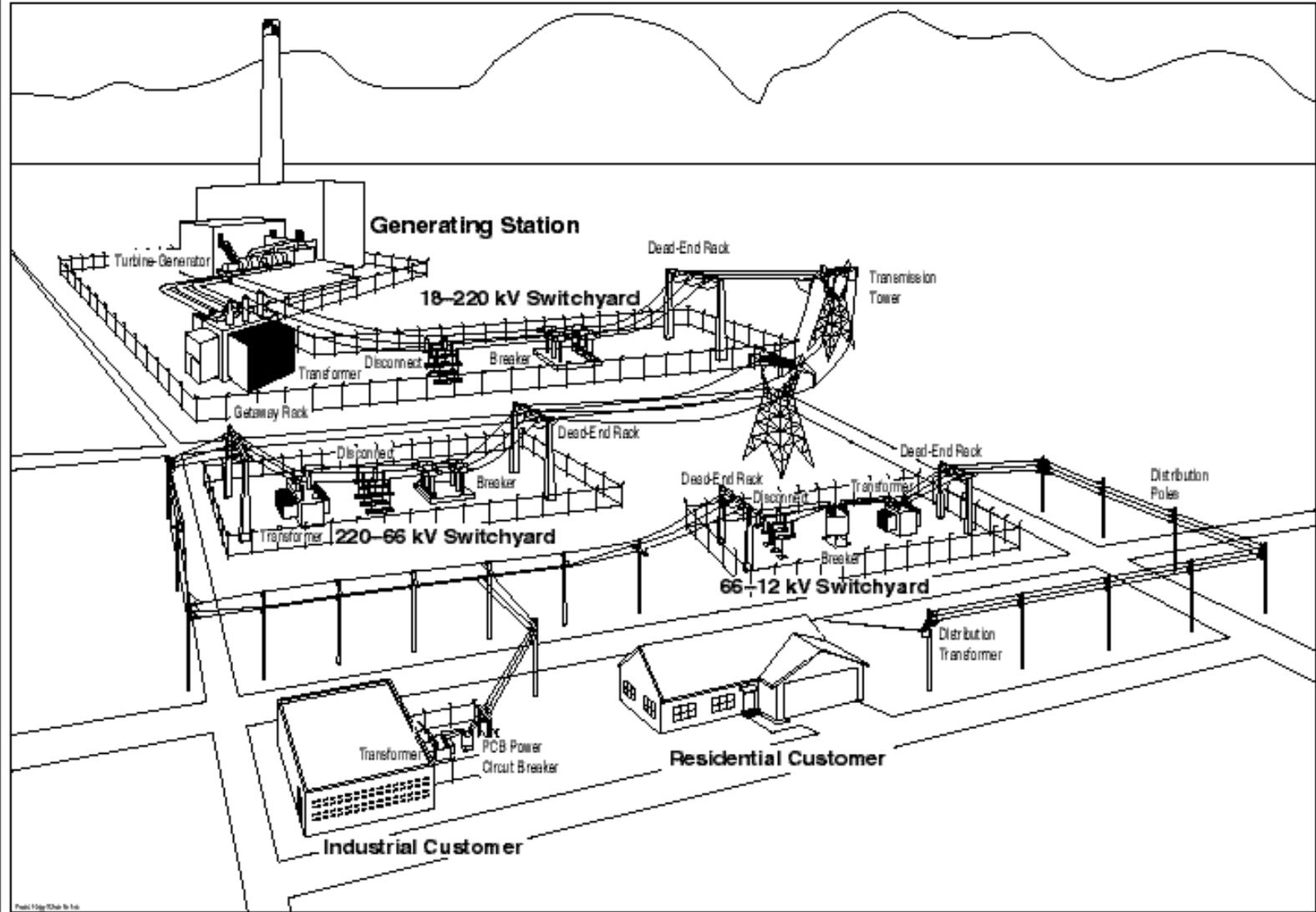
- Transmission, sub-transmission, and distribution lines which transport power from power plants ultimately to the customer

■ **Switching Stations (Substations)**

- Attended or unattended stations that switch electric circuits in and out and transform the electric voltage (up or down) to a value more suitable to the next part of the journey to the customer



Basic Electrical System





Electric System Voltage Classifications

Classification Voltages	Voltage Range	Typical
Transmission	161 kV and above	220 and 500 kV
Sub transmission	55 to 138 kV	66 and 115 kV
Distribution	33 kV and below	12 and 16 kV

EDBL: 1,700 Employees			PGBU: 1,250 Employees		
<u>Miles of Transmission Line:</u>	500 kV	1,276	<u>No. of Substations:</u>	500 - 220 kV	9
	220 kV	3,497		220 - 66 kV	40
	115 kV	1,944		66 - 16/12/4 kV	855
	66 kV	5,343	<u>Poles</u>	PGBU	124,000
	33 kV & Below	91,000		EDBL	1,460,000

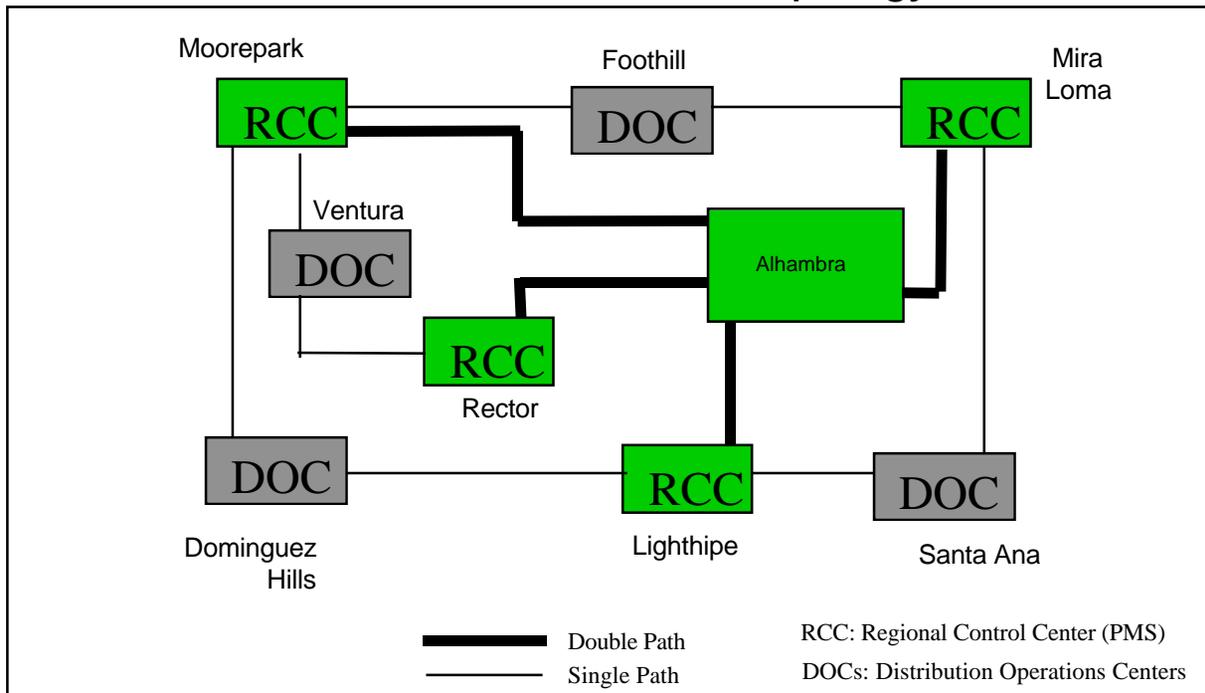


RCC



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GRID Backbone Topology

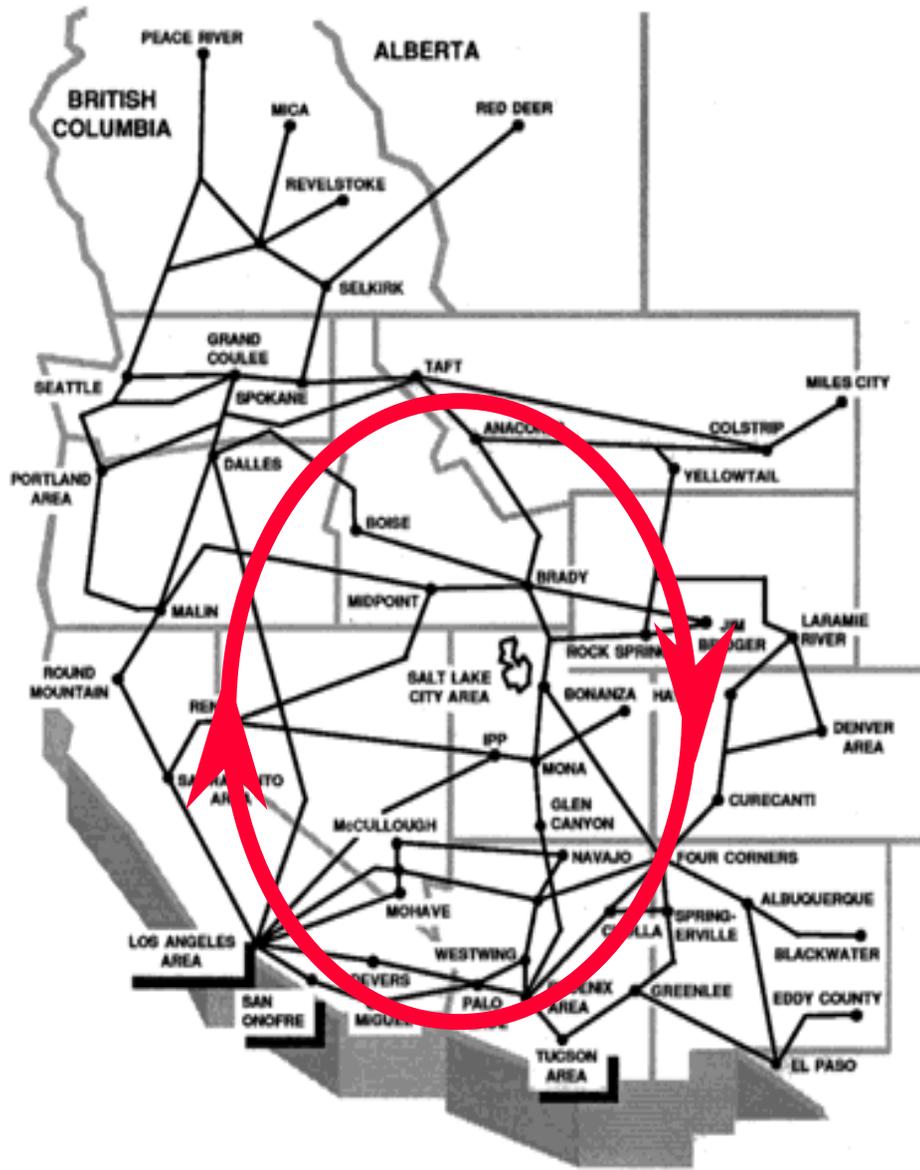


Western Interconnected System (WSCC)



76 Members
14 Western States

*Loop
Flow*





A Regulated Utility's Return On Investment

■ **Public Utilities Commission (PUC)**

- PUC is charged with oversight responsibilities for the operation of a utility as it is entrusted with a service territory – Protect the public from a monopoly

■ **Regulating**

- PUC regulates the way an electric utility Generates, Transmits, and Distributes electric power in its service territory

■ **Rate-Making**

- PUC guarantees a fixed rate of return on a utility's investment and/or cost of operations



Regulated era - Operations

■ **Rights-Of-Ways**

- An Electric utility will purchase land and/or rights of ways to build substations, transmission lines and distribution lines sometimes years before it is needed

■ **Rate of Return**

- A utility's ROR was guaranteed by PUC to build and operate generation, transmission, sub-transmission, and distribution facilities which deliver power from power plants to the customer

■ **Power Delivery Network**

- A utility was authorized to upgrade its systems as long as it meets PUC guidelines and facilitates power delivery goals



A Deregulated Electric Utility

■ **Generating Stations**

- Divested

■ **Electric Grid (Wires)**

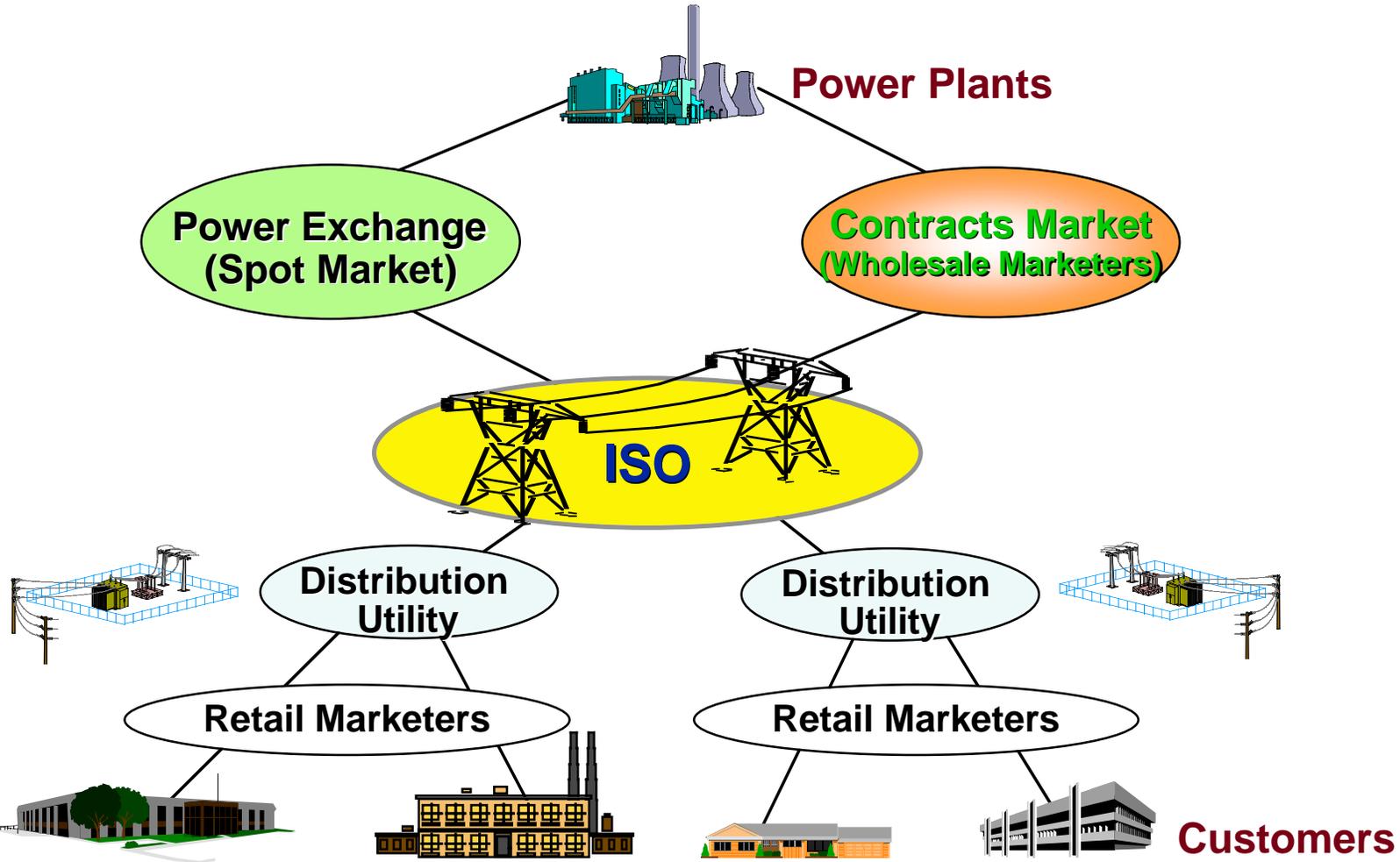
- Transmission, sub-transmission, and distribution lines which transport power from power plants ultimately to the customer are regulated

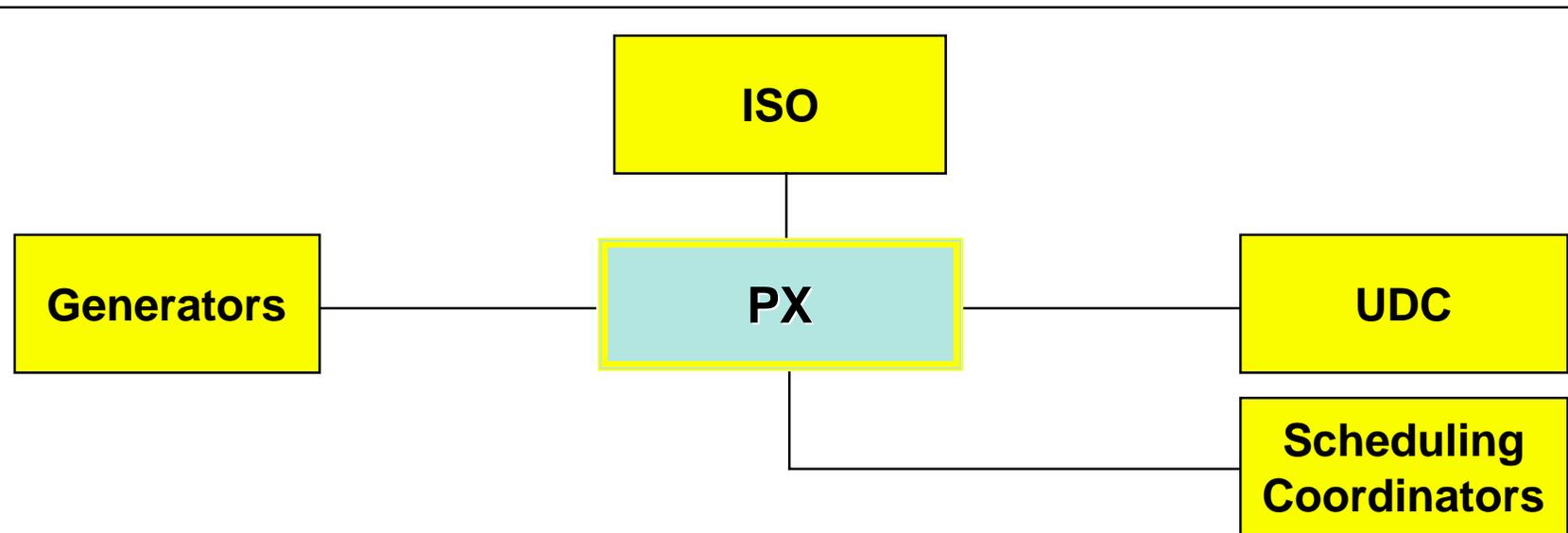
■ **Rate of Return**

- Not guaranteed. All utility investments are at investors risk.
- Rights of Ways cannot be acquired way in advance as an electric utility is mandated not to be in land business



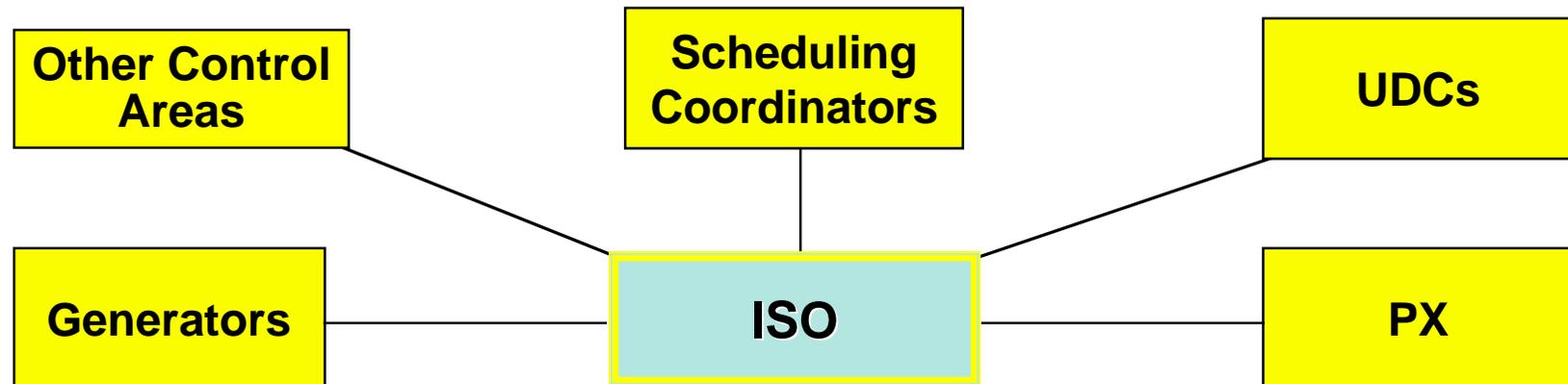
Power Grid Operations





- **Runs day-ahead and hour-ahead spot market auction (“Stock Exchange“)**
- **Generators compete based on non-discriminatory and transparent bidding rules**
 - Other scheduling coordinators may bid supply and/or load through PX
- **Submits balanced schedules to the ISO**
- **Establishes visible market clearing price**
- **Reports production and usage to the ISO for settlement**
- **Performs settlement functions with:**
 - ISO
 - Generators
 - UDCs
 - Other Scheduling Coordinators
- **Provides some operating instructions to generators and retailers**

Independent System Operator (ISO)



- ◆ **Manages reliability of transmission grid (“Air Traffic Controller”)**
- ◆ **Controls dispatch of transmission grid**
- ◆ **Provides non-discriminatory, open access to transmission grid**
- ◆ **Procures and manages ancillary services as needed**
- ◆ **Coordinates day-ahead and hour-ahead power scheduling and real-time power balancing**
- ◆ **Performs settlement function for unscheduled transactions and ancillary services**
- ◆ **Administers congestion management protocols for transmission grid/network**
- ◆ **Bills unclaimed imbalances and other ancillary services to appropriate scheduling coordinators**



Present Day Challenges

■ **Increasing Demand**

- Many miles of California's overhead transmission lines are at the end of their service lives or stressed beyond their design limits due to load growth and heavy power transfers

■ **Rights of Ways**

- Rights of Ways are difficult to acquire to build new transmission, sub-transmission, and distribution networks

■ **Return on Investment**

- For such a massive investment there are no guarantees and the rates to be charged are still mandated



Conclusion - New Technology

■ **HTS Transmission Lines**

- **HTS transmission lines, transformers, fault current limiters and substations can meet or exceed the heavy power transfers across long distances**

■ **Rights of Ways**

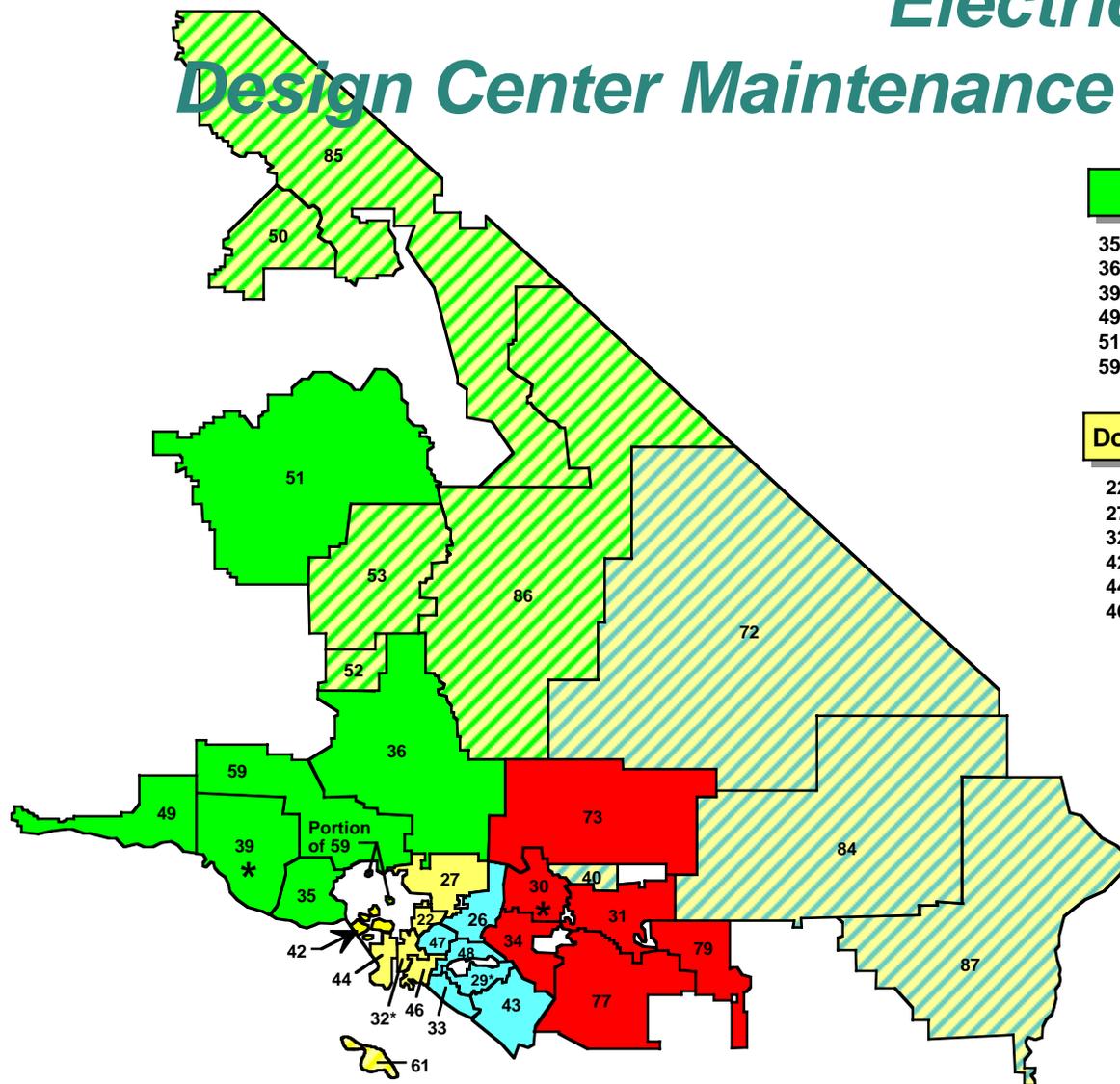
- **Huge amounts of power can be transferred on existing conduits / towers, on existing rights of ways using HTS conductors for present and future needs**

■ **Benefits**

- **System availability and reliability will be enhanced**
- **Electricity dependent economy will have the biggest boost with increased capacity of our aging infrastructure**



Electric Distribution Design Center Maintenance and Districts



Ventura

- 35 Thousand Oaks
- 36 Antelope Valley
- 39 Ventura*
- 49 Santa Barbara
- 51 San Joaquin
- 59 Valencia

Foothill

- 30 Foothill*
- 31 Redlands
- 34 Ontario
- 73 High Desert
- 77 San Jacinto Valley
- 79 Palm Springs

Dominguez Hills

- 22 Montebello
- 27 Monrovia
- 32 Dominguez Hills*
- 42 Santa Monica
- 44 South Bay
- 46 Long Beach

Santa Ana

- 26 Covina
- 29 Santa Ana*
- 33 Huntington Beach
- 43 Saddleback
- 47 Whittier
- 48 Fullerton

Independents

- 40 Arrowhead
- 50 Big Creek
- 52 Tehachapi
- 53 Kernville
- 61 Catalina
- 72 Barstow
- 84 29 Palms
- 85 Bishop
- 86 Ridgecrest
- 87 Blythe