UPGRADE ASSESSMENT FOR A 230-kV LINE

Design/Construction WG
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Background

- Line Owned by the Metropolitan Water District – Los Angeles
- Line Constructed in 1937-1938
- Power to Run Pumps to Supply Water to LA from the Colorado River
- Extends from Hoover to Parker to Palm Springs
- One of the Earlier 230 Lines

Activities in Area

- New Lines Planned or under Construction
  - SCE Palo Verde Devers No. 2 500-kV
  - DSW /IID 500-kV Double Circuit
  - FP&L 230-kV
- Solar Project Resource Area
  - Many Solar Projects in Queue
  - New Collection Points Needed
- Fault Duty Increases

MWD Queries

- Will Fault Duty Require Equipment Upgrades?
- Can Line be Upgraded to Accommodate Higher Loads?
- Are Towers in Good Shape?
- Can a Conductor of Greater Capacity be Used?

Map of Project

An existing angle tower northwest of Parker

Existing twin towers between Hoover and I40

Typical Access Road

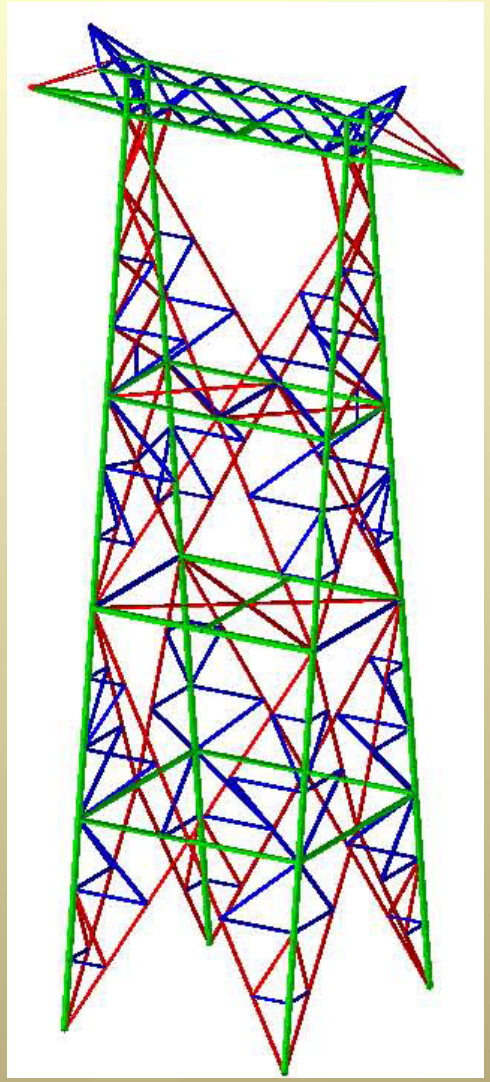
Evaluation Process

- Analyze Towers
  - Computer Modeling
  - Loading Criteria
  - Member Size Details
- Condition Assessment
- Conductor Options
  - No Tower Replacement
  - Maximum Operating Temperature

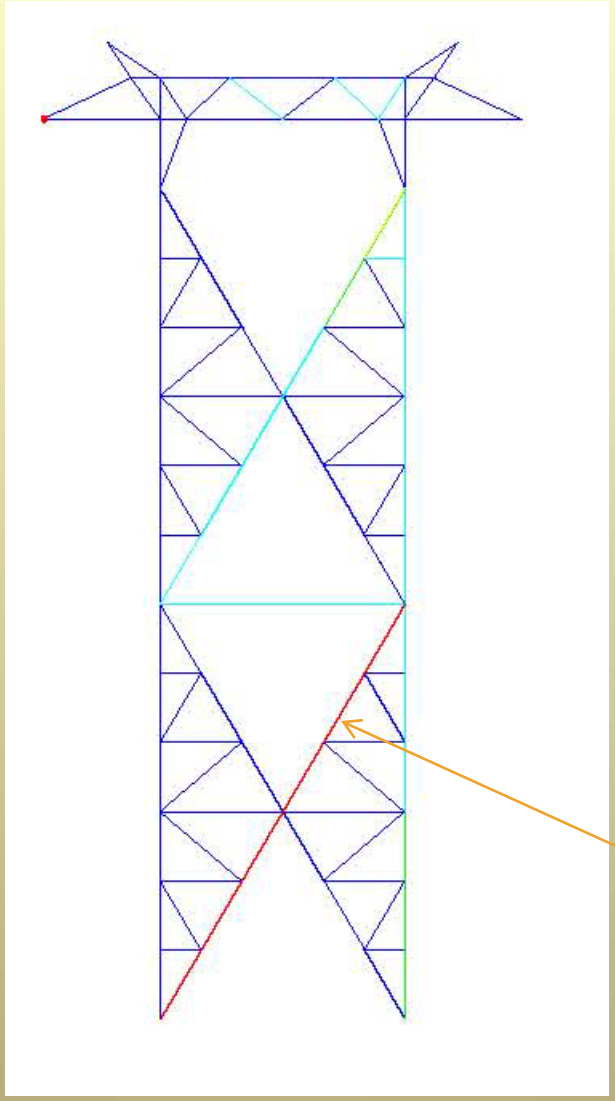
Tower Family

CASE	TOWER	SPAN	ANGLE
1	5S	1250	0°
2	5D	1050	TERMINAL
3	5S	1050	1°30'
4	5D	1050	45°

Computer Model
Type 5s



Tower was modeled using data provided by MWD



Computer Run NESC Load Case – Max. Design Span

Tower Design Specifications

TOWER TYPE	MWD DWG	MAXIMUM SPAN WITH ANGLE (ft)	MAXIMUM ANGLE	MAXIMUM SPAN NO ANGLE (ft)
5A	B-1727	1050	10°	1250
5AA	B-1736	1370	9°	1800
5S	B-1724	1050	1°30'	1250
5AS	B-1733	1370	1°30'	1710
5D	B-1729	500 NOTE 1	TERMINATION	500
5AD	B-1740	500	TERMINATION	500
5D 45°	B-1729	1050	45°	1050
5AD 45°	B-1740	1050	45°	1050

Analyzed Tower Loading Limits

TOWER	UNFACTORED LOADING (%)	NESC 2007 FACTORED LOADING (%)	NESC 2007 FACTORED LOADING LEGS (%)	OVERALL AVAILABLE CAPACITY (%)	AVAILABLE CAPACITY LEGS ONLY (%)
5A	64	93	83	7	17
5AA	95	99	70	0	30
5S	73	95	68	5	32
5AS	68	99	70	0	30
5D	62	95	80	5	20
5AD	65	90	72	10	28
5D 45°	60	97	87	3	13
5AD 45°	69	95	60	5	40

Clearances Assessment

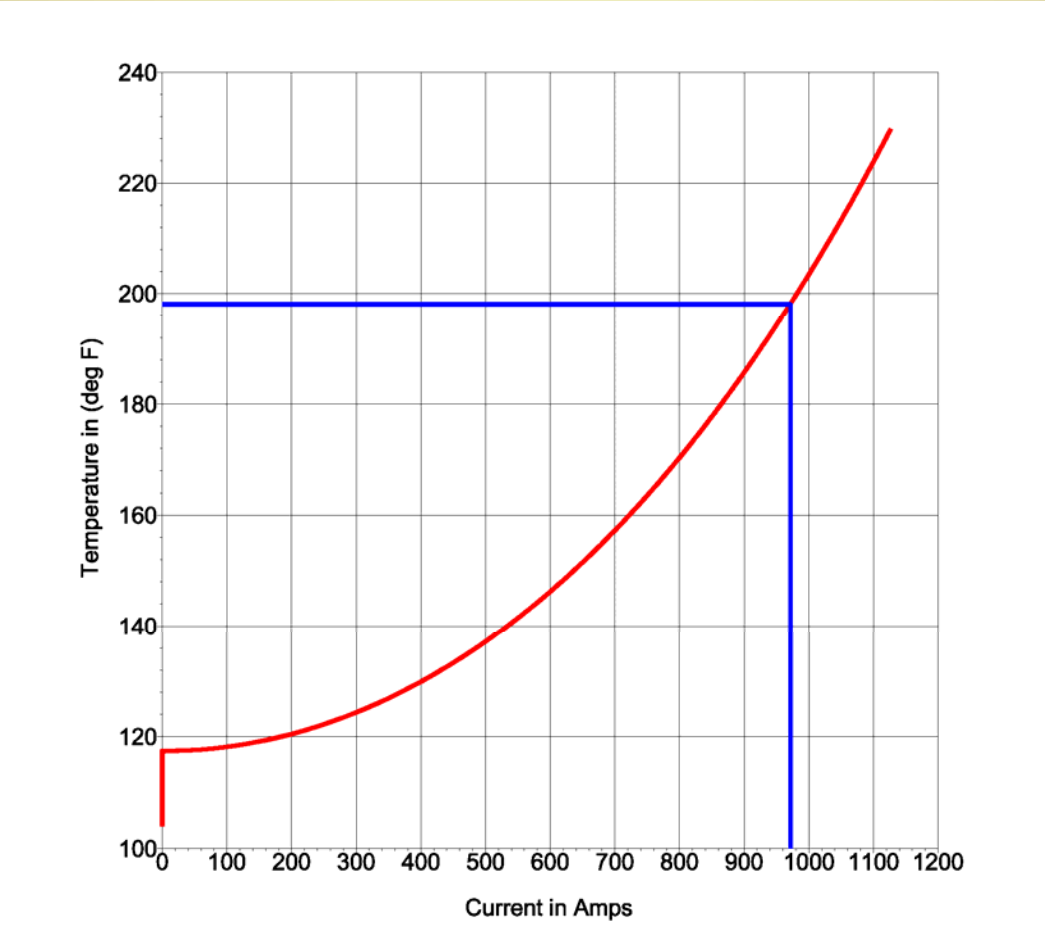
GO 95 Clearances

	Measured	Calculated	Calculated	Calculated
Conductor Temperature	62.5 °F	120°F	167°F	212°F
Span Length	1421 ft	1250 ft	1250 ft	1250 ft
Attachment Ht Tower 1	77.4 ft	77.4 ft	77.4 ft	77.4 ft
Attachment Ht Tower 2	72.3 ft	72.3 ft	72.3 ft	72.3 ft
Conductor Sag	38.95 ft	43.63 ft	47.27 ft	50.60 ft
Code Clearance	30.0 ft	30.0 ft	27.0 ft	27.0 ft
Clearance at Midspan	35.9 ft	31.22 ft	27.58 ft	24.25 ft

NESC Clearances

	Measured	Calculated	Calculated	Calculated
Conductor Temperature	62.5 °F	120°F	167°F	212°F
Span Length	1421 ft	1250 ft	1250 ft	1250 ft
Attachment Ht Tower 1	77.4 ft	77.4 ft	77.4 ft	77.4 ft
Attachment Ht Tower 2	72.3 ft	72.3 ft	72.3 ft	72.3 ft
Conductor Sag	38.95 ft	43.63 ft	47.27 ft	50.60 ft
Code Clearance	23.0 ft	23.0 ft	23.0 ft	23.0 ft
Clearance at Midspan	35.9 ft	31.22 ft	27.58 ft	24.25 ft

Operating Temperature Calculation Using IEEE 738



Conductor Choices

CONDUCTOR	DIAMETER (in)	RATED TENSILE STRENGTH (LB)	RATED CAPACITY @ 100°C (AMP)	RATED CAPACITY @ 200°C (AMP)
795 ACSR (existing)	1.093	28,200	970 (MWD)	NA
795 ACSS	1.092	25,900	889	1650
954 ACSS/TW	1.084	26,000	1228	1805
ACCR 637-T16	0.991	25,600	Not Published	1426
ACCR 824-T16	1.128	32,200	Not Published	1691
ACCR 967-T13	1.205	33,200	Not Published	1855
ACCC GROSBEAK	0.990	30,400	1098	1397
ACCC DRAKE	1.108	41,100	1265	1766
ACCC CARDINAL	1.196	37,100	1407	1971

Condition Assessment

- General Wear and Tear
- Galvanizing/Rust
- Insulators
- Footings
- Dampers
- Grounds

Rust Formation

Inside Angle- Leg

Pad and Stem Type

Foundation – Minor Exposure

Typical Ground

		CASE 1		CASE 2	
CONDUCTOR	LINE CAPACITY AT 200°C MW	CACULATED LOAD (%) TOWER 5S NO ANGLE	TOWER UPGRADE REQUIREMENTS	CACULATED LOAD (%) TOWER 5D TERMINAL	TOWER UPGRADE REQUIREMENTS
795 ACSS	657	94	NONE	114	2 MEMBERS
954 ACSS/TW	727	93	NONE	124	4 MEMBERS
ACCR 637-T16	568	88	NONE	93	NONE
ACCR 824-T16	674	95	NONE	106	4 MEMBERS
ACCR 967-T13	739	99	NONE	130	5 MEMBERS
ACCC/TW GROSBEAK	641	88	NONE	99	NONE
ACCC/TW DRAKE	743	94	NONE	121	3 MEMBERS
ACCC/TW CARDINAL	785	99	NONE	130	3 MEMBERS

		CASE 3		CASE 4	
CONDUCTOR	LINE CAPACITY AT 200°C MW	CACULATED LOAD (%) TOWER 5S 1°30' ANGLE	TOWER UPGRADE REQUIREMENTS	CACULATED LOAD (%) TOWER 5D 45° ANGLE	TOWER UPGRADE REQUIREMENTS
795 ACSS	657	115	1 MEMBER	114	3 MEMBERS
954 ACSS/TW	727	115	1 MEMBER	119	4 MEMBERS
ACCR 637-T16	568	108	1 MEMBER	104	4 MEMBERS
ACCR 824-T16	674	113	1 MEMBER	116	4 MEMBERS
ACCR 967-T13	739	98	NONE	119	7 MEMBERS
ACCC/TW GROSBEAK	641	107	1 MEMBER	96	NONE
ACCC/TW DRAKE	743	116	1 MEMBER	108	3 MEMBERS
ACCC/TW CARDINAL	785	97	NONE	113	4 MEMBERS

Study Case Results

Conclusions

- Line in Excellent Condition
- Maintenance is Effective
- Initial Design did not include NESC OLF's
- Analysis using NESC OLF's Indicate Towers Adequate
- Upgrade Options Under Consideration