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October 2, 2008
File No.: 04.02.06.02
Project No. 357891

Mr. Che McFarlin, Project Manager
California Energy Commission
Systems Assessment and Facilities Siting Division
1516 9th Street, MS 15
Sacramento, CA 95814-5504

RE: Data Response, Set 2F
Ivanpah Solar Electric Generating System (07-AFC-5)

Dear Mr. McFarlin:

On behalf of Solar Partners I, LLC, Solar Partners II, LLC, Solar Partners IV, LLC, and Solar Partners VIII, LLC (Applicant), please find attached one original and 12 hard copies of Data Response, Set 2F.

Please call me if you have any questions.

Sincerely,

CH2M HILL

John L. Carrier, J.D.
Program Manager

Enclosure
c: POS List
Project File

Ivanpah Solar Electric Generating System (ISEGS)

(07-AFC-5)

Data Response, Set 2F

(Responses to Data Requests: Cultural Resources)

Submitted to the

California Energy Commission

Submitted by

Solar Partners I, LLC; Solar Partners II, LLC; Solar Partners IV, LLC; and Solar Partners VIII, LLC

October 2, 2008

With Assistance from

CH2MHILL

2485 Natomas Park Drive
Suite 600
Sacramento, CA 95833

Introduction

Attached are Solar Partners I, LLC, Solar Partners II, LLC, Solar Partners IV, LLC, and Solar Partners VIII, LLC (Applicant) responses to the California Energy Commission (CEC) Staff's data requests for the Ivanpah Solar Electric Generating System (Ivanpah SEGS) Project (07-AFC-5). The CEC Staff served these data requests on May 8, 2008, as part of the discovery process for Ivanpah SEGS. The responses are grouped by individual discipline or topic area. Within each discipline area, the responses are presented in the same order as CEC Staff presented them and are keyed to the Data Request numbers. New graphics or tables are numbered in reference to the Data Request number. For example, the first table used in response to Data Request 15 would be numbered Table DR15-1. The first figure used in response to Data Request 15 would be Figure DR15-1, and so on. AFC figures or tables that have been revised have "R1" following the original number, indicating revision 1.

Additional tables, figures, or documents submitted in response to a data request (supporting data, stand-alone documents such as plans, folding graphics, etc.) are found at the end of a discipline-specific section and may not be sequentially page-numbered consistently with the remainder of the document, though they may have their own internal page numbering system.

The Applicant looks forward to working cooperatively with the CEC and U.S. Bureau of Land Management (BLM) staff as the Ivanpah SEGS Project proceeds through the siting process. We trust that these responses address the Staff's questions and remain available to have any additional dialogue the Staff may require.

Cultural Resources (126-129)

BACKGROUND

The California Register of Historical Resources (CRHR) eligibility status of and the proposed project's effects on the Boulder Dam-San Bernardino 115-kV line, CA-SBR-10315H, and related cultural resources have been the subject of an ongoing discussion among the applicant and the staffs of both the Energy Commission and the Bureau of Land Management (12/12/07 Data Requests 36–39 (CEC Log No. 43714), 5 February 2008 Energy Commission Staff Comment on Response to Data Request 37, and 6 February 2008 BLM Staff Comment on Applicant's Draft Survey Report). The BLM and the State Historic Preservation Officer concluded a consensus determination on 22 October 1993 that the subject transmission line was eligible for inclusion in the National Register of Historic Places, and, as a consequence of this consensus determination, pursuant to 14 CCR § 4851(a)(1), it was automatically listed in the California Register of Historical Resources.

It is the opinion of the Energy Commission and BLM staffs that the interconnection of the proposed project to the transmission line could cause a substantial adverse change in the ability of the CRHR-listed line to convey its historical significance, which constitutes a significant impact under CEQA. Energy Commission staff needs a CRHR eligibility status assessment that is less than five years old for the Boulder Dam-San Bernardino 115-kV transmission line, so the line's eligibility needs to be reassessed, including an evaluation of the physical integrity of the line, the project's impacts on the line's ability to convey its significance, and the possibility that the line is one element of a historic district that encompasses multiple linear facilities within the entirety of the original BLM Right-of-Way (R.O.W.) Grant No. R 01730 to the Southern Sierras Power Company.

To accurately gauge the project's potential impact on the Boulder Dam-San Bernardino 115-kV transmission line, staff needs a detailed description of the precise character of the project's interconnection to this line. The description of the interconnection to the transmission line and to the larger R.O.W. historic district needs to provide sufficient detail for staff to assess the scale of the effect on both resources and to develop appropriate mitigation measures, if that effect is ultimately found to be a substantial adverse change in the significance of one or both resources.

DATA REQUEST

126. Please have a qualified architectural historian assess whether the Boulder Dam-San Bernardino 115-kV line (CA-SBR-10315H) and linear archaeological feature CA-SBR-12574H are resources that share a historical association as contributors to a potential BLM R.O.W. Grant No. R 01730 Historic District, and whether other such elements may also exist in the project area, including:

a. If the above resources share a historical association, a formal CRHR evaluation of the historic district;

b. A historical context for the historic district

Response: As stated in Applicant's May 29, 2008 letter, the Applicant objects to this data request as irrelevant and burdensome. Without waiving that objection, the Applicant submits Attachment DR126-1B. Staff has stated that the prior JRP Report (Attachment DR-126-1) failed to adequately address the question of a historic district. The report has been revised to address this issue.

127. Please have a qualified architectural historian formally reassess the CRHR status of CA-SBR-10315H as both an element of the above historic district and as a individual historical resource, including:

a. The historical significance of the Boulder Dam-San Bernardino 115-kV transmission line;

b. A historical context for the Boulder Dam-San Bernardino 115-kV transmission line;

c. An assessment of all seven aspects of the line's integrity—location, design, materials, workmanship, setting, feeling, and association.

Response: Please see Data Response 126.

128. Please have a qualified architectural historian assess impact of the proposed project's interconnection on the Boulder Dam-San Bernardino 115-kV line, and, on the potential BLM R.O.W. Grant No. R 01730 historic district, including:

a. A precise physical description of the proposed project's interconnection to the transmission line;

b. An assessment of the significance of the interconnection's impact on the Boulder Dam-San Bernardino 115-kV line relative to the portion of the that line extant in the project area;

c. A justification of the above recommendation;

d. Mitigation measures proposed to reduce any substantial adverse impact.

Response: Please see Data Response 126.

129. Please provide the qualifications of the architectural historian addressing these data requests, indicating that he/she meets the Secretary of the Interior's Professional Standards for an Architectural Historian.

Response: Please see Data Response 126.

ATTACHMENT DR126-1B

Ivanpah Solar Electric Generating System
Data Requests
Cultural Resources

IVANPAH CONTEXT

Origins of Electric Power Transmission

Before 1879 the only electric lighting system in existence was the "electric arc" system that produced light by causing an electric spark to jump between two carbon rods. The lights were expensive to operate, posed a fire danger, and the glaring brilliance of the light made them suitable only for outdoor use. The California Electric Light Company began operating in San Francisco in September of 1879 using arc lights with electricity produced from a central power generating station. In October of that same year, Thomas Alva Edison introduced the incandescent light bulb. Edison's invention dramatically changed the electrical generating industry by making electric lights cheaper, safer, and easy on the eyes. Edison's light bulb and his development of an improved system of power generation and distribution gave birth to the electric utility industry.[1]

These innovations in electric power generation inspired efforts to address glaring deficiencies in direct current (D.C.) motor technology. Streetcars, for example, needed motors that could stop, accelerate and endure inferior rails. Elevators required dependable motor technology in order to handle more frequent accelerations and to ensure passenger safety. Sewing machines and other appliances needed motors to operate independently.[2]

Throughout the 1880s, several inventors took up the challenge to improve motor efficiency. In 1886, American inventor Frank J. Sprague (1857-1934) installed a 15-h.p. central-station motor operating at 220 volts and installed it in a freight elevator in Boston, Massachusetts. In 1887-88, Sprague used his motors to construct a streetcar system in Richmond, Virginia. In 1884, another American inventor, Philip Diehl (1847-1913), introduced a variable-speed D.C. motor for dental machines, which was later adapted for use on sewing machines. In 1887, Schuyler Skaats Wheeler (1860-1923), along with Charles Curtis and Francis Crocker, developed motors designed to operate on incandescent-light circuitry.[3]

[1] William A. Myers, *Iron Men and Copper Wires: A Centennial History of the Southern California Edison Company* (Glendale, California: Trans-Anglo Books, 1983), 11.
[2] Thomas P. Hughes, *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: The Johns Hopkins University Press, 1983), 82.
[3] Hughes, *Networks of Power: Electrification in Western Society, 1880-1930*, 83.

Besides motors, early power plants also incorporated low-voltage D.C. dynamos. The system limited the distance that electricity could be transmitted to a maximum distance of around three miles. Only urban areas with concentrated populations could be economically served with a local electrical generating plant. An alternating current (A.C.) system developed by Nikola Tesla, William Stanley and others began to be used for electrical lighting installations by 1890. A.C. generators produced a higher voltage that allowed service to be extended to a distance of approximately five miles. A "converter," now called a transformer, reduced the high distribution voltage to a lower 120 volts that had become the standard voltage for interior wiring.[4]

The development of the long distance transmission lines in California was an evolutionary process that dates to 1879, the year in which California Electric Light Company began operation. This San Francisco-based company generated electricity, and distributed it to local subscribers from a central station. During the 1880s the use of electricity in California became increasingly widespread, and local electric companies began to spring up in cities throughout the state. These early power plants, which used low-voltage D.C. dynamos, could only transmit electricity about three miles. Only urban areas with concentrated populations could be economically served with a local electrical generating plant. The first important technological advancement that would allow the transmission of electricity over greater distances was the development of A.C. system, which could produce higher voltages than the D.C. system. By 1890, the pioneering technology invented by Nikolas Tesla was put to use in a limited capacity in power plants in four California cities: Santa Barbara, Highgrove, Visalia, and Pasadena.5

Developments in the 1890s made truly long distance power transmission feasible. In Southern California, Almarian William Decker used experimental oil-filled "step-up" transformers to convey 10,000 volts of A. C. current 14 miles. Previously, 1,000 volts was seen as the maximum voltage that could by transmitted. Decker also developed a three-phase alternating current system that was far superior to the existing system. The new system allowed electrical motors to operate with ease, where the earlier single-phase electric motors needed constant attention and were difficult to start. The three-phase alternating current system was a boost to the development of rotating electrical machinery used in manufacturing. In 1899 an 83-mile transmission line began operation between a power plant on the upper Santa Ana River and Los Angeles. It was made possible by the development of glazed porcelain insulators capable of handling 40,000 volts.6 Technological developments spurred the dramatic increase in the demand for electrical power, which in turn increased the need for more hydroelectric power plants and long distance transmission lines. Also, in the 1890s was a rush to secure water rights for hydroelectric development. By the turn of the century a network of transmission lines were being built across California.7

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[4] Myers, *Iron Men and Copper Wires,* 23.
[5] Myers, *Iron Men and Copper Wires*. 11, 23.
[6] Myers, *Iron Men and Copper Wires*, 24-31, 39.
[7] Charles M. Coleman, *PG&E of California: The Centennial Story of Pacific Gas and Electric Company 1952-1952* (New York: McGraw-Hill Book Company Inc., 1953), 212.

Although the A.C. system was a promising development, it did not catch on immediately, primarily because the D.C. system was already in place in most of the existing power stations. Pioneering developments at the Pomona Plant of the San Antonio Light & Power Company, however, greatly helped to advance the electric industry in California. In 1892, this was the first hydroelectric facility in California to use "step-up" A.C. transformers, in which the generator potential of 1,000 volts was increased to 10,000 volts for transmission. The voltage was then "stepped down" at the receiving stations. The concept of boosting voltage for transmission was a major innovation that soon became standard practice throughout the industry. This plant was also important in a nationwide context: only Oregon and Colorado had step-up hydroelectric plants and distribution systems that pre-date the Pomona Plant. On November 28, 1892, San Antonio Light & Power began delivery of 10,000 volts of electricity from its plant at San Antonio Canyon to Pomona, a distance of 14 miles. A month later service was extended to San Bernardino, roughly doubling the length of the line.8

Over the next decade, technological and engineering advances made it possible for power companies to transport electricity in increasing amounts over ever-longer distances. In 1893, the Redlands Electric Light & Power Company Mill Creek Plant Number 1 became the first three-phase A.C. plant in California, a technology that increased efficiency and reliability of power transmission.9 In 1899, the Edison Electric Company built an 83-mile transmission line between its power plant on the upper Santa Ana River and Los Angeles. By far the longest in the world at the time, this engineering feat was made possible by the development of glazed porcelain insulators capable of handling 40,000 volts.10 In 1901, Bay Counties Power Company completed a transmission line 142 miles in length that brought hydroelectric power from the Colgate Powerhouse in the Sierra Nevada near Grass Valley to Oakland. The line consisted of two parallel rows of cedar poles carrying copper and aluminum wires. In addition to its length, the line was impressive because of its 4,427-foot crossing of the Carquinez Straits. John Debo Galloway was the construction engineer for the project and is credited with directing the design and construction of the cable span, the longest in the world at that time. The Colgate-Oakland line also marked the first time electrical power produced in the Sierra crossed the rugged mountain terrain and the wide Sacramento Valley to be utilized by residents of the Bay Area.11

The first decade of the 20th century marked a period of marked growth in the hydroelectric industry. Between 1900 and 1910 the population of California increased by 60 per cent, and with it came an increased demand for electric power.12 Dozens of hydroelectric companies formed throughout California, each building networks of long-distance transmission lines to service new and growing markets. By 1902 the Bay Counties Power Company and the Standard Electric Company had a network of transmission lines in place that provided coverage to much of the

[8] Fredrick Hall Fowler, *Hydroelectric Power Systems of California and Their Extensions into Oregon and Nevada* (Washington DC: GPO, 1923), 1; Myers, *Iron Men and Copper Wires*, 24-31.
[9] Fowler, *Hydroelectric Power Systems of California*, 1-2.
[10] Myers, *Iron Men and Copper Wires*, 39.
[11] Charles M. Coleman, *PG&E of California: The Centennial Story of Pacific Gas and Electric Company 1952-1952* (New York: McGraw-Hill Book Company Inc., 1953), 146-148.
[12] Coleman, *PG&E of California*, 257.

Bay Area, as well as communities such as Marysville, Stockton, and Amador City. In 1907, California Gas & Electric (CG&E) purchased the lines of these two companies, as well as other smaller Northern California operations. The transmission lines of this consolidated system spanned from Chico in the north to San Jose in the south, serving dozens of communities in between.[13] In 1907, Edison Electric completed its Kern River No. 1 hydroelectric plant in Kern Canyon. This 118-mile long transmission line delivered power to Los Angeles, carrying a 75,000-volt line, and was the first line entirely to use steel towers. The Wind Engine Company, a windmill manufacturer, supplied the towers.[14] In 1908, the Great Western Power Company completed its hydroelectric plant at Big Bend on the Feather River, and by January 1909 began sending electrical power to the Bay Area via its 165-mile system of transmission lines.[15] It was at this time, in late 1908, that the Stanislaus Electric Power Company (SEP) built its power plant on the Stanislaus River. The Stanislaus-Mission San Jose line, later coupled with the S&SFP Stanislaus-San Francisco line, served communities in Calaveras, San Joaquin, Alameda, Santa Clara, and San Mateo counties. By the spring of 1909, the major hydroelectric companies of Northern California, including CG&E, SEP, Great Western, and the American River Power Company, had a network of long-distance transmission lines in place that criss-crossed the state.

California Electric Company

What came to be known as the California Electric Company, the leading private power company in eastern Southern California and parts of Nevada, first started out as a mining company which capitalized on the rising energy industry in the Southlands. The Nevada Power, Mining and Milling Company formed in 1904 and three years later reorganized as the Nevada-California Power Company. Nevada-California Power conducted most of its work in Mono and Inyo counties and western Nevada. Attempting to branch southward, Nevada-California Power in 1911 created Southern Sierras Power Company as a wholly owned "ally" company which would conduct power operations in eastern Southern California. In this agreement, the companies operated separately but were managed together to assist one another. Southern Sierras Power immediately began construction on a 238-mile-long transmission line running from Bishop, where it connected to a Bishop Creek power plant, to San Bernardino. Southern Sierras is credited with providing power to much of the Inland Empire during this period. In 1912, Nevada-California purchased Inyo Telephone Company in order to improve telephone communications throughout its system, and renamed it Interstate Telegraph Company. These "Allied Companies," as they were called, continued to conduct their separate operations independently of one another. Two years later, the heads of the companies–realizing their bonding capacities had maxed out–created an overarching holding company with a greater

[13] Galloway and Markwart Consulting Engineers, "Map of Central California Showing Principal Power Plants and Transmission Lines." In: J.D. Galloway, "Report on the Stanislaus Electric Power Company on the Stanislaus River, California," March 1909; Fowler, *Hydroelectric Power Systems of California*, 273-274.
[14] Myers, *Iron Men and Copper Wires*, 44-47.
[15] Jackson Research Projects, "Great Western Power Company: Hydroelectric Power Development on the North Fork of the Feather River, 1902-1930," prepared for PG&E, 1986, 96, 102; Fowler, *Hydroelectric Power Systems of California*, 275.

bonding capacity. Nevada-California Electric Corporation began business as a non-operating holding company in 1915. These companies remained linked as such (with additional subsidiaries added along the way) until 1941 when they consolidated as the California Electric Power Company. In 1964, California Electric Power Company merged with Southern California Edison.[16]

Hoover Dam and the Impact of Hydroelectric Power in the West

California's expanding population in the first decades of the twentieth century fueled a greater demand for electrical power. The heightened demand for electrical power coincided with congressional efforts to implement flood control measures along the volatile Colorado River. Every year, the Colorado River spilled out over its banks, often causing severe flooding that destroyed crops and homes. In 1928, following the negotiation of the original Colorado River Compact in 1922, Congress passed the Boulder Canyon Project Act, authorizing the construction of Hoover Dam and the all-American Canal System.[17] The Black Canyon area of the Colorado River between Nevada and Arizona was selected as the site for the dam. Construction of Hoover Dam began in 1931, and the last concrete was poured in 1935. The following year, the power plant structures were completed and commercial operation began.

Hoover Dam's design represents one of the crowning achievements in American engineering. The concrete, arch-gravity dam had a massive concrete structure rising 726.4 feet from bedrock, with a base thickness of 660 feet and a crest thickness of 45 feet. The crest length of 1,244 feet is roughly a quarter mile long, while the arch on axis has a radius of 500 feet. The construction of Hoover Dam was a massive undertaking that involved redirecting the Colorado River through tunnels bored in the rock walls of the canyon, erecting temporary cofferdams to divert the river, excavating the site, and then constructing the massive concrete dam and power plant. Hoover Dam's design and construction assured its capability of containing in reservoir roughly 30 million acre-feet (maf) of water.[18] In contrast, massive Shasta Dam on the Sacramento River stores 4.49 maf, less than one-sixth of this amount.[19]

Power generation at Hoover Dam had its origins in the Boulder Canyon Project Act, which stipulated that costs for the construction of the dam and All-American Canal would be provided through the sale of hydroelectric power generated by the dam.[20] In 1936-37, the first of the dam's

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[16] Myers, *Iron Men and Copper Wires* 79-85, 182-187, 205-208; [16] Laura L. Klure, *California Electric Power Company* (Riverside, CA: A to Z Printing, 2005) 10-11.

[17] Norris Hundley, Jr., *The Great Thirst: Californians and Water, 1770s-1990s* (Berkeley, CA: University of California Press, 1992), 209; Hundley, *Water and the West* (Berkeley, CA: University of California, Berkeley Press), 138-153.

[18] David P. Billington and Donald C. Jackson, *Big Dams of the New Deal Era: A Confluence of Engineering and Politics* (Norman, OK: University of Oklahoma Press, 2006), 102-151.

[19] State of California, Department of Water Resources. *Dams Within the Jurisdiction of the State of California*. Bulletin No. 17, January 1958, 33.

[20] Billington and Jackson, *Big Dams of the New Deal Era*, 114-115.

four generating units installed in the Nevada wing of the powerhouse was activated. All of the Nevada units, including one Arizona unit, were up and running by 1937, producing electricity for Los Angeles, Glendale, Burbank, and Pasadena, California, as well as for Boulder City and Las Vegas. Two more generators went on line in 1938, powering the Metropolitan Water District's Colorado River Aqueduct project, and another pair was installed in the Arizona wing in 1939 to supply energy for the Southern California Edison Company. With nine turbines generating over more than seven hundred thousand kilowatts by the end of 1939, the powerhouse in Black Canyon was the world's hydroelectric facility. [21]

Hoover Dam's immediate impact was substantial: water and power for the Los Angeles metropolitan area; water and flood protection for the fertile agricultural lands of Southern California and Arizona. More significantly, the dam provided for massive population and economic growth of the West. Since its settlement in the nineteenth century, the West functioned mostly as an economic colony of the East, sending minerals, timber, petroleum, and other raw materials to eastern factories and importing finished manufactured goods. The absence of electric power and dependable sources of water preempted industrial growth and limited immigration. Hoover Dam fundamentally changed this configuration, allowing California and the southwest to attain their full economic potential. Soon, other western regions began demanding similar projects of their own.[22]

During World War II, Hoover Dam proved critically important to transforming the West into a military industrial center. With the availability of electricity and water generated by the dam, the West was able to establish shipyards, aircraft plants, and other manufacturing plants responsible for producing a vast military arsenal that contributed to the allied victory over Japan and Germany.[23]

Transmission Lines to Hoover Dam

The Boulder Canyon Project Act paved the way for the construction of several power transmission lines that would supply electricity to many cities throughout southern California and the southwest. According to the act, the federal government was to build the powerhouse and supply generating equipment. The generators would then be leased to, and managed by, the power contractors. The leases stipulated that contractors reimburse the government for the cost of the machinery over a ten year period, and to pay a specified rate for the use of falling water. Power transmission lines from the dam were to be supplied by the power contractors.

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[21] Joseph Edwards Stevens, *Hoover Dam: An American Adventure* (Norman, OK: University of Oklahoma Press), 258-260.
[22] Stevens, *Hoover Dam: An American Adventure*, 259.
[23] Stevens, *Hoover Dam*, 260.

Before the construction of Hoover Dam commenced, however, a transmission line was needed in order to provide power to build the project. The federal government subcontracted this task to a private company, Southern Sierras Power Company (later the California Electric Power Company). Between 1930 and 1931, the company designed and built a new line, on 52-foot H-frame towers, to ultimately carry current at 132,000 volts (132 kV), although it began to deliver power at 88 kV. The line ran 225 miles from San Bernardino, California, where an auxiliary steam-powered generating plant was located, to a new substation at the dam construction site; towers were spaced on an average of every 750 feet, requiring more than 1,500 towers in all.24 Among Hoover Dam-related transmission lines, this was the only line carried on two-legged steel towers with horizontal crossarms.

In 1931, Interstate Telegraph Company, which at this time was a subsidiary of the larger Nevada-California Electric Corporation, built a telephone line for private transmission-line communications from Boulder City to Yermo, ten miles east of Barstow, running roughly parallel to the Southern Sierras transmission line. At Yermo, the line connected with an existing Interstate Telegraph Company line. The government finished the line between Boulder City and the dam site. The new 140-mile long line consisted of 25-foot cedar poles topped with wood crossarms. The pole line is no longer extant; however, it remains unclear when the pole line was removed. Current transmission line communications are conducted through microwave signals.25

Southern California Edison Company provided power to users at 50 cycles per second, rather than 60 cycles, as did the other power contractors at Hoover Dam. The Edison contract was modified to allow the California Electric Power Company to transmit 60-cycle over the 132 kV line, completed in 1931. This line was associated with generator A-8, a 55,000-horsepower 40,000 kW unit, which began delivering power to San Bernardino in August 1937. At some time before 1964, transmission voltage on this line was increased to 138 kV. Designated the "138 Line," it is regarded as a "sub-transmission" line, which distributed blocks of power to users adjacent to its route.

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[24] Historic Resources Inventory, San Bernardino-Boulder Dam 132kV line (October, 1989); Dames and Moore, *Class III Cultural Resource Inventory for Los Angeles Department of Water and Power – Mead to Adelanto Transmission Line Project: Stateline and Baker Divisions* (August, 1993), 22-23, 94-95.

[25] F.Z. Stone, "Difficulties are Overcome in Construction of the Hoover Line," *Sierra Service* Bulletin Vol. 6, No. 4 (May 1931), The Nevada Electric Corporation Services: Riverside, CA, 1931; The Southern Sierras Power Company, "Detail Map of Hoover Dam 132-KV. Transmission Line, Victor Sub.—State Line Section, C.R. 4935," Sheets 3-10, Riverside, CA, 1931, revised 1939; The Nevada-California Electric Corporation, "Wood Crossarm for 'H' Frame Structure Hoover Dam 132 KV. Line, for Use on Structures #51 to 62 Incl. C.R. 5584," Drawing No. 633-162, Riverside, CA, 5 October 1938; Myers, *Iron Men and Copper Wires* 182-187; Department of Interior, Bureau of Land Management, "Case Recordation (Mass) Serial Register Page: Serial Number CARI—0 001730, accessed online at http://www.geocommunicator.gov/GeoComm/index.shtm on 23 September 2008; Historic Resources Inventory, San Bernardino-Boulder Dam 132kV line; Dames and Moore, *Class III Cultural Resources Inventory for Los Angeles Department of Water and Power*.

The process of determining rates became complicated because they had to be sufficient to cover construction costs and also compete against steam-generated power in Southern California. Despite initial fears that there would be few customers, demand for power generated from the project far exceeded supply. The City of Los Angeles and the privately-owned Southern California Edison Company each asked for all the power produced. After several months of negotiation, President Hoover's secretary of the interior, Ray Lyman Wilbur, developed a final distribution plan. According to the agreement, the majority of power produced–36 percent–was provided to the Los Angeles Metropolitan Water District; the City of Los Angeles received 13 percent; other Southern California cities six percent; and Southern California Edison Power Company nine percent. Nevada and Arizona each received 18 percent. But because neither state was in a position to use all of their allotted power, the remainder was divided up between Los Angeles and Edison until such states were ready to use it. Los Angeles and Southern California Edison, meanwhile, leased and operated the powerhouse at the dam. Both, along with the Metropolitan Water District, financed, built, and operated the transmission lines connecting the dam to southern California.[26]

The 138 kV transmission line from Boulder Dam to San Bernardino is historically significant for several reasons. First, the purpose of the line was to provide power to the Hoover Dam construction site. Following completion of Hoover Dam, the line was used to transmit power from the dam to San Bernardino. It also had the distinction of being the first power facility built in association with the dam. The availability of electrical power greatly contributed to the growth of San Bernardino and the greater Los Angeles metropolitan region. Although the total distance of the line–225 miles–is not considered exceptional for the 1930s, it continues to represent a rare example of low-voltage long distance transmission.

In 1988, Peak and Associates, Inc., evaluated the Southern California Edison San Bernardino Transmission Line as part of the Class III Cultural Resource Inventory of the Las Vegas, Nevada to San Bernardino, California Fiber Optic Cable System project. Another evaluation conducted by the Archaeological Advisory Group took place in 1989. In August 1993, Dames and Moore evaluated the line for the Class III Cultural Resource Inventory for Los Angeles Department of Water and Power. In October 1993, the State Historic Preservation Office (SHPO) concurred with the federal government's conclusion that the line was eligible for the NHRP under Criterion A because of its association with Hoover Dam. It is the opinion of the BLM's cultural resource expert, Sarah Murray, that "Clearly 'c' is also appropriate for those sections that retain integrity of construction (e.g. "H" lattice w/ Southern Sierra signs)." The previous evaluations did not include the telephone line in their studies. The telephone line was originally recorded in 2007 by CH2M HILL as a linear archeological site. Presently, the remaining features include pole stumps measuring six to twelve inches high, and various artifacts strewn about the area. The artifacts include metal nuts and bolts, metal plates, steel cable, and wood crossbeams—some of which

[26] Stevens, *Hoover Dam*, 31-32.

still have insulators attached. Finally, a two-track service road runs along the old communications line alignment. For the purposes of CEQA (and as will be discussed in greater detail below), the telephone line is not a historic resource.

The transmission line and the telephone line are linked through their historical association with the construction of the Hoover Dam. As a result, it is possible to consider these features in two ways: 1) as parts of a single resource, built and used as a single unit; or 2) as separate contributing resources which, taken together, represent a historic district. This report discusses both concepts in detail, and concludes that, for the purposes of CEQA, these resources do not constitute a historic district. Because the telephone line lacks integrity as a historic resource, it would not contribute to a historic district; the transmission line has been determined eligible, and thus should be viewed as an individually eligible resource. Even if the telephone line still existed, its historical purposes and use indicate the two lines are a single resource, as this report does. Therefore, there is a single resource, the transmission line, rather than an historic district.

CEC cultural resources staff has asked if the transmission line and telephone line remnants constitute an historic district. If the telephone line is considered part of the previously evaluated single historic resource and not part of a larger potential historic district, the significance of the transmission line remains the same as originally evaluated. This route would be justified given the nature of engineering and execution of the two lines. Without the transmission line, there would not have been a telephone line; indeed the telephone line would have no other purpose. Without the telephone line, the transmission line would not operate properly, because operators would have no way of directly communicating along the line. The resource was previously found eligible for listing on the National Register (and SHPO concurred) under Criterion A because of its association with the construction of the Hoover Dam. This transmission line, built between 1930 and 1931, provided power to the dam site and Boulder City. The telephone line was built in conjunction with the transmission line by the same corporation for the purposes of transmission-line communications. Thus, it was an integral part of sending power to the dam construction site. The BLM also stated that the transmission line is eligible under Criterion C as well, considering the significance of the design of the towers. In this regard, the telephone line has nothing to add to the significance of the transmission line.

If one were to consider the telephone line and transmission line as a historic district, it is important to understand the significance of that district. The theme of the district would be energy and development and transmission to and from Hoover Dam, and its period of significance would run from 1930, when the transmission line construction began, to 1936, when the Hoover Dam was completed. The geographic boundaries would be the width and length of the transmission line right-of-way from the Hoover Dam construction site to the Southern Sierras Power Company's San Bernardino power station, including the telephone line, which ran from the Hoover Dam to Yermo. The transmission line and telephone line run approximately one-half to one mile apart to prevent interference and distortion in the telephone line.

If the telephone line and the transmission line were deemed to be a district, i.e., a “Southern Sierras Power Company Boulder Dam-San Bernardino Transmission Line Historic District,”, then the district, like the transmission line alone, would be significant under Criteria A for its association with the construction of the Hoover Dam. Hoover Dam’s design represents one of the crowning achievements in American engineering. The construction of Hoover Dam was a massive undertaking that involved redirecting the Colorado River through tunnels bored in the rock walls of the canyon, erecting temporary cofferdams to divert the river, excavating the site, and then constructing the massive concrete dam and power plant. Power generation at Hoover Dam had its origins in the Boulder Canyon Project Act, which stipulated that costs for the construction of the dam and All-American Canal would be provided through the sale of hydroelectric power generated by the dam. With nine turbines generating over more than seven hundred thousand kilowatts by the end of 1939, the powerhouse in Black Canyon was the world’s hydroelectric facility. Hoover Dam’s immediate impact was substantial: water and power for the Los Angeles metropolitan area; water and flood protection for the fertile agricultural lands of Southern California and Arizona.

More significantly, the dam provided for massive population and economic growth of the West. Since its settlement in the nineteenth century, the West functioned mostly as an economic colony of the East, sending minerals, timber, petroleum, and other raw materials to eastern factories and importing finished manufactured goods. The absence of electric power and dependable sources of water preempted industrial growth and limited immigration. Hoover Dam fundamentally changed this configuration, allowing California and the southwest to attain their full economic potential. Soon, other western regions began demanding similar projects of their own. Furthermore, the Hoover Dam proved critically important to transforming the West into a military industrial center. With electricity and water from the dam, major cities in the West, such as San Diego, were able to establish shipyards, aircraft plants, and other manufacturing plants responsible for producing a vast military arsenal that contributed to the allied victory over Japan and Germany.[1]

The Boulder Dam-San Bernardino transmission line proved crucial for the construction of the Hoover Dam. Southern Sierras Power Company, under contract with the federal government, began construction of its transmission line in 1930 and completed the 225-mile line in a record 225 days. At the same time, it constructed a telephone line for transmission-line communications. Southern Sierras provided more than 100 million kilowatt hours of electricity to Boulder City and the Hoover Dam construction site. On October 26, 1936, the power plant known as Unit N-2 began production of electricity for the City of Los Angeles’ new 266-mile long transmission line. In August 1937, Unit A-8 went into operation for Southern Sierras Power Company’s, Nevada-California Electric Corporation.

Like the transmission line alone, any potential historic district is not associated with an individual who is significant to local, state or national history, so it is not eligible under Criterion B. Under Criterion C, the lines do not constitute a district because they do not contain distinctive characteristics as a district. The transmission line, as noted, is individually eligible; at most, the telephone line would be considered a contributing element, not individually eligible on its own. The telephone line design was not significant and Southern Sierras Power Company and Interstate Telegraph Company had previously worked together on the combination transmission–telephone lines. Individually, the transmission tower appears eligible for design type–H-frame towers with single tower transposition units. However, the H-frame style is significant because it is the only style used on this project. Of all the other transmission line towers that originally connected to the Hoover Dam, none used H-frame metal towers. Furthermore, the use of transposition towers to change the relative positions of the three conductors had generally been done over two towers. For this project Southern Sierras Power used a single tower to perform this task. Finally, any potential district would not be eligible for listing in the National Register under Criterion D, because it will likely not yield information important to history.

When determining eligibility for listing in the National Register, one must evaluate integrity, using the seven aspects – location, design, setting, materials, workmanship, feeling, and association – specified in the regulations. The location, design, materials, workmanship and feeling of a potential historic district has been negatively affected (to greater or lesser degrees) by the destruction of the telephone line and removal of nearly 20 miles of transmission line. However, most of the transmission line remains in place. The design, materials and workmanship have been further affected by the replacement and repairs of some individual transmission towers. Nonetheless, the vast majority of the towers retain the original H-frame design with original materials and workmanship. Any potential district's setting, or physical environment, has been altered dramatically in the past 70 years with the expansion of the Southern California population. Interstate Highway 15 now runs roughly parallel to large portions of the line. Furthermore, in the study area, the district's setting is adversely impacted by the City of Primm and a large golf course. Because the transmission line no longer has a direct connection with the Hoover Dam, and the telephone line is no longer extant, the integrity of association of the district is negatively effected. The transmission line continues to carry electricity; however, it no longer carries electricity to the Hoover Dam construction site. Furthermore, the transmission line, now owned and operated by Southern California Edison, is no longer associated with the no-longer existing Southern Sierras Power Company, and its allied and successor companies.

INTEGRITY CONSIDERATIONS

The integrity of resource is importance because it allows the resource to convey its significance. Seven aspects of integrity are considered when evaluating a historic resource. In considering the transmission line and telephone line as a single historic resource, the following discussion evaluates the resource's integrity.

Location

Location is defined as the place where the property was located during the period of significance. The transmission and telephone lines were originally constructed between 1930 and 1931 to provide power and private communications to the Boulder Dam (now Hoover Dam) construction site. The transmission line ran from the dam construction site to Boulder City and onto San Bernardino power station. The telephone line ran from the dam construction site to Boulder City (originally constructed by the federal government) to Yermo, ten miles east of Barstow. Following the construction of the dam, power was sent along the transmission line from the dam to areas San Bernardino. Within the project area the transmission line has not been relocated. The transmission line no longer connects directly to Hoover Dam's powerhouse or with San Bernardino, as it originally did. In 1984, approximately 15 miles of the total 225 miles of the line was removed. The line now terminates at the El Dorado Substation on the eastern end. Additional miles of line have been removed at the western end, such that the line now terminates near Hesperia rather than in San Bernardino. Within the project area, the telephone line is no longer extant. Remains of the telephone line include telephone pole stumps rising six to twelve inches from the ground. A two-track road, presumably the original service road for the telephone line, also remains. Along the alignment various artifacts remain, including crossarms, metal nuts and bolts, metal plates and steel cable. These items appear strewn about, often times near the telephone pole stumps. The integrity of location of the telephone line was lost when the line was removed.

Design

Design of a property consists of elements that create the form, plan, space, structure and style. The design of the transmission line includes the path of the transmission line and the specific plans for the towers. Overall, approximately 1,600 transmission towers were built along 225 miles between the Hoover Dam and San Bernardino and an unknown number of telephone poles between Boulder City and Yermo. The main transmission towers were designed to be 52-foot-tall, H-frame structures with two latticed masts spaced 17 feet apart. A 34-foot horizontal arm stretches along the top of the masts and carries three transmission cables. The cables were connected to the horizontal arm via nine insulators strung together (see **Photograph 2**). Different towers were used to support line angles. Self-supporting A-frame towers were used for angles between 25 and 50 degrees, while three vertical, guyed masts connected at the top with a horizontal arm were used for angles greater than 50 degrees.

The original design also called for metal H-frame transposition towers which changed the relative position of the three cables in order to prevent interference with radio signals and communications-line transmissions. The design of the single transposition tower was of significance at the time because previously transposition had generally taken place between two towers (see **Photograph 3**). Since original construction, replacement towers have been installed at places along the entire line. Within the project area, at least one replacement tower exists. The replacement tower, which has an unknown construction date, consists of two vertical wood poles topped with two horizontal wood arms. The transmission cables are connected to the arms by way of a series of insulators. As a whole, the original transmission line was designed to connect with the Hoover Dam. Presently, the line does not make this direct connection; rather it connects with the El Dorado Substation eliminating some 15 miles of original 225-mile line. Additional miles have been lost on the western end, so the terminus is no longer in San Bernardino. While the vast majority of the roughly 1,600 towers remain, a number of towers have been replaced since the original construction. The new towers do not follow the original design. In addition, some towers have been retrofitted and had guy wires added due to corrosion at the base. Individually, however, most of the original towers do not appear to have been significantly altered from their original design. The line was designed to be operated at 138 kV but is currently operated at 115 kV.

The telephone line design consisted of No. 10 N.B.S. copper wires strung on 25-foot cedar poles with douglas fir crossarms. The integrity of the design of the telephone line was lost when the poles were demolished.

Setting

The setting of a property consists of the physical environment. When the transmission line and the telephone line were originally constructed, they passed through a desert relatively void of human activity and cultural resources. In the 1930s, several roads crossed the Ivanpah Valley; however, activity was comparatively minimal. The towns of Calada and Roach were closest to the project site but the desert remained sparsely populated. Today the valley contains the City of Primm, Nevada, which hugs the state line; a large golf course; a transmission line running parallel to the 138 kV line (now operated at 115 kV) and telephone line; and Interstate Highway 15–a four-lane thoroughfare connecting Los Angeles with Las Vegas and eastern cities. While the valley remains sparsely populated–the majority of residents live in Primm–the more modern transmission line, city, highway and golf course mark a change in the 138 kV (now 115 kV) line's and telephone line's original setting. The setting along portions of the transmission line and telephone line as a whole has been similarly changed. Southern California has seen extensive growth in the past 80 years, spreading over much of the western portion of the line. Compared with much of California, eastern Southern California is still sparsely populated. However, compared to what it was like 80 years ago, this part of the state has seen substantial development in terms of transportation corridors and other construction.

Materials

The physical elements that were used in the construction of the property make up the materials of a resource. The materials used during construction of the transmission line included metal riveted and latticed masts, metal crossbeams, insulators, and original transmission cables. While it is likely that some older materials deteriorated and needed replacing, it appears the majority of the most significant materials remain, especially within the project area. The H-frame towers retain their metal lattice work riveted together. The crossbeams atop the masts are also of original materials. Some materials were lost when 15 miles on the eastern end of the 225-mile line were removed in the 1980s and additional miles on the western end, and throughout the line where some of the original towers were replaced. In addition, some towers have been retrofitted with footings and guy wires because of corrosion. In the project area, only one tower was replaced. Materials used for the original telephone line included the 25-foot cedar poles, douglas fir crossarms, insulators and 10N.B.S copper wire. The remaining materials include six to twelve inches of the poles and various scattered artifacts, some of which are likely not original.

Workmanship

The workmanship of a resource is demonstrated in the physical evidence that represents the culture of the time the resource was constructed. With regard to the transmission and telephone lines, the workmanship would include the design and materials used in building the resources. The workmanship of the transmission line demonstrates construction methods of the early to mid-twentieth century, and is represented by the style and design of the towers. With the replacement of individual towers along the line, retrofitting of others, and the removal of more than 20 miles of line, the workmanship of the entire line has been affected. Within the project area, it appears only one of the original towers was replaced with an H-frame tower consisting of wood masts and a wood crossbeam. Workmanship of the telephone line has also been affected, but to a much greater degree. Because the line no longer exists, and only stumps of the poles and some materials remain, the workmanship no longer conveys historical significance of the resource.

Feeling

Feeling is expressed in the aesthetic or historic nature of the resource and represents a particular period of time. The feeling of this transmission line is best represented in the physical characteristics of the towers as well as the environment in which it is located. Aside from the replacement and retrofitting of some of the towers and the removal of more than 20 miles of the 225-mile line, the overall line remains mostly intact. However, at several locations along the line, including within the project area, it has changed since original construction. Population growth led, in part, to the development of cities throughout the Southlands. In response, local and state governments built highways and roadways. A golf course now exists immediately to the east of the project area. Essentially, the once-lonely transmission line is no longer alone.

Association

A resource must have a direct link between an important historic event or person. This is the resource's association. The association is represented by the physical elements that reveal that historical link. The transmission line's direct link is, in part, characterized by the physical connection to the Hoover Dam for which it was built, and that fact that it still carries electricity to distant markets and users. It is also represented in the physical features that convey its historic importance, such as the original towers. In 1984, 15 miles of the eastern end of the line, which physically connected to the Hoover Dam generators, was removed. A vast majority of the original towers remain; however, several have been replaced with H-frame wood towers. Within the project area, only one tower was replaced.

IMPACTS

As described in Data Response CR-1 (Supplemental Data Response, Set 1A), the 115kV single-circuit gen-tie line from Ivanpah 1 composed of approximately 70-foot-tall steel poles will cross under the existing 500 kV LADWP line near a tower then cross through the SCE right-of-way and over the 33 kV distribution line just to the southwest of the substation. A steel pole with increased tensile strength will angle the circuit into a breaker bay in the southern 115 kV switchyard of the substation. The gen-tie lines from Ivanpah 2 and Ivanpah 3 will interconnect into bays in the 115kV switchyard from a double-circuit transmission line composed of steel poles approximately 85 feet tall approaching the substation from the north. The switchyard portion of the substation will be connected to the existing 115 kV line by looping the line into the switchyard. Depending on the final location of the substation (location A or B) relative to the existing 115 kV towers, additional turning structures may be needed between the existing line and the switchyard and one or two of the existing 115 kV towers may be removed.

Because the project would remove at most two towers, impacts to the overall resource–a more than 200-mile-long transmission line–would be less than significant; that is, the removal of two towers would not result in the transmission line and telephone line being considered ineligible for listing in the National Register of Historic Places. The transmission line was originally found eligible by itself in 1993 by the Bureau of Land Management and concurred by the State Historic Preservation Officer after more than 20 miles of the transmission line and corresponding towers had been removed. Additionally several towers along the transmission line's alignment have been removed or replaced owing to changing requirements, or as maintenance or repair of failing structures. These changes did not lead the Office of Historic Preservation (OHP) to consider the line ineligible in 1993. In the present study, the transmission line and the telephone line are considered as a single resource. However, the telephone line is no longer extant.

The California Code of Regulations discusses the nature of substantial adverse impacts of a project on historical resources. It states that a project causes substantial adverse changes to the historical resource if it leads to the demolition, destruction, relocation, or alteration of the resource or its immediate environment to a degree that the historical resource's significance would be materially impaired. In addition, the significance of a resource is materially impaired if a project causes demolition or adverse material alteration of the resource's physical characteristics that convey its historical significance and that justify its eligibility for inclusion in the California Register of Historical Resources. The replacement of two transmission towers will not materially impair the significance of the resource. The resource consists of some 1,600 transmission towers stretching more than 225 miles. The replacement of two towers does not represent a significant alteration to the transmission line. Furthermore, without those two towers the transmission line will still be able to convey its historical significance. Thus, the project does not materially impair the significance of the historical resource and does not represent a substantial adverse impact. Furthermore, the telephone line no longer exists aside from telephone line stumps and artifacts assumed to be connected with the telephone line. The telephone line no longer possesses any characteristics noteworthy enough to convey its historic significance. The removal of remaining stumps would not cause an adverse effect that has not already occurred to the telephone line.

This report found that the transmission line and the telephone line were built and used as a single unit and should be considered as a single resource rather than as a historic district. But even if the two together were deemed a district, the impact would remain insignificant. The current project would not materially impair by demolition or adverse alteration a Southern Sierras Power Company Boulder Dam-San Bernardino Transmission Line Historic District. The historic district's important physical characteristics exist only in the transmission line. While the telephone line is an element of the historic district, the defining characteristics of the element were the telephone poles themselves. Since the poles no longer stand the line no longer posses its historically significant characteristics. Thus, removing two transmission line towers, as the current project proposes, would not lead to the resource's inability to convey its historical significance.

PHOTOGRAPHS

Photograph 1. Showing 1931 Boulder Dam-San Bernardino 138 kV transmission line on left with the newer Los Angeles Metropolitan Water District 500 kV transmission line on the right, City of Primm in background with Interstate Highway 5, camera facing northwest, December 10, 2007.

Photograph 2. Showing original tower in foreground and replacement wood tower in background, camera facing northwest, December 10, 2007.

Photograph 3. Original transposition tower, camera facing north, December 10, 2007.

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Mr. Herbert's academic fields of specialization were in California and Western United States history. For more than twenty–five years, Mr. Herbert has worked as a consulting historian on a wide variety of historical research and cultural resources management projects, as a researcher, writer, and project manager. He has managed, written, or worked on building inventory and evaluation projects for a variety of government agencies such as Caltrans and the Department of Defense. He has given numerous lectures on the topics of public history and has provided expert witness services and testimony in more than a dozen cases or administrative proceedings. Based on his level of education and experience, Mr. Herbert qualifies as a historian/architectural historian under the United States Secretary of the Interior's Professional Qualification Standards (as defined in 36 CFR Part 61).

Professional Background

Mr. Herbert has taught history at community colleges in Sacramento and Solano counties and regularly teaches a graduate seminar in public history at California State University, Sacramento (2001–present). In 1990, he was elected chairman of the California Council for the Promotion of History (CCPH) and served a two-year term. He served as one of CCPH's representatives on California Resources Secretary Douglas Wheeler's Historic Preservation Task Force (1992–1994); and on the National Cultural Alliance's Cultural Awareness Campaign, California Steering Committee. Mr. Herbert is a Registered Professional Historian (#508) with CCPH and a member of the National Council on Public History, California Historical Society, Ninth Circuit Court Historical Society. Mr. Herbert earned is MAT in History for the University of California Davis and his BA in History from the University of California, Berkeley.

Relevant Experience

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BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA

APPLICATION FOR CERTIFICATION FOR THE *IVANPAH SOLAR ELECTRIC GENERATING SYSTEM*	**DOCKET NO. 07-AFC-5** **PROOF OF SERVICE** **(Revised 7/14/08)**

<u>INSTRUCTIONS:</u> All parties shall 1) send an original signed document plus 12 copies <u>OR</u> 2) mail one original signed copy AND e-mail the document to the web address below, AND 3) all parties shall also send a printed <u>OR</u> electronic copy of the documents that <u>shall include a proof of service declaration</u> to each of the individuals on the proof of service:

CALIFORNIA ENERGY COMMISSION
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DECLARATION OF SERVICE

I, Haneefah Walker, declare that on October 2, 2008 I deposited copies of the attached Data Response, Set 2F in the United States mail at Sacramento, California with first-class postage thereon fully prepaid and addressed to those identified on the Proof of Service list above.

Transmission via electronic mail was consistent with the requirements of California Code of Regulations, title 20, sections 1209, 1209.5, 1210. All electronic pages were sent to all those identified on the Proof of Service list above.

I declare under penalty of perjury that the foregoing is true and correct.

Haneefah Walker

Haneefah Walker