TRAFFIC AND TRANSPORTATION

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SUMMARY OF CONCLUSIONS

U.S. Bureau of Land Management (BLM) and Energy Commission staff (hereafter jointly referred to as staff) have analyzed the traffic-related information provided in the Application for Certification and other sources to determine the potential for the Ivanpah Solar Electric Generating System Project (ISEGS) to have significant adverse traffic and transportation-related impacts. Staff has also assessed the availability of mitigation measures that could reduce or eliminate the significance of these impacts.

Neither construction nor operation of the project would have a significant adverse impact on the local or regional road network, except for northbound Interstate 15 (I-15) on Friday afternoons and evenings related primarily to motorists enroute to Las Vegas. Vehicle trips generated during construction and operation of the project would contribute to a significant adverse direct and cumulative impact on northbound I-15 on Fridays between the hours of 12 p.m. and 10 p.m. during construction and operation.

To reduce project impacts on area traffic and to facilitate safety during construction, the applicant has proposed to limit the amount of project-related traffic generated on area roadways on Friday afternoons. To mitigate the ISEGS impact on area traffic to the extent possible during construction and operation to a less-than-significant level, and in particular on northbound I-15 on Friday afternoons, staff has incorporated the applicant's proposal along with other mitigation into Condition of Certification **TRANS-1**. Staff has determined that, with the implementation of the Traffic Control Plan required by proposed Condition of Certification **TRANS-1**, construction and operation of the ISEGS would not cause a direct significant impact on northbound I-15 on Friday afternoons, but would contribute to a cumulatively considerable significant impact on northbound I-15 on Friday afternoons. Condition of Certification **TRANS-2** is recommended to ensure the repair of physical damage to area roadways caused during project construction.

Because the project has the potential to result in exposure of aircraft pilots, motorists, and hikers to solar radiation reflected from project heliostats and/or power tower receivers, Conditions of Certification **TRANS-3** and **TRANS-4** are recommended to ensure that potential glare from the project is minimized to the maximum extent possible and does not pose a health and safety risk. In addition, because the project would place structures greater than 200 feet in height in the vicinity of military flight training routes and air traffic from the proposed Southern Nevada Supplemental Airport, staff has proposed Condition of Certification **TRANS-5** to ensure the project complies with FAA recommendations for lighting of tall structures. Condition of Certification **TRANS-6**, which would require notifying the FAA of potential air hazards from turbulence at an altitude of 1,350 feet above the ground surface above the ISEGS site during daylight hours. Conditions of Certification referred to herein serve the purpose of both the Energy Commission's Conditions of Certification for purposes of the California Environmental Quality Act (CEQA) and BLM's Mitigation Measures for purposes of the National Environmental Policy Act (NEPA).

The Ivanpah Solar Electric Generating System Project, as proposed would be consistent with all applicable laws, ordinances, regulations, and standards, including the Circulation and Infrastructure Element of the County of San Bernardino General Plan.

INTRODUCTION

In the **Traffic and Transportation** analysis of this Final Staff Assessment/Draft Environmental Impact Statement (FSA/DEIS), staff addresses the extent to which the project may impact the transportation system in the local area. This analysis focuses on (1) whether construction and operation of the Ivanpah ISEGS Project would result in traffic and transportation impacts under the California Environmental Quality Act (CEQA) and (2) if the project would be in compliance with applicable laws, ordinances, regulations, and standards (LORS).

In this analysis staff identifies the (1) the roads and routings that are proposed for use for construction and operation; (2) potential traffic-related problems associated with the use of those routes by construction workers and truck drivers; (3) anticipated encroachments upon public rights-of-way during the construction of the proposed project and associated facilities; (4) frequency of trips and probable routes associated with the delivery of hazardous materials; (5) possible effect of project operations on local airport flight traffic; and (6) potential health and safety effects of project-related glare..

LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

Traffic and Transportation Table 1 provides a general description of adopted federal, state, and local LORS pertaining to traffic and transportation relevant to the proposed project.

Traffic and Transportation Table 1
Laws, Ordinances, Regulations, and Standards

Applicable Law	Description
Federal	
Code of Federal Regulations (CFR), Title 14 Aeronautics and Space, Part 77 Objects Affecting Navigable Airspace (14 CFR 77)	This regulation establishes standards for determining physical obstructions to navigable airspace; sets noticing and hearing requirements; and provides for aeronautical studies to determine the effect of physical obstructions to the safe and efficient use of airspace.
CFR, Title 49, Subtitle B	49 CFR Subtitle B includes procedures and regulations pertaining to interstate and intrastate transport (including hazardous materials program procedures) and provides safety measures for motor carriers and motor vehicles that operate on public highways.
State	
California Vehicle Code (CVC), Division 2, Chapter 2.5; Div. 6; Chap. 7; Div. 13; Chap. 5; Div. 14.1; Chap. 1 & 2; Div. 14.8; Div. 15	This code includes regulations pertaining to licensing, size, weight, and load of vehicles operated on highways; safe operation of vehicles; and the transportation of hazardous materials.
California Streets and Highway Code, Division 1, Chapter 3; Division 2 Chapter 5.5	This code includes regulations for the care and protection of state and county highways and provisions for the issuance of written permits.
Local	
SANBAG Regional Transportation Plan	Identifies public policies and strategies for the transportation system in the San Bernardino County region.
SANBAG Congestion Management Plan (CMP)	Requires maintenance of level of service (LOS) E or better on CMP segments.
San Bernardino County General Plan	Establishes regional transportation objectives, policies, and implementation measures for various modes of transportation.
San Bernardino County Code, Title 5, Division 1, Highway Permit	Addresses permitting requirements for oversize/overweight vehicles.

SETTING

The project site is located approximately one mile west of the Yates Well Road interchange on Interstate 15 (I-15) in San Bernardino County, approximately 3.1 miles west of the California-Nevada border. Access to the site is via the Yates Well Road interchange on I-15 and Colosseum Road (BSE 2007A, p. 2-3). The project site is

vacant with the exception of a 115 kV electrical transmission line (BSE 2007A p.2-4) and the two-lane Colosseum Road. The ISEGS would be comprised of three separate solar energy power plants: Ivanpah 1, Ivanpah 2, and Ivanpah 3. This FSA/DEIS addresses construction and operation of all three facilities.

The project site is surrounded by open space with the exception of a golf course located approximately one mile east of the site.

Parking for construction workers would be provided at the on-site laydown areas located on the outside edges of the heliostat fields (BSE 2007A, p. 2-17).

CRITICAL ROADS AND FREEWAYS

Traffic and Transportation Figure 1 and Figure 2 show the regional and local transportation features as described in the Application for Certification (AFC).

Information about critical roadways follows. This information is based on the Traffic and Transportation section of the AFC (BSE 2007A, p.5.12-9) as well as traffic data from the California Department of Transportation (Caltrans) and the County of San Bernardino.

Interstate 15 (I-15)

I-15 is a north-south divided freeway linking Los Angeles, California, to Las Vegas, Nevada. I-15 also extends from California through Nevada, Utah, Idaho, and Montana. Access from I-15 to the project site is provided via Yates Well Road. At this location I-15 consists of two lanes in each direction. Caltrans reports that I-15 carries approximately 59,690 daily vehicle trips near the ISEGS site (Caltrans 2007a).

Yates Well Road

Yates Well Road is a two-lane east-west local road providing direct access to I-15 (Caltrans 2007b). The ramp terminal intersections at the I-15/Yates Well Road Interchange are stop-controlled. No other controlled intersections exist on Yates Well Road in the vicinity of the project (BSE 2007A, p.5.12-9). San Bernardino County reports that Yates Well Road carries approximately 249 daily vehicle trips between I-15 and Colosseum Road (COSB 2007).

Colosseum Road

Colosseum Road, an east-west two-lane direct road, provides access to the site and the Primm Valley Golf Club. Colosseum Road is located both on and immediately to the east of the project site and connects to Yates Well Road. The County of San Bernardino does not have any traffic counts on record for Colosseum Road (COSB 2007).

LEVEL OF SERVICE

“Level of service” (LOS) is a qualitative measure used to describe operational conditions within a traffic stream. LOS is used to describe and quantify the congestion level on a particular roadway or intersection in terms *speed*, *travel time,* and *delay.* The 2000

Highway Capacity Manual[1] defines six levels of service for roadways or intersections ranging from LOS A-- the best operating conditions--to LOS F—the worst. See **Traffic and Transportation APPENDIX A** for additional information.

The County of San Bernardino uses the LOS criteria to assess the performance of its street and highway system and the capacity of roadway segments (COSB 2007). The County's Threshold Standards Policy requires that LOS C or better be maintained on roadway segments under the County's jurisdiction (COSB 2006).

The San Bernardino Associated Governments (SANBAG) has adopted a Congestion Management Program (CMP). The CMP defines a network of state highways and arterials, level of service standards, and related procedures. The CMP's level of service standard requires all CMP segments to operate at LOS E or better. I-15 is a CMP roadway.

Traffic and Transportation Table 2 includes information about the existing LOS for potentially affected intersections in the project area. LOS A represents free-flowing traffic; whereas, LOS F represents slow-moving or stalled traffic (overcapacity operation). All intersections currently operate at LOS A.

Traffic and Transportation Table 2
Existing Intersection Level of Service

Intersection	AM Peak Hour	PM Peak Hour
Colosseum Road at Yates Well Road Westbound left/through approach	A	A
Colosseum Road at Yates Well Road Northbound left/right approach	A	A
I-15 southbound ramps at Yates Well Road Westbound left/through approach	A	A
I-15 southbound ramps at Yates Well Road Southbound left/through/right approach	A	A
I-15 northbound ramps at Yates Well Road Eastbound left/through approach	A	A
I-15 northbound ramps at Yates Well Road Northbound left/through/right approach	A	A

Source: BSE 2007A, page 5.12-11

Traffic and Transportation Table 3 includes information about the existing volume-to-capacity (V/C) ratios and LOS for potentially affected roadway segments in the project vicinity.

[1] The *Highway Capacity Manual* is the most widely used resource for traffic analysis. The Highway Capacity Manual is prepared by the Transportation Research Board, Committee on Highway Capacity and Quality of Service. The current edition was published in 2000.

Traffic and Transportation Table 3
Average Daily Level of Service Summary for Existing Conditions

Name	Design Capacity	Volume[1]	V/C[2]	LOS[3]
Colosseum Road	3,000	NA	NA	A
Yates Well Road	6,000	249	0.04	A
I-15 NB & SB	72,000	59,690	0.83	C

1. Volume data for Colosseum Road a 2-lane dirt road is not maintained, however, based on field observation, this road is seldom used (BSE 2007A, p. 5.12-17). Sources of capacity and volume data for Yates Well Road and I-15 are, TRB 2000, COSB 2007, and Caltrans 2007a.
2. V/C = volume-to-capacity ratio;
3. LOS = level of service

Although I-15 operates at LOS C or better most days of the week (Monday through Thursday), northbound I-15 experiences increased traffic volumes on Friday afternoons because of commuter and tourist traffic from California to Las Vegas, Nevada. On most days, as presented in **Traffic and Transportation Table 3**, I-15 experiences an average daily traffic volume of approximately 60,000 trips—or an hourly average of approximately 1,200 trips. However, on Fridays from approximately 12 p.m. to 10 p.m., northbound I-15 experiences an hourly average that ranges between approximately 1,700 and 2,000 trips and operates at LOS F (BSE 2007A, p. 5.12-11 and Figure 5.12-5).

RAILWAYS

An active Union Pacific Railroad line exists approximately five miles east of the project site (BNSF 2005). Project construction traffic is not expected to cross this rail line (BSE 2007A, p. 5.12-11).

PUBLIC TRANSPORTATION

No public transit service exists in the vicinity of the project site. Amtrak serves the corridor via bus only, with service between Las Vegas and Los Angeles. Many private bus companies operate on demand for Primm Valley Golf Club customers; but no established regular schedule exists (BSE 2007A, p. 5.12-11).

BICYCLE ROUTES

No bicycle facilities exist in the project area (BSE 2007A, p. 5.12-11).

AIRPORTS

One existing public airport, Jean Airport, is located approximately 14 miles northeast of the project site and one mile south of Jean Nevada. In addition, the Southern Nevada Supplemental Airport is proposed for the same area. Jean Airport has two paved runways that serve less than 50 aircraft, most of which are single engine airplanes and gliders (AirNav.com 2008).

In addition, the Federal Aviation Administration (FAA) and the Bureau of Land Management (BLM) are currently preparing an Environmental Impact Statement for a proposed Southern Nevada Supplemental Airport to be constructed on approximately 6,000 acres of land just south of Jean, Nevada (VHB 2008). As currently planned, the proposed Southern Nevada Supplemental Airport would provide sufficient airport capacity to accommodate future aircraft operations and aviation passenger demand in

the Las Vegas Metropolitan Area (VHB 2008). The proposed ISEGS would be located approximately 40,000 feet (7.6 miles) southwest of the nearest runway at the proposed Southern Nevada Supplemental Airport.

ASSESSMENT OF IMPACTS AND MITIGATION

METHOD AND THRESHOLD FOR DETERMINING SIGNIFICANCE

To determine whether a potentially significant impact would be generated by a project, staff reviewed the project using the criteria found in the CEQA Guidelines, Appendix G, Environmental Checklist Form, and applicable LORS used by other governmental agencies. Specifically, staff analyzed whether the proposed project would:

- Cause an increase in traffic, which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume-to-capacity ratio on roads, or congestion at intersections)
- Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways
- Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks
- Generate glare that could present a hazard to roadway vehicle traffic or aircraft
- Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)
- Result in inadequate emergency access
- Result in inadequate parking capacity
- Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks).

In addition staff analyzes two additional potential traffic and transportation impacts concerning (1) nearby school operations and (2) transportation of hazardous materials. However, no schools are located within at least 30 miles of ISEGS site. Consequently, this FSA/DEIS does not contain such an analysis. However, an analysis of the impacts of transporting hazardous materials may be found in the Operation Impacts and Mitigation Section.

DIRECT/INDIRECT IMPACTS AND MITIGATION

Proposed Project - Construction Impacts and Mitigation

Total Construction Traffic

Facility construction is projected to take place over 48 months, beginning in first quarter 2009 and completed in last quarter 2012. Construction activities would generally occur from Monday through Saturday between the hours of 5 a.m. and 7 p.m. However, additional hours may be necessary to compensate for schedule deficiencies or to

complete critical construction activities. **Traffic and Transportation Table 4** contains peak construction traffic estimates for the ISEGS.

Traffic and Transportation Table 4
Daily and Peak Hour Estimated Construction Trip Generation

Trip Type	Average Daily Traffic	AM Peak Hour			PM Peak Hour		
		In	Out	Total	In	Out	Total
Container trucks for heliostat fields	7	7	0	7	0	7	7
Delivery trucks for power block	2	2	0	2	0	2	2
Heavy vehicles for power block	3	3	0	3	0	3	3
Worker Busses	39	39	0	39	0	39	39
Private Vehicles	192	192	0	192	0	192	192
Total Construction Traffic	**243**	**243**	**0**	**243**	**0**	**243**	**243**

Source: BSE 2007A, p. 5.12-15

Assumptions on which the information in Table 4 is based follow.

1. Sixty percent of the 959 staff would arrive to the site by bus transport (15 people per bus) and 40 percent of staff would arrive by private vehicle typically with two persons per vehicle. During peak construction, workers would commute to the site in 39 busses and 192 private vehicles for a total of 231 trips. As included in **Traffic and Transportation Table 4,** delivery of construction materials during peak construction would require seven container trucks for heliostat fields; two delivery trucks for the power block; and three heavy vehicles for the power block, for a total of 12 truck trips per day (BSE 2007A, p 5.12-15). Therefore, a total of 243 construction vehicles are expected to drive to the site each day during peak construction.

2. Ninety-five percent of workers in private vehicles (183 vehicles) would originate in Las Vegas, Nevada. The remaining five percent of workers (9 private vehicles) as well as the trucks transporting the heliostats and power bloc would travel from California. Therefore, a total of 227 vehicles would travel from Nevada (39 busses; 183 private vehicles; 5 power block item deliveries) and 16 vehicles (9 private vehicles and 7 heliostat item deliveries) would travel from California (BSE 2007A, p 5.12-15). Although construction materials would likely arrive at the site throughout the day, all construction-related trips would arrive at the project site during the AM peak hour and would depart the site during the PM peak hour.

An HCM (Highway Capacity Manual) intersection analysis was conducted for the six approaches that would be directly affected by project construction traffic. Peak construction period intersection volumes were generated by adding the project peak intersection volumes to the existing peak intersection volumes. **Traffic and Transportation Table 5** includes information about the change in LOS with the addition of project peak construction traffic during the morning and afternoon peak hours.

Traffic and Transportation Table 5
Peak Hour Levels of Service During Project Peak Construction

Intersection	Existing				With Project			
	AM Peak		PM Peak		AM Peak		PM Peak	
	Trips	LOS	Trips	LOS	Trips	LOS	Trips	LOS
Colosseum Road at Yates Well Road ; westbound left/through approach	7	A	26	A	7	A	269	A
Colosseum Road at Yates Well Road' northbound left/right approach	26	A	7	A	269	A	7	A
I-15 southbound ramps at Yates Well Road; westbound left/through approach	8	A	7	A	24	A	3	A
I-15 southbound ramps at Yates Well Road; southbound left/through/right approach	26	A	3	A	253	A	248	A
I-15 northbound ramps at Yates Well Road; eastbound left/through approach	5	A	3	A	5	A	3	A
I-15 northbound ramps at Yates Well Road; northbound left/through/right approach	8	A	19	A	24	A	246	B

Source: BSE 2007A, page 5.12-11, Figure 5.12-3, and Figure 5.12-4; and CH2ML 2008a.

As indicated in **Traffic and Transportation Table 5**, all intersections would continue to operate at an acceptable level of service (LOS C or better) in the morning and afternoon peak hours with the addition of peak construction traffic. Construction traffic would result in a change to the level of service at the intersection of the I-15 northbound ramps and Yates Well Road from LOS A to LOS B during the PM peak hour. However this change would not be significant because it would be above LOS C.

Traffic and Transportation Table 6 includes information about the predicted change to critical road segment LOS levels during construction of the ISEGS. As indicated in the table, project-related construction traffic would not cause the LOS on project area roadway segments to decline. All roadway segments would continue to operate at LOS C or better.

Traffic and Transportation Table 6
Intersection LOS Analysis with Project Construction Traffic

Roadway Segment on Main Street	Capacity (vehicle/ day)	Existing			Construction Traffic (vehicle/day)	With Project		
		Volume (vehicle/ day)	V/C	LOS		Volume (vehicle/ day)	V/C	LOS
Colosseum Road	3,000	NA	NA	A	243	0.08	NA	A
Yates Well Road	6,000	249	0.04	A	243	492	0.08	A
I-15 NB & SB	72,000	59,690	0.83	C	243	59,933	0.83	C

Volume data for Colosseum Road a 2-lane dirt road is not maintained, however, based on field observation, this road is seldom used and is therefore assumed to operate at LOS A (BSE 2007A, p. 5.12-17).
Sources of capacity and volume data for Yates Well Road and I-15 are: TRB 2000, COSB 2007, and Caltrans 2007a, respectively.
V/C = volume-to-capacity ratio;
LOS = level of service

As indicated previously, northbound I-15 currently operates at LOS F on Friday afternoons. The proposed project would add 227 vehicles during construction to northbound I-15 on Friday afternoons, a time at which traffic on this road is already highly congested. Because of the high volume of existing vehicle traffic on this roadway at this time, the addition of project traffic would exacerbate existing congestion on I-15, particularly in the area of Yates Well Road. Therefore, project traffic would cause an increase in traffic, which is substantial in relation to the existing traffic load and capacity of I-15.

Because northbound I-15 is already highly congested on Friday afternoons, and project-related construction traffic would exacerbate congestion in the area of Yates Well Road, project impacts on northbound I-15 on Fridays are considered significant (BSE 2007A, p. 5.12-16). To limit the proposed project's contribution to existing congestion on northbound I-15 on Friday afternoons, staff has proposed Condition of Certification **TRANS-1**, which would require development and Energy Commission staff approval of a traffic control plan that must include methods to substantially reduce the project's impact on I-15 traffic, such as staggering the departure of construction workers from the ISEGS site on Friday afternoons and/or establishing a carpool/vanpool incentive program. Staff believes that with proper implementation of the traffic control plan, project traffic accessing northbound I-15 from Yates Well Road would be distributed at sufficient intervals to reduce the congestive effect of project traffic along this segment of I-15 on Friday afternoons during construction to a less-than-significant level (i.e. fewer cars would be attempting to merge into congested I-15 traffic from the Yates Well Road on-ramp at any given time).

Regarding existing levels of service, the addition of 243 vehicle trips to Yates Well Road would not result in a significant impact. However, because this road is primarily traveled by recreationists--people traveling to the Primm Valley Golf Club and to desert recreation activities such as photography, off-highway vehicle riding, and so forth--proposed Condition of Certification **TRANS-1** also requires adequate signage along Yates Well Road as well as on the northbound and southbound I-15 off-ramps at Yates Well Road to alert travelers to the presence of construction vehicles.

Additionally, construction truck traffic could result in unexpected damage to Yates Well Road and I-15 freeway ramps. Therefore, staff is proposing Condition of Certification **TRANS-2** to require that any project construction-related damage to Yates Well Road or I-15 freeway ramps be repaired to their original condition, prior to the start of project construction.

Construction Workforce Parking and Laydown Area

The approximately 231 vehicles used to transport workers to the proposed project site during the peak construction period would park onsite. Private vehicles and busses would be parked at the approximately 377-acre laydown area at the project site (BSE 2007A, p.5.12-17; CH2ML 2008b, p.5-1). Although the precise number of available parking spaces is unknown, using a conservative assumption of 12 feet by 25 feet of area for one parking space, the applicant would need an approximate area of at least 69,300 square feet (1.5 acres) to accommodate 192 private vehicles and 39 busses. The 377-acre laydown are would be more than adequate to park 231 vehicles.

Hazards Due to a Street Design Feature

Primary access to the ISEGS site would be from Colosseum Road, which runs through the Ivanpah 2 site. However, prior to construction, this road would be realigned to run between Ivanpah 1 and Ivanpah 2 (BSE 2007A, p.5.12-17). The project site is comprised of mostly vacant desert land except for Colosseum Road and the electrical transmission line that traverses the site.

Most of the land surrounding the project site is unimproved with the exception of the two-lane unpaved Colosseum Road located adjacent to the site and the electrical transmission line (these features are located both on and adjacent to the project site). The entrance to the ISEGS site would be graded to dimensions to accommodate construction trucks; therefore, no impacts are expected to occur as a result of a street design feature.

Linear Facilities

The proposed project would use potable water from wells located at the northwest corner of the Ivanpah 1 site. Fire suppression water would be stored onsite in a raw water tank reserved for that purpose at each of the three power plants (CH2ML2009f).

All process wastewater is recycled in the system. Sanitary wastewater would be discharged into a septic system within the logistics area for the administration, operations and maintenance buildings. Portable toilets would be used at each of the three power plants. Therefore, because all water and wastewater pipelines would be constructed within the boundaries of the proposed ISEGS development, there would not be any traffic and transportation impacts resulting from these project linear facilities (CH2ML2009f).

Natural gas would be supplied to the site through a new six-mile long distribution pipeline that would run along the perimeter of the Ivanpah 3 and Ivanpah 2 sites. The line would cross Colosseum Road. Additionally, an approximately 1.6-mile segment of this roadway would be rerouted through the project site CH2ML2009f. Construction activities related to pipeline construction and rerouting would temporarily preclude public

use of Colosseum Road. The County of San Bernardino does not have any traffic counts (COSB 2007) for this unpaved rural portion of Colosseum Road, which connects Yates Well Road to other unpaved rural roads. Traffic on this road has been observed by staff to be extremely low to nonexistent; however, Colosseum Road can experience higher volume traffic for various recreation events and activities that occur in the vicinity. However, measures included in Condition of Certification **TRANS-1**, would require that traffic on this roadway be rerouted through the use of detours to ensure continuous access to the areas serviced by Colosseum Road.

Ivanpah 1, 2, and 3 would be interconnected to the grid through a new Ivanpah Substation utilizing 115-kV generation tie lines within the ISEGS development. The project would include a 220-kV upgrade to Southern California Edison's existing 115-kV line passing through the site on a northeast-southwest right-of-way over a 36-mile section from the new Ivanpah Substation to the existing Eldorado Substation in Nevada. Ivanpah 1 would be connected to the substation with a 5,800-foot-long line; Ivanpah 2, through the substation with a 3,900-foot-long line; and Ivanpah 3 would be connected through the substation with a 14,100-foot-long line. Construction of the new Ivanpah Substation and the generation tie lines would all be within the ISEGS development and the upgrade to SCE's transmission line would be within the existing transmission right-of-way. Therefore, transmission line interconnection and upgrades would not require public road closure and would not affect traffic (CH2ML2009f).

The proposed Ivanpah Substation would also require that new telecommunication infrastructure be installed to provide protective relay circuit and a supervisory control and data acquisition (SCADA) circuit, together with data and telephone services. The telecommunication path from Ivanpah Substation to the local carrier facility interface at Mountain Pass area consists of approximately eight miles of fiber optic cable to be installed overhead on existing poles and through new underground conduits to be constructed in the substation and telecom carrier interface point. This fiber optic route consists of two segments. The first segment is from Ivanpah Substation to Mountain Pass Substation using the existing Nipton 33-kV distribution line poles built along the transmission line corridor that crosses between Ivanpah 1 and 2. The second segment is from Mountain Pass Substation to the telecommunications facility approximately 1.5 miles away at an interface point to be designated by the local telecommunication carrier. The fiber cable would be installed on the existing 12-kV distribution line poles. The construction of the telecommunication facilities within existing right-of-way of the distribution lines would not affect traffic (CH2ML2009f).

Proposed Project - Operation Impacts and Mitigation

Operation Workforce Traffic

The operational phase of the proposed project would require 90 employee commutes, or 180 daily trips. Thirty employees are required for the daytime shift. The remaining 60 employees work on the night time shift and would not travel during the peak hours (BSE 2007A, p.5.12-17). However, it is assumed that the daytime workforce of 30 would travel from the Las Vegas area during the AM peak hours and to the Las Vegas area during the PM peak hours.

Thirty operational trips added to I-15 during peak hours would not represent a substantial increase in traffic volume and would not result in a significant impact Monday through Thursday. However, as indicated previously, northbound I-15 operates at LOS F on Friday afternoons and into the late evening. The number of project-related vehicles added to northbound I-15 on Friday afternoons would be minor compared to the number of vehicles traveling on northbound I-15 during the same time. However, because the project would exacerbate existing congestion on I-15 in the area of Yates Well Road, project impacts on northbound I-15 on Friday afternoons are considered significant. To limit the proposed project's contribution to existing congestion on northbound I-15 on Friday afternoons, staff has proposed Condition of Certification **TRANS-1**, which would require development and Energy Commission staff approval of a traffic control plan that must include methods to substantially reduce the project's impact on traffic on I-15, such as staggering the departure of operational employees from the ISEGS site on Friday afternoons and/or establishing a carpool/vanpool incentive program.

Condition of Certification **TRANS-1** would reduce the impact from project operation-related traffic on northbound I-15 to a less-than-significant level. Staff consulted with Dan Kopulsky of Caltrans District 8 on the content of staff's proposed Condition of Certification **TRANS-1**, and Mr. Kopulsky indicated that although the addition of any project-related trips would be considered adverse, with the expected vehicle reductions from implementation of Condition of Certification **TRANS-1**, these impacts would be less than significant (Kopulsky 2008).

Operational employees would park in a parking lot provided at Ivanpah 1. The onsite parking is expected to be large enough to accommodate at least 60 vehicles, therefore, operation of the ISEGS is not expected to result in an inadequate parking capacity.

Proposed Project - Glare

Glare is defined as difficulty seeing in the presence of bright light such as direct or reflected sunlight or other light. Glare is caused by a substantial ratio of luminance (brightness) between a field of view and the glare source. Because the proposed project involves the use of mirrors to direct reflected sunlight at power tower receivers, the potential exists for glare to be observed by motorists on adjacent roadways and aircraft pilots. The analysis below addresses two different aspects of glare from sunlight:

1. energy in consideration of human safety from the energy intensity that could be potentially absorbed by the retina, or in other words, the potential for light to result in damage to the retina as evaluated in units of kilowatts per square meter (kw/m^2); and

2. luminance or brightness perceived by observers as evaluated in units of candelas per square meter (cd/m^2).

Energy and Safety

There are currently no regulations specific to light reflected from solar plants, however, potential safety effects of solar radiation from the proposed project have been analyzed within the context of principles and procedures developed for beam safety in the Solar 1 experimental plant at Daggett, California, as conducted by the Sandia National

Laboratories (Sandia Report SAND83-8035 by T.D. Brumleve), which identified the following maximum permissible exposure (MPE) limits for reflected sunlight:

- MPE for momentary exposure (for a period of 0.25 second or less) is 10 kw/m^2
- MPE for continuous exposure (for a period greater than 0.25 second) is 1 kw/m^2 (LIA 2009)

Heliostat Energy and Safety

With regard to heliostat safety, the highest intensity of solar radiation that could be directly reflected from a single heliostat would occur at its focal distance of 500 meters and would be 3.125 kw/m^2 (CH2ML 2008a). Because this level of solar radiation is well below the MPE for momentary exposure of 10 kw/m^2, an observer, such as a motorist or pilot, would not experience retinal injury in the event of sunlight being directed away from the power tower receiver and reflected towards an observer as a momentary exposure. However, this solar radiation would exceed the MPE for continuous exposure of 1 kw/m^2, and the potential would exist for a person to experience injury if he or she stared directly into the reflected solar radiation without blinking or looking away.

It is important to note that the intensity of reflected light and solar radiation substantially diminishes as distance from the source increases. For example, at 1,000 meters from the heliostat, the highest intensity of solar radiation would be less than 1 kw/m^2 (CH2ML 2008a). Locations where an observer could potentially be exposed to solar radiation above the 1 kw/m^2 MPE for continuous exposure (should the heliostat(s) be directed to cause such an effect) would be from low-altitude aircraft passing over the project or when an observer is on foot or in a vehicle, in both cases within 1,000 meters of one or more heliostats.

During daylight hours, the heliostats would normally pivot within the range of the stowed position (mirrors facing vertically upwards) to the track position (various angles ranging from facing horizontally to nearly vertical). At night, the heliostats would normally be maintained in the stowed position. Approximately every 2 weeks, the heliostat would pivot from the stowed position to the wash position for night-time mirror washing (mirrors facing horizontally). Daily positioning of the heliostats would occur as follows:

1. At dawn, when likely all heliostats would be moved from stowed to track position to begin reflecting solar energy to the receiver/boiler;

2. During mid-day, when some heliostats would be returned to the stowed position to not exceed solar energy capacity limits of the receiver/boiler;

3. During late-afternoon or evening, when the stowed heliostats would be returned to track position to increase solar energy directed to the receiver/boiler as the sun's position begins to lower in the western horizon and be less optimal for energy production;

4. At nightfall, when all heliostats would be returned to the stowed position or to the wash position for mirror washing at a frequency of about once every two weeks.

The aiming control system of the heliostats uses optimization software to instruct the solar field controller where each heliostat should aim to maximize solar energy collection and output. The software accounts for the light flux intensity and distribution required for the four faces of the receiver/boiler and various other conditions such as sun radiation, wind, air pressure, and the number of heliostats available for tracking. When computing the optimal aiming policy, the control system factors in the differences between heliostats with respect to their tracking accuracy, the intensity of the beam they reflect, the shape of the beam and other relevant aspects. The applicant has indicated that the optimization software would also prevent the mirrors from being aimed toward the freeway or the Primm Valley Golf Course at an angle that would reflect sunlight near the ground surface (CH2ML 2009f).

Assuming all mirrors are returned to the stowed position (facing vertically upwards) before dawn, staff has identified three circumstances under which an observer could potentially be exposed to reflected solar radiation from one or more heliostats, including:

1. **Energy Capacity Regulation**. During mid-day, when some heliostats would be returned to the stowed position to avoid exceeding the solar energy capacity limits of the receiver/boiler, which would result in the potential for sunlight to be reflected upward at angles that could be observed by pilots of aircraft flying over or past the site. Depending on the time of day at which a mirror is in the stow position and the orientation of the mirror, solar radiation could be reflected toward offsite site observers on roadways, in the airspace above the site, or at elevated positions on the ground (such as in foothills near the site);

2. **Technical Malfunction**. Solar radiation could be reflected offsite as a result of a technical malfunction if the mirror position was such that it would reflect sunlight toward an observer;

3. **Maintenance**. During day-time maintenance if the heliostat was moved from the stowed to the wash position and passed momentarily through a position that would reflect sunlight to an observer;

Staff expects that for all of the scenarios described above, in most cases, exposure to solar radiation reflected from heliostats would be momentary because the observers would most likely be in motion—traveling either by vehicle or aircraft. The applicant has indicated that in the event that a heliostat was not aimed at the receiver/boiler, never would more than one heliostat be aimed at a single location or angle in the sky (CH2ML2009w). Circumstances when an observer at ground level may not be in motion and could be exposed to longer than momentary (continuous) reflection could occur when hikers are in the Clark Mountains, motorists on I-15 are stationary or moving slowly in congested traffic such as during Friday afternoons and evenings, or if an observer is hiking or on a local road in the vicinity of the project and within 1,000 meters. Should any of these potential exposure conditions occur at ground level, this reflected solar radiation would not be expected to exceed the MPE for continuous exposure of 1 kw/m^2, for hikers in the Clark Mountains and motorists on I-15, because they would be beyond 1,000 meters from the heliostat. If observers were on-foot or in a vehicle within 1,000 meters of heliostats that were misdirected, then they could be exposed to reflected solar radiation exceeding the MPE for continuous exposure. While

the brightness of light reflected from heliostats would likely cause observers to avoid looking directly into the light for longer than a fraction of a second, it is not conclusive to staff that personal reaction to bright light would adequately mitigate this risk of exposure that could cause retinal injury to one's eyes.

Circumstances when a viewer from an aircraft could be exposed to continuous reflected solar radiation at a level exceeding the continuous MPE threshold could occur when an aircraft is within 1,000 meters altitude above the heliostats and the solar radiation from a number of heliostats created a continuum of reflection in the sky, such as could occur with adjacent rows of heliostats all turned to the stowed position. Aircraft could fly as low as 1,350' (411 meters) above the ground surface, and thus there is potential for exceeding the threshold for continuous exposure. While the brightness of light reflected from heliostats would likely cause observers to avoid looking directly into the light for longer than a fraction of a second, like the potential exposure to observers on the ground, it is not conclusive to staff for observers in aircraft that personal reaction to bright light would adequately mitigate this risk of exposure that could cause retinal injury to one's eyes. In consideration of potential harmful and/or distractive exposure to observers on the ground and airborne and existing military flight paths and those planned with the development of the Southern Nevada Supplemental Airport near Jean, Nevada which would have flight paths over and near the ISEGS site, staff recommends mitigation to reduce the risk of exposure to light reflected from heliostats. Recommended Condition of Certification **TRANS-3** would require the applicant to prepare a Heliostat Positioning Plan that would accomplish the following:

1. Recognize potential sensitive receptors including observers in aircraft, motorists on I-15, hikers in the Clark Mountains and other hikers and motorists who could access locations closer to the project;

2. Identify the heliostat movements and positions that could result in reflected solar radiation from heliostats to be observed by these receptors;

3. Propose a Heliostat Operating Plan that would avoid potential for human health and safety hazards at locations of sensitive receptors including the potential for momentary and continuous solar radiation exposure to occur greater than the thresholds of significance of:

   a. MPE for momentary exposure (for a period of 0.25 second or less) is 10 kw/m^2

   b. MPE for continuous exposure (for a period greater than 0.25 second) is 1 kw/m^2

4. Develop a monitoring plan to verify any ISEGS operational impacts are less than significant, and if impacts are found or reported, that they are investigated and appropriate mitigation proposed and implemented. The monitoring plan should log, investigate and respond to complaints regarding glare.

5. The monitoring plan should be coordinated with the FAA, U.S. Department of the Navy, CalTrans, and Clark County Department of Aviation in relation to the proposed Southern Nevada Supplemental Airport and be updated on an annual basis for the first 5 years, and at 2-year intervals thereafter for the life of the project.

Power Tower Receiver

With regard to power tower receiver safety, the highest intensity of solar radiation expected to be reflected from a single power tower receiver at its surface would be as high as 688 kw/m^2. However, as noted above, the intensity of reflected light and solar radiation diminishes as distance from the source increases. Each tower on which each power tower receiver would be installed would be approximately 140 meters tall (459 feet). Each power tower receiver would be approximately 20 meters high, therefore the bottom of each power tower receiver would be located approximately 120 meters (394 feet) from the ground surface. As shown below in **Traffic and Transportation Table 7**, the intensity of energy reflected from the power tower receiver as experienced at the ground surface (120 meters below) would be approximately 0.048, which is well below the 10 kw/m^2 and 1 kw/m^2 MPEs for momentary and continuous exposure, respectively. Therefore, solar radiation reflected from project power tower receivers is not expected to pose a health and safety hazard to motorists on adjacent roadways, as they would be located even farther from the light source and would experience even lower levels of solar radiation. Additionally, with implementation of condition of certification **TRANS-6**, as described below under hazards to Hazards to Air Navigation, aircraft flying over the project site would be required to fly at least 1,350 feet (411 meters) above the ground surface, which would be approximately 900 feet (274 meters) above the power tower receiver. Therefore, as shown in **Traffic and Transportation Table 7**, the intensity of solar radiation expected to be experienced by pilots flying over the project site attributable to the power tower receivers would be approximately 0.009 kw/m^2, which is well below the MPEs for momentary and continuous exposure. Therefore, solar radiation reflected from project power tower receivers is not expected to pose a health and safety hazard to pilots or passengers in aircraft flying over the site.

Traffic and Transportation Table 7
Energy Reflected from ISEGS Power Tower Receivers

Distance from Receiver		Intensity of Reflected Light	
Meters	**Feet**	**w/m^2**	**kw/m^2**
1	3.3	687,550	687.5
5	16.4	27,502	27.5
10	32.8	6,875	6.88
50	164	275	0.28
100	328	68.8	0.069
120	393	47.8	0.048
140	459	35.1	0.035
150	492	30.6	0.031
200	656	17.2	0.017
250	820	11.0	0.011
274	900	9.2	0.009
500	1,640	2.8	0.003
1,000	3,280	0.69	0.0007

Calculations based on information presented in CH2ML 2009a, CH2ML 2009b.

Luminance and Brightness

There are currently no regulations that are directly applicable to brightness from facilities such as solar plants, however, the Illuminating Engineering Society of North America Recommended Practice for Roadway Sign Lighting includes standards for

lighting of roadway signs. The recommended maintained level of lighted roadway signs is 44 to 89 cd/m^2 (IESNA, 2001). With regard to aircraft pilots, the FAA does not evaluate the potential for glare from proposed projects to affect aircraft (FAA, 2009).

The luminance of several common objects is provided in **Traffic and Transportation Table 8** for reference.

Traffic and Transportation Table 8
Luminance of Common Objects

Object	Luminance (cd/m²)
Sun	1.6 billion
100-watt lamp	47,000
Compact fluorescent lamp	30,000
Candle flame	10,000
Daylight sky	8,000
Moonlight	2,500

The brightness of reflected light at the surface of a single heliostat would be approximately 1.34 billion cd/m^2 (CH2ML 2009c). Under operating conditions most heliostats would be positioned such that the light reflected from them would be concentrated directly at the power tower receivers. However, as discussed above, staff has identified three circumstances under which an observer could potentially be exposed to light reflected from one or more heliostats. These observers include pilots and passengers of aircraft flying over or near the site, motorists on I-15, hikers in the Clark Mountains and other hikers and motorists who could access locations closer to the project.

The highest intensity of luminance expected to be reflected from a single heliostat, at its surface, would be 1.34 billion cd/m^2 (CH2ML 2009b). In the event of heliostat repositioning or malfunction that resulted in sunlight being directed away from the power tower receiver and into the sky, the luminance of light reflected from a single heliostat as seen by an aircraft flying over the site at a distance of at least 370 meters would be as high as 35 million cd/m^2, or approximately 2% of the brightness of the sun. This level of brightness would be extremely bright and would be temporarily blinding when viewed directly. On one hand, staff could rationalize that the potential for glare from heliostats to pose a significant hazard to navigation of vehicles on adjacent roadways or air traffic flying above or adjacent to the site would not be significant, because:

- viewers of such glare would instinctively divert their eyes from the source;
- the duration of exposure may be very short because light would be reflected at a constant stationary angle and the viewer (motorist or pilot) would be traveling at a high rate of speed (the changing altitude of departing or arriving aircraft at the Southern Nevada Supplemental Airport would also severely limit the potential for any potential exposure to pilots); and

- glare that is bright enough to temporarily impair vision and cause viewers to look away is a common occurrence from other objects in the built and natural environment (such as lakes, building windows, and reflective surfaces such as mirrors and windows on other roadway vehicles).

However, it is not conclusive to staff that personal reaction to bright light would adequately mitigate this risk of exposure that could cause temporary blindness and compromise safety of an observer who may be responsible to navigate an aircraft or vehicle. Therefore, staff is recommending Condition of Certification **TRANS-3** that would require the applicant to prepare a Heliostat Positioning Plan in order to avoid the potential risk to human health and safety.

Brightness of light reflected at the surface of each power tower receiver would be approximately 555,000 cd/m^2 (CH2ML 2009b). As described above, the intensity of solar energy and brightness diminishes as distance from the source increases. As shown below in **Traffic and Transportation Table 9**, the intensity of brightness of light reflected from the power tower receivers at different distances from a power tower receiver. To provide a frame of reference, this table also includes the intensity of brightness of light produced by a 100-watt light bulb as viewed from different distances.

Traffic and Transportation Table 9
Brightness of Light Reflected from ISEGS Power Tower Receivers

Distance		Luminance (cd/m^2)	
Meters	**Feet**	**Receivers**	**100-watt Bulb**
1	3.3	555,000	47,000
5	16.4	22,200	1,880
10	32.8	5,550	470
35	115	453	38.4
50	164	222	18.8
100	328	55.5	4.70
120	394	38.54	3.26
140	459	28.32	2.40
150	492	24.67	2.09
200	656	13.88	1.18
250	820	8.88	0.75
274	899	7.39	0.63
500	1,640	2.22	0.19
1,000	3,281	0.56	0.047
1,448	4,751	0.26	0.02

Calculations based on information presented in CH2ML 2009a, CH2ML 2009b.

Roadway Traffic. As shown above and shown in **Traffic and Transportation Table 9**, the intensity of reflected light diminishes as distance from the source increases. Because the power tower receiver would be located approximately 120 meters (394 feet) from the ground surface, the intensity of brightness that would be experienced by receptors on the ground at the base of the tower would be approximately 38 cd/m^2. This level of brightness is below the standard range of 44 to 89 cd/m^2 for externally lighted roadway signs (as recommended in the Recommended Practice for Roadway Sign Lighting by the IESNA Sign Lighting Subcommittee) and is equivalent to the brightness of a 100-watt light bulb as viewed from a distance of 35 meters (115 feet). Therefore,

the brightness of reflected light from project power tower receivers is not expected to cause temporary blindness or cause retinal damage to motorists on adjacent roadways, as they would be located even farther from the light source and would experience even lower levels of reflected brightness. Specifically, the highest intensity luminance expected to be experienced by drivers on adjacent roadways, including Colosseum Road, Yates Well Road, and I-15 would be less than 38 cd/m^2, which is the same brightness experienced from viewing a 100-watt light bulb from a distance of 35 meters (115 feet).

While the brightness associated with the power tower receivers, and brightness associated with the heliostats if recommended mitigation Condition of Certification **TRANS-3** is implemented, would not cause temporary blindness or retinal damage to motorists or observers from aircraft, specular reflections from the heliostats and diffuse reflections associated with the receivers would certainly be bright enough, and in an unexpected location, so that some observers could be distracted in trying to identify their source. This is not likely to be a safety issue on Colosseum Road, where drivers could slow and stop, but may create a hazard on I-15 due to the high speed of vehicles on that roadway. Because the light reflected from seven 459-foot power towers and the potential reflections from heliostats would be a feature that is out of context in this mostly natural desert setting (with the exception of nearby casinos, commercial businesses, amusement facilities, and billboards), the potential level of distraction to motorists on I-15 is expected to be higher than that of other man-made features in the vicinity. Drivers would expect to see the sun setting or rising on the horizon, but they would not expect to see bright glare off tall towers or mirrors in the desert. Staff has recommended Condition of Certification **TRANS-4** to require verification after commercial operation that power tower receiver luminance does not exceed 89 cd/m^2 at the nearest receptor, to require monitoring over the life of the project to verify that the power tower receiver materials are maintained so as to not exceed this threshold, and to establish a process for complaint processing and resolution.

Air Traffic. With regard to air traffic, with implementation of condition of certification **TRANS-6** (as described below under hazards to Hazards to Air Navigation), aircraft flying over the project site would be required to fly at least 1,350 feet (411 meters) above the ground surface, which would be approximately 900 feet (274 meters) above the power tower receiver. Therefore, as shown in **Traffic and Transportation Table 9**, the brightness of light reflected from the power tower receivers expected to be experienced by pilots flying over the project site would be approximately 7.39 cd /m^2. This level of brightness is equivalent to that of a 100-watt light bulb as viewed from a distance of 80 meters (262 feet). Therefore, brightness of reflected light from project power tower receivers is not expected to pose a safety hazard to pilots of aircraft flying over the site.

The Applicant has provided data and analysis with respect to the expected intensity of energy and luminance of reflected light from the ISEGS project and staff has independently verified the accuracy of the calculations provided and does not disagree with the assumptions provided. However, because of the technology proposed at the ISEGS site is relatively new and has never been implemented at this scale, staff has proposed Condition of Certification **TRANS-4** to ensure that upon operation of the ISEGS, that brightness would not result in a safety hazard to motorists on nearby

roadways and pilots of aircraft flying over the site. **TRANS-4** would require measurements to verify luminance does not exceed 89 cd/m^2 at any of the nearest roads and power plant boundaries to each north, south, east and west face of each power tower for Ivanpah 1, 2 and 3 power plants. Measurements at these locations would verify that public exposure to brightness of light reflected from the power towers does not exceed the established limit as applicable to motorists.

Proposed Project Hazards to Air Navigation

Obstruction Hazards. FAA Regulations, Part 77, Section 77.13(a)(1), require that objects greater than 200 feet tall from the ground surface constructed within three miles of an airport with a runway of more than 3,200 feet in length may present an obstruction hazard to aircraft. Furthermore, obstruction standards presented in 14 CFR 77.25 affecting navigable air space state that an object may present a hazard to air navigation if it penetrates the horizontal departure surface from a distance of 10,000 feet at a slope of 50 to 1 with an additional 40,000 feet at a slope of 40 to 1. The ISEGS would require construction of seven power towers to a height of 469 feet above the ground surface.

No existing airports are located within three miles of the proposed project site. However, one runway of the proposed Southern Nevada Supplemental Airport, that if constructed would be located northeast of ISEGS, is proposed to be located approximately 40,000 feet from the ISEGS site. Therefore, in May 2008, the applicant submitted FAA Form 7460-1 (Notice of Proposed Construction or Alteration) to the FAA. **Traffic and Transportation Table 11** includes information about FAA's review of project towers.

Traffic and Transportation Table 10
Status of FAA Review of Form 7460-1

Tower Number	Location	Aeronautical Study No.[1]	FAA Determination
Power Tower 1	Ivanpah 1	2008-AWP-3209-OE	No Hazard to Navigation
Power Tower 2	Ivanpah 2	2008-AWP-3210-OE	No Hazard to Navigation
Power Tower 3	Ivanpah 3	2008-AWP-3211-OE	No Hazard to Navigation
Power Tower 4	Ivanpah 3	2008-AWP-3212-OE	No Hazard to Navigation
Power Tower 5	Ivanpah 3	2008-AWP-3213-OE	No Hazard to Navigation
Power Tower 6	Ivanpah 3	2008-AWP-3214-OE	No Hazard to Navigation
Power Tower 7	Ivanpah 3	2008-AWP-3215-OE	No Hazard to Navigation

1 Source: Determinations downloaded from https://www.oeaaa.faa.gov/oeaaa/external/portal.jsp, accessed September 9, 2008.
2 Determination is based upon standardized, non-project specific analysis. Applicant has requested that the FAA initiate project specific analysis (CH2ML 2008a).

As included in **Traffic and Transportation Table 10,** the FAA has determined that none of the seven towers would present a hazard to navigation to aircraft from the proposed Southern Nevada Supplemental Airport. Although Power Tower 1 received a determination of no hazard to navigation, it was identified to be within the flight path of Instrument Route 213 (IR-213), a U.S. Navy training flight route (FAA 2008a). However, the U.S. Navy has confirmed that construction of Power Tower 1 would not impose a significant impact to IR-213, and that the Department of the Navy has no objection to the construction (Thompson 2008).

The FAA Determination for each tower includes a recommendation that each tower be marked and/or lighted in accordance with FAA Advisory circular 70/7460-1 K. To ensure that each tower is marked with appropriate lighting, staff has proposed Condition of Certification **TRANS-5.** Condition of Certification **TRANS-5** requires the applicant to implement all FAA recommendations regarding structure lighting for Power Towers 1 through 7. .

Thermal Plumes

When the ISEGS is operating, heat exhaust from the air cooled condensers (ACCs) would have the potential to cause turbulence to low flying aircraft. The intensity of turbulence produced by an ACC is a function of wind speed, solar radiation, and ambient temperature and would therefore vary depending on these conditions. Turbulence intensity would peak during calm or low wind conditions and would not occur at night when the ACC is not in operation. The thermal radiation from the collector tower would be a small fraction of the magnitude of the thermal exhaust from the ACC and it is not considered to provide a thermal source of enough intensity to cause noticeable thermal turbulence impacts to low flying aircraft.

A small aircraft would be subject to potential disruption (i.e. turbulence) from a thermal plume with an average plume velocity of 4.3 m/s or higher (CASA 2004), where the peak velocity is twice the calculated plume average velocity. The velocity of thermal plumes generated by the air cooled condensers at the ISEGS site was calculated based on equations presented in a technical paper (Best 2003) to estimate the worst-case plume vertical velocities. The worst-case ACC operating conditions for the three ACCs were derived from heat balance data available in the AFC (BSE 2007a) and other operating variables (exhaust velocity/temperature increase) are based on staff's experience from other projects. The peak height for thermal plume average velocities of 4.3 m/s for the 200 MW generating area ACC at Ivanpah 3 and the 100 MW generating area ACCs at Ivanpah 1 and 2 would be approximately 1,350 feet and 900 feet, respectively. Therefore, aircraft flying directly over the Ivanpah 3 ACC would have the potential to experience turbulence at an altitude of 1,350 feet or less and aircraft flying directly over either of the Ivanpah 1 or 2 ACCs would have the potential to experience turbulence at an altitude of 900 feet or less.

To ensure that thermal plumes associated with ISEGS operation do not impact aviation activities within the navigable airspace above the site, staff proposes Condition of Certification **TRANS-6** be implemented. This condition would require the applicant to coordinate with the FAA to: 1) notify all pilots using the airspace above ISEGS of potential turbulence from thermal plumes, 2) update all applicable airspace charts to indicate that plume hazards could exist up to an altitude of 1,350 feet above the ground surface, and 3) require pilots to avoid direct overflight of the ISEGS site at or below this altitude during daylight hours.

Therefore, because implementation of this measure would ensure pilots using the airspace above the ISEGS site would be notified to avoid direct overflight of the ISEGS site at or below 1,350 feet during daylight hours this impact would be less than significant.

Proposed Project - Emergency Services Vehicle Access

The San Bernardino County Fire Department (SBCFD) Station No. 53 in Baker, CA would provide service to the proposed project site. Station No. 53 is located approximately 45 miles from the project site and is staffed by three personnel including a full-time Captain and two paid-call firefighters (PCFs), who are supported as needed by other PCFs who live in the local area (SBCFD 2008).

In the event of an emergency at the proposed project site, emergency vehicles would enter the project site via Colosseum Road. Based on the proposed site plan, staff believes emergency services vehicle access is adequate.

Proposed Project - Transportation of Hazardous Materials

Operation of the ISEGS would result in transportation of hazardous materials. Staff has addressed this issue in the **Hazardous Materials Management** section of this FSA/DEIS. As presented in that section, staff believes that during construction and operation of ISEGS, minimal amounts and types of hazardous materials (paint, cleaners, solvents, gasoline, diesel fuel, motor oil, lubricants, 20 percent sulfuric acid, 30% sodium hydroxide, and welding gases in standard-sized cylinders) do not pose a significant risk of either spills or public impacts along any transportation route. Staff therefore does not recommend a specific route.

Although the transportation and handling of hazardous materials can increase roadway hazard potential, impacts associated with the hazardous materials can be mitigated to a level of insignificance by compliance with existing federal and state standards established to regulate the transportation of hazardous substances. These standards constitute a comprehensive regulatory program whose purpose is to ensure the safety of hazardous materials transportation. Staff has assessed the efficacy of these standards and finds that they are successful in minimizing the risks associated with hazardous materials transportation. The applicant stated that delivery of hazardous materials will comply with Caltrans, California Highway Patrol (CHP), and California Vehicle Code (CVC) (BSE 2007A, p. 5.12-18).

Specific sections of the CVC and the California Streets and Highways Code ensure that the transportation and handling of hazardous materials is done in a manner that protects public safety. Enforcement of these statutes is under the jurisdiction of the CHP.

The California Department of Motor Vehicles specifically licenses all drivers who carry hazardous materials. Drivers are required to check weight limits and conduct periodic brake inspections. Commercial truck operators handling hazardous materials are required to take instruction in first aid and procedures on handling hazardous waste spills. Drivers transporting hazardous waste are required to carry a manifest, which is available for review by the CHP at inspection stations along major highways and interstates.

The applicant would be required to comply with all LORS governing the transport, storage, and use of hazardous materials. For a more detailed discussion on the

handling and disposal of hazardous substances, see the **Hazardous Materials Management** section of this FSA/DEIS.

Proposed Project - Closure and Decommissioning Impacts and Mitigation

Following the operational life of 50 years, the project owner would close and decommission the project. Closure of the ISEGS would require a number of worker vehicle trips and truck haul trips to dismantle and haul project infrastructure from the ISEGS site. While the number of workers is unknown at this point, the number of haul trips would likely be similar to that of construction of the project. It is also likely that due to expected growth and development in the project area and in Las Vegas, that the level of service on I-15 would be lower than current conditions. As such, it is reasonable to expect that impacts to the local and regional and transportation system as a result of decommissioning of the ISEGS would be similar to those related to construction of the ISEGS. Specifically, vehicle and truck traffic related to decommissioning would like exacerbate existing congestion in I-15 on Friday afternoons, would substantially increase the volume of traffic on roadways and intersections in the vicinity of recreation resources, and would have the potential to result in unexpected damage to Yates Well Road and I-15 freeway ramps. However with implementation of measures similar to those identified in Conditions of Certification **TRANS-1** through **TRANS-5**, impacts would be expected to be less than significant.

NO PROJECT / NO ACTION ALTERNATIVE

In the No Project / No Action Alternative, the proposed action would not be undertaken. The BLM land on which the project is proposed would continue to be managed within BLM's framework of a program of multiple use and sustained yield, and the maintenance of environmental quality [43 U.S.C. 1781 (b)] in conformance with applicable statutes, regulations, policy and land use plan.

The results of the No Project / No Action Alternative would be the following:

- The impacts of the proposed project would not occur. However, the land on which the project is proposed would become available to other uses that are consistent with BLM's land use plan, including another solar project.
- The benefits of the proposed project in reducing greenhouse gas emissions from gas-fired generation would not occur. Both State and Federal law support the increased use of renewable power generation.

If this project is not approved, renewable projects would likely be developed on other sites in the Mojave Desert or in adjacent states as developers strive to provide renewable power that complies with utility requirements and State/Federal mandates. For example, there are three large solar projects proposed on BLM land in Nevada within a few miles of the Ivanpah site. In addition, as of August 2009 there were 66 applications for solar projects covering 611,692 acres pending with BLM in the California Desert District. The No Project/No Action Alternative would not cause any significant impacts to Traffic and Transportation.

CUMULATIVE IMPACTS AND MITIGATION

A project may result in a significant adverse cumulative impact where its effects are cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects (California Code Regulation, Title 14, section 15130). NEPA states that cumulative effects can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR §1508.7).

There is the potential for substantial future development in the Ivanpah Valley area and throughout the southern California desert region. Analysis of cumulative impacts is based on data provided in the following maps and tables which are contained in the **Cumulative Scenario** section of this document.

- Cumulative Impacts Figure 1, Regional Renewable Applications
- Cumulative Impacts Figure 2, Regional Renewable Applications (Detail)
- Cumulative Impacts Figure 3, Ivanpah Valley Existing and Future/Foreseeable Projects
- Cumulative Impacts Table 1, Regional Renewable Energy Projects
- Cumulative Impacts Table 2, Existing Development in the Ivanpah Valley
- Cumulative Impacts Table 3, Future Foreseeable Projects in the Ivanpah Valley Area.

The analysis in this section first defines the geographic area over which cumulative impacts to traffic and transportation could occur. The cumulative impact analysis itself describes the potential for cumulative impacts to occur as a result of implementation of the ISEGS project along with the listed local and regional projects.

Geographic Extent

Cumulative impacts can occur if implementation of the ISEGS project could combine with those of other local or regional projects. Cumulative impacts would occur locally if ISEGS project impacts combined with impacts of projects located within the Ivanpah Valley. Cumulative impacts could also occur as a result of development of some of the many proposed solar and wind development projects that have been or are expected to be under consideration by the BLM and the Energy Commission in the near future. Many of these projects are located within the California Desert Conservation Area, as well as on BLM land in Nevada and Arizona.

Cumulative impacts could occur to both the local roadway network and the regional roadway network. Local impacts are impacts that would occur to the transportation system in the immediate vicinity of the project site, such as damage to local roadways, traffic delays due to road closures, and increased congestion from project-related traffic. Cumulative impacts to the local roadway network would occur if project impacts combined with impacts of projects located within the same general vicinity of the ISEGS

site. Therefore, the analysis of cumulative traffic and transportation impacts is evaluated for the local roadway network, defined as the area up to two miles from the ISEGS project site.

Cumulative impacts could also affect the regional roadway network, based on potential impacts that would occur to I-15. Primary access to the project site would be provided via I-15, which is an interstate highway that connects Los Angeles, California to Las Vegas, Nevada, as well as California to Nevada, Utah, Idaho, and Montana. Existing traffic on I-15 is mostly attributable to commuter, commercial, and tourist traffic that originates from well beyond the project area, such as Las Vegas, Nevada; Barstow, California; Victorville, California; and Los Angeles, California. However, a comprehensive analysis of traffic generated by projects in such distant locations is beyond the scope of this analysis. Therefore, the geographic extent for the analysis of cumulative traffic and transportation impacts to the regional roadway network is defined as the area up to 30 miles from the project.

It should be noted that the geographic extent of regional cumulative impacts would not include currently proposed solar and wind projects located more than 30 miles from the ISEGS project site because the vast area over which these projects are spread and the different construction schedules would preclude the potential for traffic from these projects to combine to result in significant cumulative impacts.

Potential Environmental Impacts

Local Impacts

Construction related commuter traffic and equipment deliveries for the ISEGS project would generate up to 243 additional daily trips to roadways in the immediate vicinity of the site (Yates Well Road, Coliseum Road, and the I-15 (regional impacts to I-15 are discussed below) on- and off-ramps located at Yates Well Road) throughout the 48-month construction period. The addition of these trips to local roadways would result in less-than-significant impacts with respect to delays to local traffic, congestion, roadway hazards, and damage to roadways. Only one of the foreseeable projects presented on Cumulative Impacts Figure 3 and Table 3, the FirstSolar photovoltaic project, has the potential to add traffic to the same local roadways as the ISEGS project. Although the environmental review process has not yet begun for the FirstSolar photovoltaic project and there is currently no publicly available information regarding the potential construction schedule of this project, because construction of the ISEGS project would be ongoing for approximately four years, it is likely that there would be at least some overlap between the construction schedules of the two projects.

There is currently no available data regarding construction traffic of the proposed FirstSolar project, however, it is reasonable to assume that this project would require a level of workforce and equipment deliveries roughly equal to that of the ISEGS project. Due to the extremely low volume of traffic on Yates Well and Colosseum Roads, the combined effect of traffic from the ISEGS and FirstSolar projects would be unlikely to result in significant impacts related to congestion and level of service of these roadways. The combined effect of traffic from both projects would likely increase the potential for damage to these roadways; however, similar to Condition of Certification

TRANS-4, it is assumed that the FirstSolar project would be required to repair any damaged roadways attributable to the FirstSolar project. Therefore, impacts of the ISEGS project are not expected to combine with impacts from the FirstSolar photovoltaic project to result in significant cumulative impacts to local roadways.

Regional Impacts

Several projects presented on Cumulative Impacts Figure 3 and Table 3 with the potential to result in increased congestion on I-15 are located within 15 miles of the ISEGS project. Projects that have the potential to be under construction at the same time as the ISEGS are the Southern Nevada Supplemental Airport, the Desert Xpress Train, the I-15 Mountain Pass Truck Lane, the FirstSolar photovoltaic project, and the Caltrans Joint Port of Entry projects. Construction of each of these projects would result in increased vehicle trips on I-15. It is highly likely that some, if not all of these projects would result in additional vehicle trips on northbound I-15 on Friday afternoons. Additionally, because it is proposed to facilitate tourist travel to Las Vegas, operation of the Southern Nevada Supplemental Airport would likely result in a substantial increase in vehicle traffic on northbound I-15 on Friday afternoons.

I-15 currently operates at a congested level of service (LOS F) on Friday afternoons due to the high volume of commuter and tourist traffic traveling from California to Las Vegas, Nevada. Although implementation of **TRANS-1** would reduce the congestive effects of ISEGS-related traffic on I-15 at the Yates Well Road on-ramp, implementation of the project would still add an additional 227 vehicles to I-15 on Friday afternoons. The above referenced cumulative projects would also result in the addition of vehicles to northbound I-15 on Friday afternoons. While some projects would contribute a higher number of additional trips to I-15 than others, the combined effect of additional traffic from all of the identified cumulative projects would cause an increase in traffic, which is substantial in relation to the existing traffic load and capacity of I-15. The existing congestion on northbound I-15 on Friday afternoons would be exacerbated, and is therefore considered to be a significant cumulative impact. No additional mitigation measures are available to reduce the ISEGS project's contribution to this impact to less than considerable.

It should be emphasized that the significant cumulative impact identified above is the result of the *combined effects* of existing conditions, ISEGS traffic, and traffic from the cumulative projects listed above (Southern Nevada Supplemental Airport, the Desert Xpress Train, the I-15 Mountain Pass Truck Lane, the FirstSolar photovoltaic project) throughout the 30-mile geographic extent of cumulative impacts; whereas the direct ISEGS project impact identified in the Direct/Indirect Impacts section of this Staff Assessment only considers the effect of ISEGS traffic on existing conditions in the immediate vicinity of the proposed project. This cumulative effect is related to increased traffic and public safety concerns resulting from the combined congestive effect to northbound traffic on Friday afternoons.

The Applicant indicated that "other published reports" indicate that traffic on I-15 peaks at midnight on Friday and again noon on Saturday and suggested that if this is true, then dayshift traffic leaving project site would not contribute adversely to the most congested peak period. The Applicant also noted that it is important to consider that the peak

condition is seasonal, with the greatest impact in August and much less in January. The Applicant concluded that "when the LOS condition is accurately described, the LOS condition on eastbound I-15 at 5:00 p.m. on Friday may not be "F" for most, if not all of the year".

It should be noted that the "other published report" cited by the Applicant's is dated 1999. Per industry standards, impact analysis is conducted in consideration of the most recently available data. Traffic volumes cited in this FSA/DEIS were collected in 2006 and 2007 and are considered to be more representative of current conditions than data from 1999. Furthermore, the applicant has acknowledged in its AFC that I-15 operates at LOS F on Friday afternoons, at which time proposed construction activities would conclude and when construction workers would begin commuting from the project site. Therefore, according to data prepared by the Applicant and verified by Caltrans, proposed project construction would result in the addition of traffic trips to a roadway at a time that the roadway operates at LOS F.

With regard to seasonal traffic flows, the analysis presented in the FSA/DEIS represents a "worst-case" scenario to ensure that impacts are not understated. For example, although the number of construction workers traveling to the project site would fluctuate throughout the overall construction period, the analysis addressed the number of workers that would travel to the site during peak construction. Similarly, while I-15 may not operate at LOS F every Friday of the year, according to the 2007 Annual Traffic Report prepared by the Nevada Department of Transportation (NDOT, 2007), traffic volumes on I-15 in the vicinity of the California / Nevada state line exceeded the annual average daily traffic from April through August, and exceeded 94% of the annual average daily traffic volume in February, March, September, November and December. Therefore, although northbound I-15 may not operate at LOS F every Friday of the year, it is reasonable to assume that it operates at LOS F on most Fridays.

Cumulative Impacts Conclusion

Traffic and transportation impacts of the ISEGS project would not combine with impacts of any past, present, or reasonably foreseeable projects to result in cumulatively considerable impacts to local streets in the immediate vicinity of the ISEGS project site. However, traffic and transportation impacts of the ISEGS project would combine with impacts of past, present, or reasonably foreseeable projects to result in cumulatively considerable local and regional impact to northbound I-15.

COMPLIANCE WITH LAWS, ORDINANCES, REGULATIONS, AND STANDARDS

Traffic and Transportation Table 8 provides a general description of applicable statutes, regulations, and standards adopted by the federal government, the State of California, and San Bernardino County pertaining to traffic and transportation with which the project is required to comply. Conditions of certification have been proposed to ensure project consistency with a law, ordinance, regulation, or standard where it was not already mandated by federal or state regulations.

Traffic and Transportation Table 8
Project Compliance with Adopted Traffic and Transportation LORS

Applicable Law	LORS Description and Project Compliance Assessment
Federal	
Code of Federal Regulations (CFR), Title 14, section 77 (14 CFR 77)	Includes standards for determining physical obstructions to navigable airspace. Sets forth requirements for notice to the Federal Aviation Administration of certain proposed construction or alteration. Also provides for aeronautical studies of obstructions to air navigation to determine their effect on the safe and efficient use of airspace (including temporary flight restrictions).
	The FAA has conducted aeronautical studies for all project structures which exceed 200 feet in height and has determined that construction of these structures, if properly lighted, would not present a hazard to aircraft. Implementation of Condition of Certification **TRANS-5** would ensure that that each power tower is marked and lighted according to the recommendations included in the FAA aeronautical study. Therefore the proposed project would comply with FAA regulations.
CFR, Title 49, Subtitle B	Includes procedures and regulations pertaining to interstate and intrastate transport (includes hazardous materials program procedures) and specifies safety measures for motor carriers and motor vehicles that operate on public highways.
	Enforcement is conducted by state and local law enforcement agencies and through state agency licensing and ministerial permitting (e.g., California Department of Motor Vehicles licensing, Caltrans permits), and/or local agency permitting.
State	
California Vehicle Code, Division 2, Chapter. 2.5; Div. 6, Chap. 7; Div. 13, Chap. 5; Div. 14.1, Chap. 1 & 2; Div. 14.8; Div. 15	Includes regulations pertaining to licensing, size, weight, and load of vehicles operated on highways; safe operation of vehicles; and the transportation of hazardous materials.
	Enforcement is provided by state and local law enforcement agencies and through ministerial state agency licensing and permitting and/or local agency permitting.
California Streets and Highway Code, Division 1 & 2, Chapter 3 & Chapter 5.5	Includes regulations for the care and protection of state and county highways and provisions for the issuance of written permits.
	Enforcement is provided by state and local law enforcement and through ministerial state agency licensing and permitting and/or local agency permitting.
Local	
SANBAG Regional Transportation Plan	Identifies public policies and strategies for the transportation system in the San Bernardino County region.
	Enforcement is provided by CHP, local law enforcement, and through ministerial state agency licensing and permitting and/or local agency permitting.
SANBAG Congestion Management Plan (CMP)	Requires maintenance of level of service (LOS) E or better on CMP segments.
	Although it would contribute to an existing LOS F condition on I-15 on Friday afternoons, the ISEGS project would not cause any CMP segment to exceed minimum LOS E standards.

San Bernardino General Plan	Establishes regional transportation objectives, policies, and implementation measures for various modes of transportation.
	Project construction and operation traffic would comply with the general plan because the project would not cause LOS to drop below the County of San Bernardino's minimum criteria of LOS C.
San Bernardino County Code Title 5 Division 1 Highway Permit	Addresses permitting issues for oversize/overweight vehicles.
	Enforcement is provided by CHP, local law enforcement, and through ministerial state agency licensing and permitting and/or local agency permitting.

NOTEWORTHY PUBLIC BENEFITS

Neither the applicant nor staff has identified any traffic-related benefits associated with the ISEGS.

RESPONSE TO AGENCY AND PUBLIC COMMENTS

Comments were provided verbally and in writing regarding the proposed ISEGS from agencies, organizations, and members of the public prior to and following the publication of the Preliminary Staff Assessment (PSA). The Clark County Department of Aviation provided comments on the **Traffic and Transportation** section of the PSA in their letter dated January 23, 2009. The comments and responses are presented in this section.

Clark County Comment 1: Department of Aviation (CCDOA 2009). Glare Impacts. The PSA states that the project could adversely affect aviation operations at the proposed Southern Nevada Supplemental Airport) due to glare from the solar thermal arrays. The potential for adverse impacts from glare could also adversely affect operations at the existing Jean Airport. CCDOA Strongly urges the Commission to study this issue in more detail with respect to both airports.

Response: As discussed in detail above under the heading Proposed Project Glare, staff has identified three circumstances under which observers could potentially be exposed to reflected solar radiation project heliostats. These observers include pilots of aircraft flying over or near the site, motorists on I-15, hikers in the Clark Mountains and other hikers and motorists who could access locations closer to the project. Additionally, nearby observers may also experience glare from light reflected from the power tower receivers.

With regard to heliostat safety, the highest intensity of solar radiation that could be directly reflected from a single heliostat would occur at its focal distance of 500 meters and would be 3.125 kw/m^2 (CH2ML 2008a). Because this level of solar radiation is well below the MPE for momentary exposure of 10 kw/m^2, there is still potential for an observer, such as a motorist or pilot, to experience retinal injury in the event of sunlight being directed away from the power tower receiver and reflected towards an observer as a continuous exposure. Staff expects that for all of the scenarios described above, in most cases, exposure to solar radiation reflected from heliostats could be momentary because the observers would most likely be in motion—traveling either by vehicle or

aircraft. While the brightness of light reflected from heliostats would likely cause observers to avoid looking directly into the light for longer than a fraction of a second, it is not conclusive to staff that personal reaction to bright light would adequately mitigate this risk of exposure that could cause retinal injury to one's eyes.

Therefore, to minimize the potential for such reflections to occur, Condition of Certification **TRANS-3** has been recommended to require the applicant to prepare a Heliostat Positioning Plan. This measure requires the project owner to identify the most likely scenarios under which heliostat movement would result in offsite glare and to develop a heliostat positioning plan that avoids or minimizes the potential for observers to be exposed to glare from heliostats that could cause temporary blindness or retinal damage to one's eyes.

The project also has the potential to result in glare from project power tower receivers. However, due to the distance that observers, such as pilots, motorists, and hikers, would be located from the receivers, the brightness of reflected light from project power tower receivers is not expected to pose a safety hazard to these observers. However, because the technology proposed at the ISEGS site is relatively new and has never been implemented at this scale, staff has proposed Condition of Certification **TRANS-4** to ensure that upon operation of the ISEGS, that brightness would not result in a safety hazard to motorists on nearby roadways and pilots of aircraft flying over the site.

Clark County Comment 2: Department of Aviation (CCDOA 2009). Thermal Effects. Thermal plumes from the ISEGS could create hazards to air navigation. The concentrated heat from the project may produce enough rising hot air to cause turbulence to overflying aircraft. This effect would impact the planned flight tracks to the Southern Nevada Supplemental Airport and would likely impact Visual Flight Rules (VFR) traffic in the area that currently tracks along the I-15 corridor en route to Jean Airport.

Response: As discussed above under Operation Impacts and Mitigation, aircraft would be subject to potential disruption (i.e. turbulence) from a thermal plume with an average plume velocity of 4.3 m/s or higher (CASA 2004), where the peak velocity is twice the calculated velocity. The peak height for thermal plume average velocities of 4.3 m/s for the Ivanpah 3 and Ivanpah 1 and 2 generating area ACCs would be approximately 1,350 feet and 900 feet, respectively. Therefore, aircraft flying directly over the Ivanpah 3 ACC would have the potential to experience turbulence at an altitude of 1,350 feet or less and aircraft flying directly over either the Ivanpah 1 or 2 ACCs would have the potential to experience turbulence at an altitude of 900 feet or less. As such, staff has recommend Condition of Certification **TRANS-6**, which would require the applicant to coordinate with the FAA to: 1) notify all pilots using the airspace above ISEGS of potential turbulence from thermal plumes, 2) update all applicable airspace charts to indicate that plume hazards could exist up to an altitude of 1,350 feet above the ground surface, and 3) require pilots to avoid direct overflight of the ISEGS site at or below this altitude during daylight hours.

Clark County Comment 3: Department of Aviation (CCDOA 2009). Military Training Routes. There are several military training routes in the vicinity. The ISEGS will clearly have an impact to these routes and any development must therefore be coordinated with the military.

Response: As discussed above under Operation Impacts and Mitigation, the FAA has determined that none of the seven towers would present a hazard to navigation to aircraft from the proposed Southern Nevada Supplemental Airport. Power Tower 1 was identified to be within the flight path of Instrument Route 213 (IR-213), a U.S. Navy training flight route (FAA 2008a). However, the U.S. Navy has confirmed that construction of Power Tower 1 would not impose a significant impact to IR-213, and that the Department of the Navy has no objection to the construction (Thompson 2008).

Clark County Comment 4: Department of Aviation (CCDOA 2009). Ivanpah Lands Act. The PSA omits mention of a critical federal law that contains several relevant obligations, specifically, the Ivanpah Valley Airport Public Lands Transfer Act (Public Law 1106-362, hereafter referred as the Ivanpah Lands Act). In accordance with this law, CCDOA prepared an Airspace Feasibility Study that was certified by the FAA Administrator. The Commission should examine the degree to which the proposed ISEGS facility conflicts or does not conflict with the Airspace Feasibility Study and with the FAA's statutory obligations to ensure VFR access to the Las Vegas Basin at a level that is equal to or better than existing access and to minimize impacts to the Mojave.

Response: The Ivanpah Lands Act is not directly applicable to the proposed ISEGS project. The Ivanpah Lands Act identifies several requirements that must be met by Clark County and the FAA prior to conveyance of certain Federal public lands in the Ivanpah Valley, Nevada, to Clark County, Nevada, for the development of an airport facility. Although the ISEGS project is proposed to be constructed on Federal lands, none of the lands involved in the project would be used for air traffic and are not subject to the Ivanpah Lands Act.

The Ivanpah Lands Act requires Clark County to identify any potential adverse effects on access to the Las Vegas Basin under visual flight rules that would result from the construction and operation of a commercial or primary airport, or both, on the land to be conveyed and that the FAA must certify that the assessment made by Clark County is thorough and that alternatives have been developed to address each adverse effect identified in the assessment, including alternatives that ensure access to the Las Vegas Basin under visual flight rules at a level that is equal to or better than existing access.

As the commentor notes, the Airspace Feasibility Study prepared by Clark County, which was certified by the FAA, indicated that the introduction of new traffic patterns would not adversely affect the flow of VFR traffic. As discussed above, under the discussion of hazards to navigation, the FAA evaluated the potential for the ISEGS project to result in obstruction hazards to air traffic from the proposed Southern Nevada Supplemental Airport.

CONCLUSIONS

Staff has analyzed the project's potential construction and operational impacts related to the regional and local traffic and transportation system and concludes the following:

1. During construction, because project-related construction traffic would not result in an unacceptable level of service along study area roadway segments or intersections, potential impacts created by workforce traffic and truck traffic would be

less than significant. The project would exacerbate existing congestion on I-15 on Friday afternoons in the area of Yates Well Road, and impacts are considered significant. To reduce the proposed project's construction- and operation-related contribution to congestion on northbound I-15 on Friday afternoons, staff has proposed Condition of Certification **TRANS-1** to reduce direct impacts to less than significant.

2. During construction, the project would substantially increase the volume of traffic on roadways and intersections in the vicinity of recreation resources. Therefore, staff's proposed Condition of Certification **TRANS-1** requires adequate signage along local roads and intersections to alert travelers to the presence of construction vehicles.

3. Because proposed project construction traffic has the potential to result in unexpected damage to Yates Well Road and I-15 freeway ramps, staff has proposed Condition of Certification **TRANS-2** to ensure that any damage to local roadways would be repaired to pre-project levels to not present a safety hazard to motorists.

4. Saturday through Thursday during operation, workforce and truck traffic to and from the facility would not result in a substantial increase in congestion, deterioration of the existing level of service, or creation of a traffic hazard during any time in the daily traffic cycle and would have a less-than-significant impact along the routes or roadway intersections that would be used to access the ISEGS site.

5. Solar radiation and light reflected from proposed project heliostats could cause a significant human health and safety hazard to observers in vehicles on adjacent roadways or air traffic flying above the site, and could cause a distraction of drivers on I-15 that would lead to road hazards and to pilots of aircraft flying over the site. Staff has proposed Condition of Certification **TRANS-3** to ensure solar radiation and light from the heliostats does not impair the vision of motorists or pilots traveling near the site and that the potential for exposure of observers does not cause a human health and safety hazard.

6. Solar radiation and light reflected from proposed project power tower receivers is not expected to pose a significant human safety or hazard to navigation of vehicles on adjacent roadways or air traffic flying above the site, but could potentially cause a distraction of drivers on I-15 that would lead to road hazards. Staff has proposed Condition of Certification **TRANS-4** to ensure glare from power tower receivers does not impair the view of motorists or pilots traveling near the site and that the potential for exposure of observers to light reflected from heliostats is minimized to the maximum extent possible.

7. .Because the proposed project would result in construction of structures greater than 200 feet tall in the vicinity of a proposed airport and existing military training flight route, staff has proposed Condition of Certification **TRANS-5** to ensure that onsite power towers are lighted in accordance with FAA recommendations. The project would not adversely affect aircraft operations associated with any aircraft flight traffic.

8. The construction and operation of the ISEGS as proposed, with the effective implementation of staff's recommended conditions of certification below, would ensure that the project's direct adverse traffic and transportation impacts would be less than significant.

9. Vehic**le trip**s generated by construction and operation of the ISEGS would combine with vehicle trips generated by past, present and reasonably foreseeable projects to contribute to the existing significant cumulative impact of congestion on northbound I-15 on Friday afternoons.

10. Staff has determined that, with the implementation of the traffic control plan required by proposed Condition of Certification **TRANS-1**, construction and operation of the ISEGS would not cause a direct significant impact on northbound I-15 on Friday afternoons, but would contribute to a cumulatively considerable significant impact on northbound I-15 on Friday afternoons. All other direct and cumulative project impacts would be less than significant or would be mitigated to a level of less than significant.

11. During project operation, heat exhaust from the Ivanpah 3 air cooled condenser would result in thermal plumes that would result in the potential for aircraft to experience turbulence at an altitude of 1,350 feet or less. Therefore staff has proposed Condition of Certification **TRANS-6** to ensure that thermal plumes associated with ISEGS operation do not impact aviation activities within the navigable airspace above the site.

If the Energy Commission elects to grant certification for this project, staff is proposing three conditions of certification.

PROPOSED CONDITIONS OF CERTIFICATION

TRAFFIC CONTROL PLAN

TRANS-1 Prior to start of construction of the ISEGS, the project owner shall prepare and implement a Traffic Control Plan for ISEGS construction and operation traffic, containing a Traffic Management Plan addressing the movement of workers, vehicles, and materials, including arrival and departure schedules, and designated workforce and delivery routes. The plan shall include:

- requiring at least 60% of construction workers to arrive to the site by bus transport (15 people per bus);
- limiting truck deliveries to the project site to no more than 12 truck trips per day;
- redirection of construction traffic with a flag person as necessary to ensure traffic safety and minimize interruptions to non-construction related traffic flow;
- signage, lighting, and traffic control device placement at the project construction site and laydown areas;

- signage along eastbound and westbound Yates Well Road and at the entrance of each of the I-15 northbound and southbound off-ramps at Yates Well Road notifying drivers of construction traffic throughout the duration of the construction period;
- signage and detours to redirect traffic from Colosseum Road during construction activities related to roadway realignment and pipeline installation in and across the Colosseum Road right of way;
- a Heavy Haul Plan addressing the transport and delivery of heavy and oversized loads requiring permits from Caltrans or other state and federal agencies;
- a work schedule and end-of-shift departure plan, and/or a carpool/vanpool incentive program to substantially reduce the number of project-related vehicles traveling from the project site to Las Vegas during Friday afternoon peak traffic hours, including limiting departures from the site to 12 or fewer vehicles every three minutes between 12:00 PM and 10:00 PM every Friday.

The project owner shall consult with the County of San Bernardino and the Caltrans District 8 office in the preparation and implementation of the Traffic Control Plan and shall submit the proposed Traffic Control Plan to the County of San Bernardino and the Caltrans District 8 office in sufficient time for review and comment and to BLM's Authorized Officer and the Energy Commission Compliance Project Manager (CPM) for review and approval prior to the proposed start of construction and implementation of the plan. The project owner shall provide a copy of any written comments from the County of San Bernardino and the Caltrans District 8 office and any changes to the Traffic Control Plan to BLM's Authorized Officer and the CPM prior to the proposed start of construction.

Verification: At least 90 calendar days prior to the start of construction, including any grading or site remediation on the power plant site or its associated easements, the project owner shall submit the proposed traffic control plan to the County of San Bernardino and the Caltrans District 8 office for review and comment and to BLM's Authorized Officer and the CPM for review and approval. The project owner shall also provide BLM's Authorized Officer and the CPM with a copy of the transmittal letter to the County of San Bernardino and the Caltrans District 8 office requesting review and comment.

At least 30 calendar days prior to the start of construction, the project owner shall provide copies of any comment letters received from either the County of San Bernardino and the Caltrans District 8 office, along with any changes to the proposed traffic control plan to BLM's Authorized Officer and the CPM for review and approval.

REPAIR OF PUBLIC RIGHT-OF-WAY

TRANS-2 The project owner shall restore all public roads, easements, and rights-of-way that have been damaged due to project-related construction activities to original or near-original condition in a timely manner.

Prior to the start of site mobilization, the project owner shall consult with the County of San Bernardino and Caltrans District 8 and notify them of the proposed schedule for project construction. The purpose of this notification is to request that the County of San Bernardino and Caltrans consider postponement of public right-of-way repair or improvement activities in areas affected by project construction until construction is completed and to coordinate with the project owner regarding any concurrent construction-related activities that are planned or in progress and cannot be postponed.

Verification: At least 30 days prior to the start of mobilization, the project owner shall photograph or videotape all affected public roads, easements, and right-of-way segment(s) and/or intersections and shall provide BLM's Authorized Officer, the CPM, the affected local jurisdiction(s) and Caltrans (if applicable) with a copy of these images.

Within 60 calendar days after completion of construction, the project owner shall meet with BLM's Authorized Officer and the CPM, the County of San Bernardino and Caltrans District 8 to identify sections of public right-of-way to be repaired. At that time, the project owner shall establish a schedule to complete the repairs and to receive approval for the action(s). Following completion of any public right-of-way repairs, the project owner shall provide a letter signed by the County of San Bernardino and Caltrans District 8 stating their satisfaction with the repairs to BLM's Authorized Officer and the CPM.

HELIOSTAT POSITIONING PLAN AND MONITORING

TRANS-3 The project owner shall prepare a Heliostat Positioning Plan that would accomplish the following:

1. Identify potential sensitive receptors including observers in aircraft, motorists on I-15, hikers in the Clark Mountains and other hikers and motorists who could access locations closer to the project;

2. Identify the heliostat movements and positions that could result in exposure of these observers to reflected solar radiation from heliostats;

3. Prepare a Heliostat Operating Plan that would avoid potential for human health and safety hazards at locations of sensitive receptors including the potential for momentary and continuous solar radiation exposure to occur greater than the thresholds of significance of :

   a. MPE for momentary exposure (for a period of 0.25 second or less) is 10 kw/m^2

   b. MPE for continuous exposure (for a period greater than 0.25 second) is 1 kw/m^2

4. Prepare a monitoring plan that would: a) verify that the Heliostat Operating Plan would avoid potential for human health and safety hazards at locations of sensitive receptors, and b) provide requirements and procedures to document, investigate and resolve complaints regarding glare.

5. The monitoring plan should be coordinated with the FAA, U.S. Department of the Navy, CalTrans, and Clark County Department of Aviation in relation to the proposed Southern Nevada Supplemental Airport and be updated on an annual basis for the first 5 years, and at 2-year intervals thereafter for the life of the project.

Verification: Within 90 days before commercial operation of any of the three ISEGS power plants, the project owner shall submit the Heliostat Positioning Plan to the CPM for review and approval. The project owner shall also submit the plan to CalTrans, FAA, and the Clark County Department of Aviation for review and comment and forward any comments received to the CPM.

VERIFICATION OF POWER TOWER RECEIVER LUMINANCE AND MONITORING

TRANS-4 Upon commercial operation of each of the three ISEGS power plants (Ivanpah 1, 2 and 3) and at intervals of every 5 years thereafter, the project owner shall evaluate the intensity of luminance of light reflected from all four sides (north, south, east and west) of the power tower receivers, as measured from the power plant boundary, nearest road and at distances of 200, 500, 1,000 and 1,500 meters from the power tower receivers for each power tower. The measurements are to ensure that luminance does not exceed the standard of 89 cd/m^2 at the nearest road or power plant boundary.

The project owner shall measure solar radiation and luminance with an illuminance meter, photometer, or similar device.

If luminance is identified to be above 89 cd/m^2 at any power plant boundary or nearest road location, the project owner shall propose mitigation measures for review by BLM's Authorized Officer and the CPM, and upon receiving both approvals, shall implement project modifications to maintain luminance within the threshold of 89 cd/m^2 at the nearest road and power plant boundary. The modifications may include surface treatment or material changes to increase absorption and reduce reflectivity of the power tower receivers or operational controls, such as reducing the number of heliostats reflecting toward the power tower receiver that is identified as the source of that light. The project owner shall also prepare a monitoring plan that provides requirements and procedures to document, investigate and resolve complaints regarding glare.

Verification: Within 30 days following commercial operation of each of the three ISEGS power plants (Ivanpah 1, 2 and 3) during peak load conditions (95% or greater

of the power plant rated capacity) and at intervals of every 5 years thereafter, the project owner shall conduct luminance measurements as follows:

1. The luminance measurement shall be conducted for all four sides (north, south, east and west) of the power tower receivers, as measured from the power plant boundary, nearest road and at distances of 200, 500, 1,000 and 1,500 meters from the power tower receivers for each power tower.

2. Within 15 days after completing each of the surveys, the project owner shall submit a summary report of the survey to FAA, U.S. Department of the Navy, CalTrans, and Clark County Department of Aviation for review and comment, and to BLM's Authorized Officer and the CPM for review and approval.

3. If the measurements reveal that luminance exceeds 89 cd/m^2 at any of the nearest roads and power plant boundaries to each north, south, east and west face of each power tower, the survey report shall include a description of proposed mitigation measures necessary to achieve compliance, and the project owner shall also propose a schedule, subject to BLM Authorized Office and CPM approval, for implementing those measures.

4. Within 30 days following the implementation of the mitigation measures, the project owner shall repeat the luminance measurements and prepare a supplemental survey report for review and comment to FAA, U.S. Department of the Navy, CalTrans, and Clark County Department of Aviation, and for review and approval by BLM's Authorized Officer and the CPM.

5. This process would be repeated as necessary until the project complies with the luminance limit of not exceeding 89 cd/m^2 at any of the nearest roads and power plant boundaries to each north, south, east and west face of each power tower.

The field measurements and verification process are to be repeated at five-year intervals following commercial operation for the life of the project as applicable to each of the three ISEGS power plants.

The five-year field measurement and verification process and investigation of any complaints related to glare shall be coordinated with the FAA, U.S. Department of the Navy, CalTrans, and Clark County Department of Aviation as applicable, and shall document, address and satisfactorily resolve any complaints as determined by BLM's Authorized Officer and the CPM.

The project owner shall prepare a monitoring plan that provides requirements and procedures to document, investigate and resolve complaints regarding glare, and report these to BLM's Authorized Officer and the CPM within 10 days of receiving a complaint, as part of the Annual Compliance Report, and as part of the Five-Year Field Measurement and Verification Report.

POWER TOWER LIGHTING

TRANS-5 The project owner shall ensure that each power tower is marked and lighted according to the recommendations included in the FAA aeronautical study performed for each tower. Additionally, the project owner shall submit FAA Form 7460-2 Part II, Notice of Actual Construction or Alteration, to the FAA within 5 days of completion of construction of the tower to its greatest height.

The project owner shall provide evidence of compliance with FAA Advisory circular 70/7460-1 K Change 2, Obstruction Marking and Lighting by submitting a copy of Form 7460-2 to BLM's Authorized Officer and the CPM for review and approval upon completion of construction or each power tower.

Verification: Within 5 days of completion of construction of each of the seven power towers, the project owner shall submit the above referenced evidence to BLM's Authorized Officer and the CPM for review and approval.

FAA NOTIFICATION

TRANS-6 Prior to start-up and testing activities of the plant and all related facilities, the project owner shall coordinate with the FAA to notify all pilots using the airspace in the vicinity of the ISEGS of potential air hazards from turbulence. These activities would include, but not be limited to: 1) issuing a notice to airmen (NOTAM of the identified air hazard, 2) updating all applicable FAA-approved airspace charts to indicate that plume hazards could exist up to an altitude of 1,350 feet above the ground surface, and 3) requesting FAA to require pilots to avoid direct overflight of the ISEGS site at or below this altitude during daylight hours.

Verification: At least 60 days prior to start of project operation, the project owner shall submit to BLM's Authorized Officer and the CPM for review a letter from the FAA showing compliance with these measures.

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HIGHWAY CAPACITY MANUAL

The *Highway Capacity Manual* is prepared by the Transportation Research Board, Committee on Highway Capacity and Quality of Service. It represents a concentrated, multi-agency effort by the Transportation Research Board, the Federal Highway Administration, the American Association of Highway and Transportation Officials, and other traffic/transportation related agencies. It is the most widely used resource for traffic analysis. Several versions of the Highway Capacity Manual have been published. The current edition was published in 2000. It contains concepts, guidelines, and computational procedures for computing the capacity and quality of service of various highway facilities, including freeways, signalized and unsignalized intersections, rural highways, and the effects of transit, pedestrians, and bicycles on the performance of these systems.

LEVEL OF SERVICE

The description and procedures for calculating capacity and level of service are found in the *Highway Capacity Manual 2000*. The *Highway Capacity Manual 2000* represents the latest research on capacity and quality of service for transportation facilities.

Quality of service requires quantitative measures to characterize operational conditions within a traffic stream. Level of service is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience.

Six levels of service are defined for each type of facility that has analysis procedures available. Letters designate each level, from A to F, with level of service A representing the best operating conditions and level of service F the worst. Each level of service represents a range of operating conditions and the driver's perception of these conditions. Safety is not included in the measures that establish service levels. A general description of service levels for various types of facilities is shown in **Table A-1**.

Traffic and Transportation Table A-1
Level of Service Description

Facility Type	Uninterrupted Flow	Interrupted Flow
	Freeways Multi-Lane Highways Two-Lane Highways Urban Streets	Signalized Intersections Unsignalized Intersections - Two-Way Stop Control - All-Way Stop Control
Level of Service		
A	Free-flow	Very low delay
B	Stable flow. Presence of other users noticeable.	Low delay
C	Stable flow. Comfort and convenience starts to decline.	Acceptable delay
D	High density stable flow	Tolerable delay
E	Unstable flow	Limit of acceptable delay
F	Forced or breakdown flow	Unacceptable delay
Source: *Highway Capacity Manual 2000*		

Interrupted Flow

One of the more important elements limiting, and often interrupting, the flow of traffic on a highway is the intersection. Flow on an interrupted facility is usually dominated by points of fixed operation such as traffic signals and stop and yield signs. These all operate quite differently and have differing impacts on overall flow.

Signalized Intersections

The capacity of a highway is related primarily to the geometric characteristics of the facility, as well as to the composition of the traffic stream on the facility. Geometrics are a fixed, or non-varying, characteristic of a facility.

At the signalized intersection, an additional element is introduced into the concept of capacity: time allocation. A traffic signal essentially allocates time among conflicting traffic movements seeking use of the same physical space. The way in which time is allocated has a significant impact on the operation of the intersection and on the capacity of the intersection and its approaches.

Level of service for signalized intersections is defined in terms of control delay, which is a measure of driver discomfort, frustration, fuel consumption, and increased travel time. The delay experienced by a motorist is made up of a number of factors that relate to control, traffic, and incidents. Total delay is the difference between the travel time actually experienced and the reference travel time that would result during base conditions (i.e., in the absence of traffic control, geometric delay, any incidents, and any other vehicles). Specifically, level of service criteria for traffic signals is stated in terms of average control delay per vehicle, typically for a 15-minute analysis period. Delay is a complex measure and depends on a number of variables, including the quality of progression, the cycle length, the ratio of green time to cycle length and the volume-to-capacity ratio for the lane group.

For each intersection analyzed, the average control delay per vehicle per approach is determined for the peak hour. A weighted average of control delay per vehicle is then determined for the intersection. A level of service designation is given to the control delay to better describe the level of operation. Descriptions of levels of service for signalized intersections can be found in **Table A-2**.

Traffic and Transportation Table A-2
Description of Level of Service for Signalized Intersections

Level of Service	Description
A	Very low control delay, up to 10 seconds per vehicle. Movement forward (progression) is extremely favorable, and most vehicles arrive during the green phase. Many vehicles do not stop at all. Short cycle lengths may tend to contribute to low delay values.
B	Control delay greater than 10 and up to 20 seconds per vehicle. There is good progression or short cycle lengths or both. More vehicles stop causing higher levels of delay.
C	Control delay greater than 20 and up to 35 seconds per vehicle. Higher delays are caused by fair progression or longer cycle lengths or both. Individual cycle failures may begin to appear. Cycle failure occurs when a given green phase does not serve a waiting line of vehicles, and overflow occurs. The number of vehicles stopping is significant, though many still pass through the intersection without stopping.
D	Control delay greater than 35 and up to 55 seconds per vehicle. The influence of congestion becomes more noticeable. Longer delays may result from some combination of unfavorable progression, long cycle lengths, or high volumes. Many vehicles stop, the proportion of vehicles not stopping declines. Individual cycle failures are noticeable.
E	Control delay greater than 55 and up to 80 seconds per vehicle. The limit of acceptable delay. High delays usually indicate poor progression, long cycle lengths, and high volumes. Individual cycle failures are frequent.
F	Control delay in excess of 80 seconds per vehicle. Unacceptable to most drivers. Oversaturation and arrival flow rates exceed the capacity of the intersection. Many individual cycle failures. Poor progression and long cycle lengths may also be contributing factors to higher delay.
Source: *Highway Capacity Manual 2000*	

The use of control delay, often referred to as signal delay, was introduced in the 1997 update to the *Highway Capacity Manual*. It represents a departure from previous updates. In the third edition of the *Highway Capacity Manual*, published in 1985 and the 1994 update to the third edition, delay only included stop delay. Thus, the level of service criteria listed in Table B differs from earlier criteria.

Unsignalized Intersections

The current procedures on unsignalized intersections were first introduced in the 1997 update to the *Highway Capacity Manual* and represent a revision of the methodology published in the 1994 update to the 1985 *Highway Capacity Manual*. The revised procedures use control delay as a measure of effectiveness to determine level of service. Delay is a measure of driver discomfort, frustration, fuel consumption, and

increased travel time. The delay experienced by a motorist is made up of a number of factors that relate to control, traffic, and incidents. Total delay is the difference between the travel time actually experienced and the reference travel time that would result during base conditions (i.e., in the absence of traffic control, geometric delay, any incidents, and any other vehicles). Control delay is the increased time of travel for a vehicle approaching and passing through an unsignalized intersection, compared with a free-flow vehicle if it were not required to slow or stop at the intersection.

Two-Way Stop Controlled Intersections

Two-way stop controlled intersections in which stop signs are used to assign the right-of-way, are the most prevalent type of intersection in the United States. At two-way stop-controlled intersections, the stop-controlled approaches are referred as the minor street approaches and can be either public streets or private driveways. The approaches that are not controlled by stop signs are referred to as the major street approaches.

The capacity of movements subject to delay is determined using the "critical gap" method of capacity analysis. Expected average control delay based on movement volume and movement capacity is calculated. A level of service designation is given to the expected control delay for each minor movement. Level of service is not defined for the intersection as a whole. Control delay is the increased time of travel for a vehicle approaching and passing through an all-way, stop-controlled intersection, compared with a free-flow vehicle if it were not required to slow or stop at the intersection. A description of levels of service for two-way stop-controlled intersections is found in **Table A-3**.

Traffic and Transportation Table A-3
Description of Level of Service for Two-Way Stop Controlled Intersections

Level of Service	Description
A	Very low control delay less than 10 seconds per vehicle for each movement subject to delay.
B	Low control delay greater than 10 and up to 15 seconds per vehicle for each movement subject to delay.
C	Acceptable control delay greater than 15 and up to 25 seconds per vehicle for each movement subject to delay.
D	Tolerable control delay greater than 25 and up to 35 seconds per vehicle for each movement subject to delay.
E	Limit of acceptable control delay greater than 35 and up to 50 seconds per vehicle for each movement subject to delay.
F	Unacceptable control delay in excess of 50 seconds per vehicle for each movement subject to delay.
Source: *Highway Capacity Manual 2000*	

REFERENCE

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