1. Accomplishments

1.1 What are the major goals and objectives of the program?
The major goals and objectives of the program as outlined in the proposal include the following categories.

Research
SOLARIS’s research is focused on safety in addition to other U.S. DOT strategic areas. The three main research areas involve: 1) Traffic Safety Data Management and Crash Mitigation; 2) Technologies for Safe Traffic Operations and Managements; and 3) Safe and Sustainable Infrastructure. SOLARIS will conduct applied research in all of these areas to produce methodologies and tools that can be implemented to tackle long-standing and emerging transportation issues. The expected outcomes of each research topic are listed below:

Traffic Safety Data Management and Crash Mitigation

- Improved quality of safety data through better data collection and inventory
- Implementation of scientifically sound crash data analysis methodologies and software tools
- Reduction of injury and fatal crashes in both rural and urban areas
- Maximization of the rate of return for all safety project investments

Technologies for Safe Traffic Operations and Management

- Congestion mitigation to reduce travelers’ frustration and to promote safe driving
- Reduction in air pollution and noise to promote livable communities
- Efficient freight movement to improve the regional and national economy

Sustainable and Safe Transportation Infrastructure

- Improved safety, mobility, and environment for tribal lands and rural towns
- Innovative materials that will prolong the life of pavements and bridges
• Expanding and integrating advanced traffic modeling technologies into infrastructure risk analysis under earthquake and other disastrous events

*Rigorous Project Selection Process*
To aid in the project selection process, SOLARIS organized a Technical Advisory Committee composed of professionals from public and private agencies. The Technical Advisory Committee is responsible for reviewing, ranking, and recommending research projects.

**Leadership**
SOLARIS is composed of several nationally and internationally known transportation programs and academic leaders. The resources from the five institutions composing the consortium make SOLARIS a highly qualified team that can significantly contribute to the advancement of transportation research. Four ways in which SOLARIS will measure the effectiveness of its leadership include studying innovative ideas that strengthen long-term vision and goals; delivering new models and tools that are readily implementable into practice, disseminating research through journal publications and conference presentations; participating in academic and professional organizations. The leadership group includes Center Director Zong Tian, Center Coordinator Erika Hutton, and Associate Directors Pitu Mirchandani from Arizona State University and Rafiqul Tarefder from the University of New Mexico.

**Education and Workforce Development**
Education and workforce development are important to the success of SOLARIS. The universities in the consortium currently have both undergraduate and graduate programs that focus on transportation. SOLARIS plans to enhance these transportation programs by providing course material in sustainability and mobility for large sparse rural-urban regions. Another educational and workforce development goal for SOLARIS is to hold workshops, conferences, and continuing education courses in order to educate the public, industry, and academic communities. Summer camps, internships, and fellowships will also be conducted in order to attract a new generation of professionals to transportation.

**Technology Transfer**
SOLARIS has established a plan in order to provide technology transfer. This plan includes the publication of reports, peer-reviewed journals, and conference papers; showcases; seminars; webinars; and international cooperation and collaboration. So far, UNR has hosted visiting scholars to present at seminars for transportation professionals and students. PhD and Master candidates are also
presenting at seminars every week at UNR. In addition, links to principal investigators presenting research through webinars is posted on the website. Currently, the center is working towards posting video of distinguished lecturers and graduate seminars on the website as well.

**Collaboration**

SOLARIS has outlined the framework by which collaboration within the consortium, public agencies, educational and professional organizations, and industry and other private companies will be developed. This collaboration framework aims at providing collaborative brainstorming, research, decision making, and activities related to education and technology transfer. The following list provides detailed information about the different collaborative categories.

**Collaboration within the Consortium**

Some of the collaborative efforts involving the five institutions of SOLARIS include the sharing of transportation courses via interactive classrooms and distance learning technologies. This will provide students with a broad set of transportation-related courses, which no single university would be able to offer. SOLARIS plans to create a method in which faculty members from different institutions can serve as graduate committee members. In addition, collaborative research between the institutions will best use institutional resources and expertise on delivering high quality research products.

**Collaboration with Public Agencies**

The different institutions composing SOLARIS have a strong collaborative effort with many transportation agencies. These agencies include the USDOT; the Departments of Transportation from Arizona, Nevada, and New Mexico; the Regional Transportation Commission (RTC) of Washoe County; the RTC of Southern Nevada; Maricopa County Department of Transportation, Maricopa Association of Governments, Cities of Phoenix, Tucson, and Tempe in Arizona; and the City of Las Vegas.

**Collaboration with Educational and Professional Organizations**

Outreach activities for K-12 schools and tribal colleges will focus on recruiting students that are interested in transportation research and education. The faculty members of the consortium are active in various professional organizations such as ASCE, ITE, TRB, APTA, INFORMS, and ITS America. In addition, the faculty members have or are currently serving as committee chairs in some of these organizations.
**Collaboration with Industry and Private Companies**
Partnerships with industry, industry-related organizations, and private companies are encouraged by SOLARIS in order to develop, promote and support transportation research and education. These types of collaboration efforts will effectively promote technology transfer activities.

**1.2 What was accomplished under these goals?**

**Research**
Quarterly progress reports are still being required to confirm projects are on schedule with a sufficient completion rate. The reports are now designed to fulfill the needs of matching organizations as well as the UTC program’s requirements.

**Leadership**
Center Coordinator Erika Hutton and Associate Directors Pitu Mirchandani (ASU) and Rafiqul Tarefder (UNM) continue their roles at SOLARIS. Dr. Nader Ghafoori continues serving as the UNLV Coordinator.

Center Director Zong Tian was appointed as an editor for the journal of Case Studies on Transport Policy. He is also a guest editor for a special issue for the Journal of Transportation Research – Part C. Additionally, he is a member of the planning committees for two major international conferences: International Symposium on Enhancing Highway Performance (ISEHP 2016) and 2016 World Conference on Transportation Society (WCTRS).

The Institute for Operations Research and Management Science (INFORMS) organization selected Dr. Pitu Mirchandani as one of eight Fellows this year. The formal presentation of this year’s Fellows will be held in November.

PI Hualiang Teng from UNLV was one of five appointed to the Governor’s California-Nevada Interstate Rail Commission in September, which is expected to lead a thorough discussion on a possible high-speed rail system for Nevada.

**Education and Workforce Development**
The Native American Scholarship has been opened year round and is posted on the SOLARIS website. Dr. Tian provided a two-day workshop for City of Houston on new methodologies and technologies for improving signal timing and coordination practices. Graduate students from UNR participated the ITE District 6, Intermountain Section, and Nevada Chapter annual meetings. Two students won first and second best student paper awards from ITE Intermountain Section.
Technology Transfer
The center has been conducting weekly seminars. In these seminars, guest speakers and graduate students present their current research activities. Distinguished Lecturers this period included: Yafen Yin, professor at University of Florida, made a presentation on April 23; Kumares Sinha from Purdue University presented on May 14. Guest speakers are scheduled once a month, if possible, during the semester. The upcoming seminar schedule and past presentations are posted on the SOLARIS website.

The guidelines developed for one of the research projects conducted at UNR regarding right-turn volume reduction for signal warrant analysis have been adopted by the Nevada Department of Transportation to implement statewide, and an improved practice is expected due to the research. UNR researchers have also been assisting various agencies to improve signal timing and coordination. Several demonstration projects have been completed for Caltrans using the tools developed at SOLARIS. These demonstration projects have shown benefit-cost ratios exceeding 300:1.

Collaboration
The collaboration efforts SOLARIS has been part of during this reporting period include the following:

Collaboration within the Consortium
UNR and UNLV are still discussing the possibilities of offering web-based graduate level classes available for students at both universities. This would best use the available resources and faculty expertise in both institutions. SOLARIS has successfully implemented a method in which faculty members from different institutions can serve as graduate committee members. UNR members are serving for ASU and ASU for UNR.

Collaboration with Public Agencies
The Nevada Department of Transportation Board approved continues to match projects to be conducted by consortium members within Nevada, including the University of Nevada, Reno, the University of Nevada, Las Vegas, and the Desert Research Institute. UNR researchers continue to work with the RTCs in both Washoe County and Las Vegas to address imminent transportation issues and improve transportation system efficiency, such as implementing new signal timing for arterial streets. Additionally, UNR researchers have been collaborating with Caltrans in California, including a roundabout safety project to be jointly funded by the UTC and Caltrans.
Collaboration with Educational and Professional Organizations

A good example of collaboration across different disciplines is to sponsor a graduate student, Kyle Smith, who plans to pursue two advanced degrees: one in Economics and one in Transportation Engineering. The student will work on research funded jointly by the UTC and the Regional Transportation Commission of Washoe County (RTC) to address the funding shortfalls in public transit.

Collaboration with Industry and Private Companies

The Center for Advanced Transportation Education and Research (CATER) at UNR established an advanced traffic signal control lab with partial sponsorship from Econolite Inc. Econolite has agreed to donate their Centracs control software for research purposes. The lab construction began in April and concluded in June. Final completion of lab set up will be done in the next reporting period.

1.3 What opportunities for training and professional development has the program provided?

The weekly seminars are open to the general public, particular to local and state transportation agencies and graduate students.

1.4 How have the results been disseminated?

- Dr. Zong Tian presented at the OST-R Transportation Innovation Speaker Series in Washington D.C. for his work on the current status of adaptive traffic signal control systems application.
- He also conducted a two-day workshop for the City of Houston using advanced tools and methodologies for signal timing.
- Dr. Elie Hajj presented an update on his project centered on thin asphalt overlays at the Asphalt Institute Summer Meeting.
- Dr. Zong Tian attended three international conferences in China where he presented research findings and participated in a summer camp hosted by Beijing Jiaotong University.
- Graduate students at UNR submitted posters at the 2015 Nevada Chapter of American Planning Association Annual Conference where they received the second and third prize. The posters were voted on by 35 elected officials, government executives and consultants in the areas of planning, transportation and economic development.
- Students and faculty attended the annual Fall Conference in Las Vegas where various students presented ongoing research.

1.5 What do you plan to do during the next reporting period to accomplish the goals and objectives?

The following tasks are planned in order to accomplish the goals and objectives of SOLARIS.

- Stay updated on funded projects and their progress.
• Complete request for proposals for second round of project selection.
• Update SOLARIS website and RiP as necessary. TRiD will also be updated as projects are completed during the next period.
• Attend TRB annual meeting in January.
• Continue fostering professional relationships for Distinguished Lecturer seminar series.

2. Products

2.1 Publications, conference papers, and presentations
• Students at SOLARIS are presenting weekly at seminars at UNR.
• Student posters were presented at the 2015 NVAPA Conference, winning the second and third prizes.
• PhD candidate paper was accepted for publication in ASCE’s Journal of Transportation Engineering.
• PhD papers were submitted to the ITE annual meeting and won the first and second prizes.
• Students and faculty presented at the Fall Conference in Las Vegas.
• UNR students won three out of six selected best student papers through a competition from the SHRP 2 sponsored safety research and will present their results during TRB.

2.2 Website(s) or other internet site(s)
The SOLARIS website is located at http://www.unr.edu/solaris. This website is used to disseminate any information related to the program. It is updated as needed.

2.3 Technologies or techniques
The SMRT tool will continue to be promoted to agencies to improve the current practice on signal timing and coordination. The right-turn volume reduction guideline has been adopted by the Nevada Department of Transportation. The study on vehicle acceleration and queue storage design at ramp meters will be adopted by Caltrans to update their Freeway Design Manual. The pedestrian handling guide at coordinated signal systems has been used in signal timing projects in Reno and showed much improved results due to minimization of signal transition. UNR is also developing the virtual controller interface device (CID) which will play a key role in conducting research in the signal control area.
2.4 Inventions, patent applications, and/or licenses
Nothing to report for this period.

2.5 Other products
Nothing to report for this period.

3. Participants & Collaborating Organizations

3.1 Who has worked on the program?
The members of SOLARIS include the University of Nevada, Reno (UNR); the University of Nevada, Las Vegas (UNLV); Arizona State University (ASU); the University of New Mexico (UNM); and the Desert Research Institute (DRI). Table 1 lists the individuals who have worked on the program during this reporting period.
Table 1: SOLARIS Staff Working on the Program

<table>
<thead>
<tr>
<th>Name</th>
<th>Program/Project Role</th>
<th>Number of hours worked during the reporting period</th>
<th>Contribution to Program/Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zong Tian</td>
<td>Program Director</td>
<td>180</td>
<td>Oversees overall operations of the program. Responsible for coordinating with stakeholders and developing and implementing the SOLARIS Strategic Plan.</td>
</tr>
<tr>
<td>Pitu B. Mirchandani</td>
<td>Associate Director at ASU</td>
<td>100</td>
<td>Serves as liaison between SOLARIS and ASU.</td>
</tr>
<tr>
<td>Rafiqul A. Tarefder</td>
<td>Associate Director at UNM</td>
<td>80</td>
<td>Serves as liaison between SOLARIS and UNM.</td>
</tr>
<tr>
<td>Nader Ghafoori</td>
<td>UNLV Coordinator</td>
<td>40</td>
<td>Serves as liaison between SOLARIS and UNLV.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Funding Support</th>
<th>UNR</th>
<th>ASU</th>
<th>UNM</th>
<th>UNLV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborated with individual in foreign country</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Country(ies) of foreign collaborator</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Traveled to foreign country (for center related business)</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>If traveled to foreign country(ies), duration of stay</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### 3.2 What organizations have been involved as partners?

Table 2 lists the organizations that have partnerships with SOLARIS and Table 3 lists the members of the Technical Advisory Committee.

**Table 2: Organization Creating Partnerships with SOLARIS**

<table>
<thead>
<tr>
<th>Organization Name</th>
<th>Location of Organization</th>
<th>Partners Contribution to Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nevada Department of Transportation</td>
<td>Nevada</td>
<td>X</td>
</tr>
<tr>
<td>Regional Transportation Commission of Washoe County</td>
<td>Nevada</td>
<td>X</td>
</tr>
<tr>
<td>Regional Transportation Commission of Southern Nevada</td>
<td>Nevada</td>
<td>X</td>
</tr>
<tr>
<td>Las Vegas Global Economic Alliance</td>
<td>Nevada</td>
<td>X</td>
</tr>
<tr>
<td>New Mexico Department of Transportation</td>
<td>New Mexico</td>
<td>X</td>
</tr>
<tr>
<td>Maricopa Association of Governments</td>
<td>Arizona</td>
<td>X</td>
</tr>
<tr>
<td>Arizona Department of Transportation</td>
<td>Arizona</td>
<td>X</td>
</tr>
<tr>
<td>California Department of Transportation</td>
<td>California</td>
<td>X</td>
</tr>
<tr>
<td>Econolite Control Products Inc.</td>
<td>California</td>
<td>X</td>
</tr>
<tr>
<td>City of Carson City</td>
<td>Nevada</td>
<td>X</td>
</tr>
<tr>
<td>Douglas County</td>
<td>Nevada</td>
<td>X</td>
</tr>
</tbody>
</table>
Table 3: Technical Advisory Committee Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Expertise</th>
<th>Position/Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nevada</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tracy Larkin (Chair)</td>
<td>Operations, Design</td>
<td>Deputy Director, NDOT</td>
</tr>
<tr>
<td>Mike Fuess</td>
<td>Traffic Operations</td>
<td>Assistant District Engineering, District 2, NDOT</td>
</tr>
<tr>
<td>Ken Mammen</td>
<td>Safety</td>
<td>Chief Safety Engineer, NDOT Planning</td>
</tr>
<tr>
<td>Steve Merrill</td>
<td>Design/GIS</td>
<td>Chief Engineer, Location Division, NDOT</td>
</tr>
<tr>
<td>Troy Martin</td>
<td>Structure</td>
<td>Engineer, Bridge Division, NDOT</td>
</tr>
<tr>
<td>Nathan Morian</td>
<td>Pavement</td>
<td>Engineer, Materials Division, NDOT</td>
</tr>
<tr>
<td>Randy Travis</td>
<td>Traffic Information/Planning</td>
<td>Chief, Traffic Information, NDOT</td>
</tr>
<tr>
<td>Manju Kumar</td>
<td>Operations, Planning</td>
<td>Research Coordinator, NDOT</td>
</tr>
<tr>
<td>Jim Poston</td>
<td>ITS/Operations</td>
<td>Engineer, RTC of Washoe County</td>
</tr>
<tr>
<td>Scott Gibson</td>
<td>Pavement</td>
<td>Engineer, RTC of Washoe County</td>
</tr>
<tr>
<td>Fred Ohene</td>
<td>Traffic Operations</td>
<td>Assistant General Manager, RTC Southern Nevada</td>
</tr>
<tr>
<td>Raymond Hess</td>
<td>Transportation Planning</td>
<td>Manager, Planning Division, RTC Southern Nevada</td>
</tr>
<tr>
<td>Tom Skancke</td>
<td>High Speed Rail</td>
<td>President/CEO, Las Vegas Global Economic Alliance</td>
</tr>
<tr>
<td><strong>New Mexico</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mohammad Moabed</td>
<td>Pavement/Traffic</td>
<td>Former District 2 Engineer, NMDOT</td>
</tr>
<tr>
<td>Parveez Anwar</td>
<td>Pavement Materials</td>
<td>Engineer, NMDOT</td>
</tr>
<tr>
<td><strong>Arizona</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sarath Joshua</td>
<td>ITS/Safety</td>
<td>Program Manager, Maricopa Association of Governments</td>
</tr>
<tr>
<td>Scott E. Nodes</td>
<td>Traffic/Design</td>
<td>Arizona DOT</td>
</tr>
<tr>
<td><strong>Academia (External)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Robert Bertini</td>
<td>ITS/Traffic</td>
<td>Professor, Portland State University</td>
</tr>
</tbody>
</table>
3.3 Have other collaborators or contacts been involved?
The City of Houston requested a workshop by Dr. Tian on the methodologies and technologies to advance signal timing and coordination.

4. Impact
Research projects have not yet been completed, as such the impact of this program cannot be measured during this reporting period. However, faculty and students have made several key presentations at national and regional conferences. Our research in the signal control area has attracted interests from various agencies, which could become potential sponsors. Our safety research has attracted a potential roundabout safety study from Caltrans. Our practice-focused research approach has also caught the attention of the Maricopa Association of Governments in Phoenix, AZ for possible funding in the next fiscal year.

4.1 What is the impact on the development of the principal discipline(s) of the program?
More awareness to Transportation Engineering within the college and community due to the various activities that have been created under the grant, including invited speakers, technology transfer and research.

4.2 What is the impact on other disciplines?
Currently, the grant is funding a graduate student with a degree in Economics. The student will work on research to address the financial challenges facing the public transit system in Washoe County. This brings different perspectives on how to address the overall transportation system as a whole.

4.3 What is the impact on the development of transportation workforce development?
Exchange of information has been made possible through Distinguished Lecturer Seminars, which include professional and academic entities, held at the University of Nevada, Reno.

4.4 What is the impact on physical, institutional, and information resources at the university or other partner institutions?
With a new round of proposals underway, the awareness of opportunity for research collaboration with other institutions is growing.
4.5  **What is the impact on technology transfer?**
Several presentations have been made at international and regional conferences, including ITE annual meeting. The signal timing tools have been tested in various agencies to improve the efficiency of developing signal timing plans.

4.6  **What is the impact on society beyond science and technology?**
Improved signal system efficiency not only shows significant reduction in travel time and user costs, but also the improvement on air quality due to reduction in hazardous emissions. All these will bring improved quality of life for the citizens and protection of natural resources.

5.  **Changes/Problems**

5.1  **Changes in approach and reasons for change**
Nothing to Report

5.2  **Actual or anticipated problems or delays and actions or plans to resolve them**
Nothing to Report

5.3  **Changes that have a significant impact on expenditures**
No significant impact is perceived.

5.4  **Significant change in use or care of animals, human subjects, and/or biohazards**
Nothing to Report

5.5  **Changes of primary performance site location from that originally proposed**
Nothing to Report

5.6  **Additional information regarding products and impacts**
Nothing to Report
6. **Special Reporting Requirements**

The University of Nevada, Reno’s Office of Sponsored Projects will submit Federal Financial Reports as needed.