American Association of State Highway and Transportation Officials (AASHTO)
Institute of Transportation Engineers (ITE)
National Electrical Manufacturers Association (NEMA)

Systems Engineering Management Plan NTCIP 1202 Actuated Signal Controllers Version 4

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SEMP in support of: Task Order No. HOIT220173PR

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CHANGE HISTORY

Date	Version	Note
9/6/22	v1	Initial Draft Systems Engineering Management Plan (SEMP)
9/6/22	V1a	QA – Chan
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9/8/22	V1c	QA - Chan
9/9/22	V1-CST	Submission to ITE

NOTICE

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1 PURPOSE OF THE SYSTEMS ENGINEERING MANAGEMENT PLAN

This document establishes the Systems Engineering Management Plan (SEMP) for the NTCIP 1202 Actuated Signal Controllers Version 4 (NTCIP 1202 v04) Project performed under the United States Department of Transportation (USDOT) Task Order No. HOIT220173PR, and awarded to the Institute of Transportation Engineers (ITE). This SEMP establishes a common understanding of how the systems engineering portions of the project will be organized, structured, conducted and controlled to meet the project goals for:

a) The USDOT Intelligent Transportation Systems (ITS) Joint Program Office (JPO) who is sponsoring the work;

b) The Standard Development Organizations (SDOs) overseeing the development;

c) The consulting team contracted to perform the work; and

d) The consultants, manufacturers, and public transportation professionals who participate in the ASC Working Group which will use the deliverable items specified in this SEMP.

The organization of this SEMP is derived from the Systems Engineering Plan described in the International Council on Systems Engineering (INCOSE) Systems Engineering Handbook, Version 3.2 and IEEE Std 1220-2005, IEEE Standard for Application and Management of the Systems Engineering Process. The overall management of the project including the objectives, tasks, schedule, and deliverables are defined in the associated Project Management Plan (PMP) for NTCIP 1202 v04 (see Appendix A).

Portions of this SEMP may be updated during the course of the project if the management team or the ITS JPO determines that modification would significantly facilitate the system engineering functions including, but not limited to, changes in associated portions of the PMP, changes in the risk prioritization and analysis, or the identification of new risk areas. At a minimum, the SEMP will be reassessed after the completion of each major task as defined in the PMP.

1.1 Background of Project

USDOT and ITE have worked on ITS Standards since the inception of the ITS Standards Program over 20 years ago. This project includes the steps necessary to publish a “The National Transportation Communications for ITS Protocol (NTCIP) 1202 version 4”, hereinafter referred to as NTCIP 1202 v04, under the purview of ITE. The current version of NTCIP 1202 is version 3 (NTCIP 1202 v03), which incorporated new user needs, requirements, and design elements to better enable ASC to Roadside Unit (RSU) communications. Subsequently the Connected Intersections standardization project developed detailed guidance for interoperable deployments of connected intersections which include an ASC and RSU. Part of that effort identified new signal, phase, and timing (SPaT) concepts, such as the Assured Green Period (AGP), which need to be formally added to NTCIP 1202.

NTCIP 1202 v04 is to incorporate new and updated user needs, requirements and design elements resulting from the Connected Intersections standardization effort, results from the City of Anaheim NTCIP 1202 testing project, recommended changes from NTCIP 9014 Infrastructure Standards Security Assessment (ISSA) and other infrastructure owner operator (IOO) and vendor comments and suggestions. NTCIP 1202 v04 will provide the ITS Community with a complete and correct standard that has been through a systems engineering process and supports full nationwide interoperability for ASCs.

The NTCIP standards are jointly published by AASHTO, NEMA, and ITE, as per these associations' existing agreement. ITE will work with SAE International to develop and publish this standard.

Under this task order, the ITE will:

- Provide project management of all tasks described in the Performance Work Statement (PWS) for Task Order No. HOIT220173PR, 1202 Actuated Signal Controllers Version 4.
- Identify and engage the services of a qualified ITS system engineer(s) and qualified technical editor.
- Identify and engage appropriate stakeholders in the standard development and publication process.
- Develop an NTCIP 1202 v04 Concept of Operations (ConOps) draft, including detailed use cases and user needs, culminating in a ConOps walkthrough.
- Develop an NTCIP 1202 v04 Software Requirements Specifications (SRS) draft, including detailed requirements and full user need to requirements traceability, culminating in an SRS walkthrough.
- Develop an NTCIP 1202 v04 Standard System Design Details (SDD) draft, including detailed design dialogs, messages and data elements with full user need to requirements to design traceability, culminating in a SDD walkthrough.
- Publish the new NTCIP 1202 v04 Standard that has achieved consensus in accordance with the SDOs approval processes.

2 SYSTEMS ENGINEERING PROCESS APPLICATION

2.1 Systems Engineering Process Planning

The central activity of the NTCIP 1202 v04 Standard Project is a standards development effort that identifies and defines how a management station may wish to interface with a field device to control and monitor traffic signal controllers and associated detectors in a standards-conformant fashion. A systems engineering process (SEP) is being applied to the project incorporating layers of review and modification of the deliverable documents corresponding to the Standards consensus process. The PMP for the NTCIP 1202 v04 Project provides the details of the tasks and schedule and list of the major deliverables.

2.2 Process Inputs

Inputs to this systems engineering process are as follows:

- NTCIP 1202 v03A
- NTCIP 8002 Annex B-1
- Connected Transportation Interoperability (CTI) 4501, Connected Intersections Implementation Guide
- City of Anaheim NTCIP 1202/1218 Standards Testing Project
- NTCIP 9014, Infrastructure Standards Security Assessment (ISSA)
- SAE International J2735, V2X Communications Message Set Dictionary
- Project Management Plan for the NTCIP 1202 v04 Project

2.3 Technical Objectives

The technical objectives for the NTCIP 1202 v04 are identified in the project scope description found in Section 2.1.1 of the NTCIP 1202 v04 PMP.

The Measure of Effectiveness (MOE) for the NTCIP 1202 v04 project is a complete and traceable standard that satisfies all the user needs expressed in the Concept of Operations.

2.4 Training

The project team requires no additional training. Most of the team have worked with device standards and considered subject matter experts in center-to-field communications and the Connected Vehicle Environment program.

2.5 Standards and Procedures

Table 1 identifies the standards or procedures used in the production of the project deliverables. If there are multiple drafts of a deliverable item, only the final deliverable is listed. Deliverable items in the scope description are mapped to Task Order Proposal Request (TOPR) deliverables using the form [TOPR Deliverable].

Table 1. Deliverable Items and Associated Standards or Procedures

Task	Deliverable Item	Standard or Procedure
1.1	Kickoff Meeting	
	Progress Reports [TOPR Deliverable]	
1.2.1	Draft PMP [TOPR Deliverable]	Project Management Plan Template, Technical Exhibit 4 of the PWS
	PMP [TOPR Deliverable]	Project Management Plan Template, Technical Exhibit 4 of the PWS
1.2.2	Draft SEMP [TOPR Deliverable]	INCOSE Systems Engineering Handbook Version 3.2 and IEEE Std 1220-2005
	SEMP [TOPR Deliverable]	INCOSE Systems Engineering Handbook Version 3.2 and IEEE Std 1220-2005
2.1	Stakeholder and SME List [TOPR Deliverable]	
	Draft Questionnaire [TOPR Deliverable]	
	Final Questionnaire [TOPR Deliverable]	
	Stakeholder Interview and Questionnaire Report Summary [TOPR Deliverable]	
2.2	Draft ConOps [TOPR Deliverable]	NTCIP 8002 IEEE 1362
2.3	SME List [TOPR Deliverable]	
	Draft ConOps Walkthrough Plan [TOPR Deliverable]	IEEE 1028
	Final ConOps Walkthrough Plan [TOPR Deliverable]	IEEE 1028
	ConOps Walkthrough Workbook [TOPR Deliverable]	
	Deliver ConOps Walkthrough Comment Resolution Report [TOPR Deliverable]	IEEE 1028
2.4	Final Updated ConOps [TOPR Deliverable]	NTCIP 8002 IEEE 1362
3.1	Draft SRS [TOPR Deliverable]	NTCIP 8002 IEEE 830
3.2	SME List [TOPR Deliverable]	
	SRS Walkthrough Plan [TOPR Deliverable]	IEEE 1028
	SRS Walkthrough Workbook [TOPR Deliverable]	
	SRS Walkthrough Comment Resolution Report [TOPR Deliverable]	IEEE 1028

Task	Deliverable Item	Standard or Procedure
3.3	**Final Updated SRS [TOPR Deliverable]**	NTCIP 8002 IEEE 830
4.1	**Draft SDD [TOPR Deliverable]**	IEEE 1016
4.2	**SME List [TOPR Deliverable]**	
	Draft SDD Walkthrough Plan [TOPR Deliverable]	IEEE 1028
	SDD Walkthrough Workbook [TOPR Deliverable]	
	SDD Walkthrough Comment Resolution Report [TOPR Deliverable]	IEEE 1028
4.3	**Final Updated SDD [TOPR Deliverable]**	IEEE 1016
5	**Draft NTCIP 1202 Test Procedures [TOPR Deliverable]**	NTCIP 8007
	Final NTCIP 1202 Test Procedures [TOPR Deliverable]	NTCIP 8007
6.1	**Proposed User Comment Draft (pUCD) [TOPR Deliverable]**	NTCIP 8001
	User Comment Draft (UCD) [TOPR Deliverable]	NTCIP 8001
6.2	**UCD Comment Resolution Tracking Report [TOPR Deliverable]**	NTCIP 8001
	Proposed Ballot Ready Standard [TOPR Deliverable]	NTCIP 8001
	Published NTCIP 1202 v04 Standard and MIB [TOPR Deliverable]	NTCIP 8001

2.6 Systems Engineer Role

The Systems Engineer (SE) role has a broader influence in the NTCIP 1202 v04 Standard project than that of traditional SE roles. Responsibilities include:

- Preparing with SMEs, a list of Interview Questions and Conducting Interviews.
- Preparing Stakeholder Interview and Questionnaire Report Summary.
- Preparing and maintaining the SEMP.
- Developing the Concept of Operations and Requirements documents for the NTCIP 1202 v04 Standard.
- Assisting with systems engineering portions of design documents.
- Leading walkthroughs of documents at various stages of the project.
- Providing the overall project rigor required to verify that complete and correct project products are being developed.
- Ensuring traceability throughout project documents as appropriate.

General resource levels for the Systems Engineer are shown in Table 3. Resource levels are categorized as follows:

a) Primary – The task is primarily an SE function.
b) Secondary – The SE plays a secondary role in the task.
c) Advisory – The SE plays a small or advisory role in the task.
d) N/A – The task does not apply to the SE.

Table 3. Resource Levels for the Systems Engineer

Project Task	PMP Section	Resource Level
1.1 Monthly Progress Report	2.1.1.1.1	Secondary
1.2.1 Project Management Plan (PMP)	2.1.1.1.3	Secondary
1.2.2 Systems Engineering Management Plan (SEMP)	2.1.1.1.4	Primary
2.1 Review Relevant and Prior and Ongoing Research	2.1.1.2.1	Secondary

Project Task	PMP Section	Resource Level
2.2 Develop Draft Concept of Operations	2.1.1.2.2	Primary
2.3 Walkthrough on Draft Concept of Operations	2.1.1.2.3	Primary
2.4 Final Updated Concept of Operations	2.1.1.2.4	Primary
3.1 Develop Draft Software Requirements Specification	2.1.1.3.1	Primary
3.2 Walkthrough on Draft Software Requirements Specification	2.1.1.3.2	Primary
3.3 Final Software Requirements Specification	2.1.1.3.3	Primary
4.1 Draft System Design Description	2.1.1.4.1	Primary
4.2 Walkthrough on Draft System Design Description	2.1.1.4.2	Primary
4.3 Final System Design Description	2.1.1.4.3	Primary
5 Develop NTCIP 1202 Test Procedures	2.1.1.5	Primary
6.1 Draft NTCIP 1202 v04	2.1.1.6.1	Primary
6.2 Ballot and Final NTCIP 1202 v04	2.1.1.6.2	Secondary

2.7 Constraints

The following constraints have been established for the NTCIP 1202 v04 Project:

a) The project schedule end date is February 15, 2024.
b) Capital expenditures are contractually limited and must be preapproved by ITE.
c) Project travel costs are contractually limited and must be preapproved by ITE.

3 SYSTEMS ANALYSIS AND CONTROL

This section describes how the systems engineering portions of the project will be performed and controlled. Included are the project team organization, a configuration management plan, a verification and validation plan and a risk management plan.

3.1 Team Organization

The effort will be carried out by the project team identified in Figure 1.

The project management team consists of the Project Administrator/Coordinator(s), the Project Manager, the ASC Working Group Committee Co-Chairs, and SDO Liaisons.

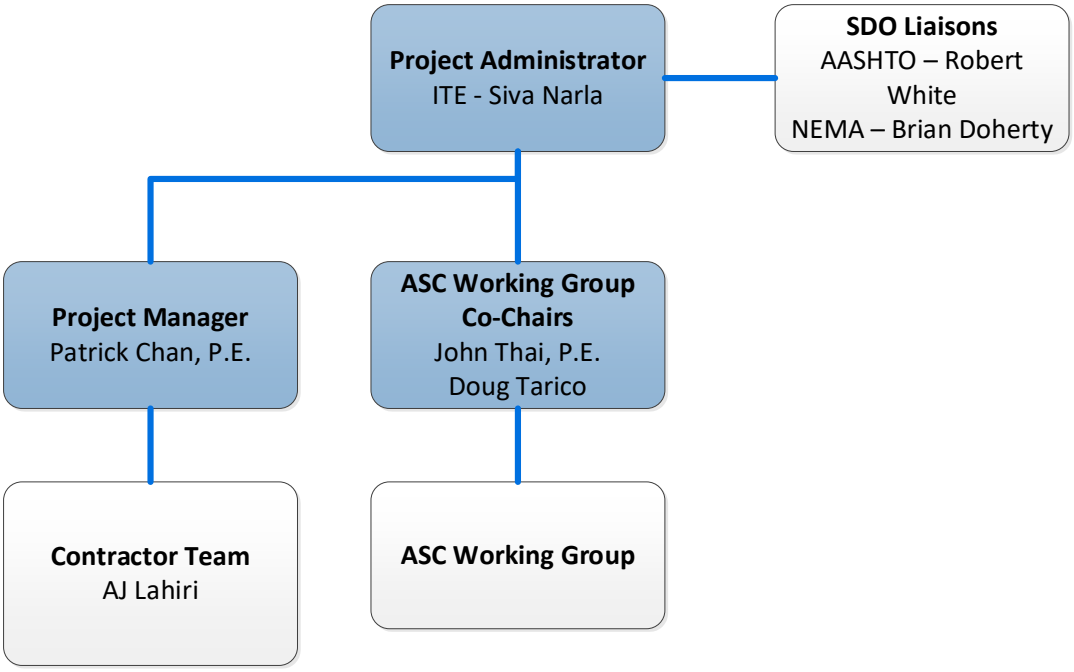

Figure 1. NTCIP 1202 v04 Project Organization

The development of NTCIP 1202 v04 involves a team of contractors to perform the development work and an SDO organizational structure to review and approve the effort.

There are several contractors who will perform various aspects of the development effort. The contractors and SDO staff who will perform various aspects of the development effort have the following responsibilities:

- **Subject Matter Experts** – **TBD**. SME responsibilities are to create the detailed Concept of Operations, Functional Requirements, and Design details. SME incorporate the user needs and requirements identified for the standard and create a design for NTCIP 1202 v04. SMEs are also responsible for generating and updating the contents of the document.
- **System Engineer** – **Patrick Chan, AJ Lahiri**. The Systems Engineers' responsibilities are to maintain the SEMP, to ensure that the plan in the SEMP is adhered to, and to assist in ensuring the completeness and correctness of the NTCIP 1202 v04 document. The responsibilities also include supervising the verification and validation of the standard.
- **Management Team.** The members of the Management Team are listed in the PMP, but include the ASC Working Group co-chairs, and the NTCIP 1202 v04 Project Manager. Their responsibilities include risk monitoring, reviewing task schedules and milestones, and resolving roadblocks.

This contractor team will be responsible for creation of all the project deliverables (described in detail in the PMP), which will include all baseline outputs described in Table 2 of the PMP.

The work item is to be performed under the direction of the NTCIP Joint Committee. The NTCIP Joint Committee is made up of representatives from three SDOs: ITE, AASHTO, and NEMA. The development effort will be carried out by the ASC Working Group, a technical subdivision of the NTCIP Joint Committee. The responsibility of the NTCIP Joint Committee will be to review and accept the UCD developed by the ASC Working Group, along with the comments (and resolutions to those comments) arising during draft review periods. The NTCIP Joint Committee will ultimately recommend sending the UCD of the standard out for user comments, and sending the Ballot draft for balloting and approval.

The responsibilities of the voting members of the ASC Working Group will be to provide input and direction in the development of NTCIP 1202 v04, review each deliverable from the contractor team, develop and maintain the standards publication, engage in liaison activities with other groups with similar interests or domains, and participate in Working Group meetings. As part of the deliverable reviews, the ASC Working Group will perform a review of the completeness and correctness of each deliverable submitted by ITE as described in SEMP Section 3.4.

In summary, the NTCIP Joint Committee provides policy and direction and provides assistance and review and comment (vetting) at the technical level detail of the standard. The ASC Working Group is expected to work closely with ITE at the technical level. The NTCIP Joint Committee members may also participate at the technical level with the ASC Working Group, but NTCIP Joint Committee policy and direction should avoid resolution of detailed technical issues, and instead defer technical issues to the ASC Working Group.

3.2 Risk Management Plan

Risk management is the identification and control of risks associated with the development effort. The goal of risk management is to identify potential problems before they occur, plan for their occurrence, and monitor the system development so that early actions can be taken.

Risk management includes the following general steps:

a) Risk Identification
b) Risk Analysis and Prioritization
c) Risk Mitigation
d) Risk Monitoring

The specific risks associated with development of NTCIP 1202 v04, and the plan for dealing with these risks, are defined below.

3.2.1 Risk Identification

The risks associated with the development of NTCIP 1202 v04 are affected by the nature of the development, specifically that this is a major update to an existing standard, not a new development effort. The following six risk areas have been identified and will be analyzed in the following section:

Risk Area #1: Incorrect or Incomplete Inputs on User Needs and Requirements

The risk is that the contractor team does not get correct or complete inputs on User Needs and Requirements from the User Needs targeted user interviews. This development effort will be identifying a set of needs and requirements for NTCIP 1202 v04. The PMP and SEMP identify the User Needs targeted user interviews, occurring early in the development process, as the primary venue for obtaining information from which User Needs are identified from the ASC Working Group, public sector agency representatives, and deployers. Requirements are later derived from the User Needs.

The assumption in the project development cycle is that complete and correct inputs will be obtained from all sources, enabling the contractor team to proceed with the development of the ConOps and requirements. What if this assumption is not correct – i.e., the key stakeholders are not able to be interviewed to provide their inputs, or those who are the subject of targeted interviews provide incomplete inputs. This is a risk area that will need to be carefully evaluated and monitored by the management team.

Risk Area #2: User Needs (or Requirements) come in late in the process

The risk is that User Needs or Requirements come in late in the process; that is, new User Needs (or more likely new Requirements) are identified after the “final” needs or requirements have been developed. This

could happen as new stakeholders become involved during the development process, or as each step through the process uncovers new or changed needs or requirements.

Risk Area #3: Stated schedule of drafts is not sufficient

The risk is that the project schedule is not sufficient to achieve consensus from the ASC Working Group. The project schedule has been developed to create a first draft, second draft, and final for each of the key deliverables (ConOps, Requirements, and Design Content). To maintain this schedule will require numerous ASC Working Group reviews. The risk that is identified is that key people do not agree on the details at any step and after the set of drafts open issues remain (potentially causing the need for additional drafts to be created).

Risk Area #4: Multi-Version Incompatibility

The risk is that the development of User Needs and Requirements show that there are many changes requested that could "break" backward compatibility with NTCIP 1202 v02 and NTCIP 1202 v03. There are many existing deployments which are using NTCIP 1202 v02, and this work item has the goal of addressing MVI or dealing with the consequences. Addressing the inputs from some deployers (e.g., problems they have encountered) might cause changes that would impact backward compatibility for other deployers. The risk is that the development may not be able to satisfy both cases (changes requested by one developer vs. backward compatibility for another).

Risk Area #5: Identified User Needs/ Requirements have larger than expected design impact

The risk is the possibility that input obtained during the User Needs targeted user interviews, and from comments received from deployers, will identify additional user needs and requirements that have a design impact that exceeds the extent of NTCIP 1202 revisions and updates that were included in the project proposal. For example, an agency may have a user need for whole new set of functions that are not supported by NTCIP 1202. This user need in turn creates requirements and data concepts significantly more than expected in the work plan. Such significant additions could take weeks of additional effort to document in the ConOps, the requirements, and the design content, including ASC Working Group discussions and comments review.

Risk Area #6: Resource Availability

The risk is that the availability of ITE and ASC Working Group resources may be insufficient to complete a task on schedule. Although resources have already been mapped for each task and subtask in the PMP, unanticipated events may prevent one or more resources from completing their assigned subtasks on schedule. In addition, the volunteer and consulting resources of the ASC Working Group will experience the additional workload of disposing of maintenance user comments (UCs) while also adding the systems engineering content in NTCIP 1202. The UCs ranged from simple (resolution) to complex.

3.2.2 Risk Analysis and Prioritization

For the risk areas identified, these risks were categorized in terms of the type of risk, magnitude of the risk, and likelihood of the risk occurring.

Risks that may affect the work item NTCIP 1202 v04 fall into three general categories:

a) Technical. Risks affecting the completeness or correctness of the resulting NTCIP 1202 v04 Standard.
b) Schedule. Risks that cause schedule slippage.
c) Cost. Risks that cause cost to exceed budget.

The magnitude of risk can be characterized as:

a) Large – Has the following characteristics:
   i) Technical. Results in errors that do not allow deployments to use parts of the NTCIP 1202 v04 as developed.
   ii) Schedule. Results in schedule slippage of more than two months.
   iii) Cost. Results in cost overrun of more than five percent.
b) Medium – Has the following characteristics:
   i) Technical. Results in errors that require additional work for the contractor team or the ASC Working Group to resolve.
   ii) Schedule. Results in schedule slippage of 1-2 months.
   iii) Cost. Results in cost overruns of less than five percent.
c) Small – Has the following characteristics:
   i) Technical. Results in minor errors that can be corrected through the normal standards maintenance process.
   ii) Schedule. Results in schedule slippage of 1-3 weeks.
   iii) Cost. Results in cost expenditures that don't match budget plan, but do not exceed the overall budget.

The likelihood of the risk occurring can be characterized as:

a) High (greater than thirty percent)
b) Medium (less than thirty percent)
c) Low (less than 10 percent)

Given these three dimensions, the risk areas for the work item can be analyzed and prioritized, and are summarized in Table 2.

Table 2. Summary of Risk Analysis and Prioritization

Risk area	Category	Magnitude	Likelihood	Priority
Risk Area #1. Incorrect or incomplete inputs on User Needs and Requirements	Technical	Medium	High	1
Risk Area #2. User Needs (or Requirements) come in late in the process	Technical, Schedule, and Cost	Medium	Medium	2
Risk Area #3. Stated schedule of drafts is not sufficient	Technical, Schedule	Medium	Medium	2
Risk Area #4. Multi-Version Incompatibility	Technical	Small	Low	3
Risk Area #5. Identified User Needs/ Requirements have larger than expected design impact	Technical, Schedule, and Cost	Medium	Low	2
Risk Area #6: Resource Availability	Schedule	Small	Low	3

Risk Area #1: Incorrect or Incomplete Inputs on User Needs and Requirements

Incorrect or incomplete inputs collected from the User Needs targeted user interviews represents a primarily technical risk that user needs or requirements will not be captured early enough in the development process. The magnitude of the impact is judged to be medium since missed needs or requirements could result in errors in the standard that would require the ASC Working Group to rework the standard at a later date. The likelihood is judged to be high since some key participants in the process, such as deployers,

may not be selected or scheduled to be User Needs user interview targets, or may choose to decline their interview.

From a prioritization standpoint this is judged to be the highest priority risk and one that will be closely monitored.

Risk Area #2: Late User Needs (or Requirements) come in late in the process

New needs (or requirements) come in late in the process and represent primarily a technical risk, but do have cost and schedule components if the new requirements require additional iteration through parts of the process. The magnitude of this risk is also judged to be medium, due to its potential to impact schedule and/or cost. Overall, the likelihood is considered medium, likely because prior experience from other ITS standards development indicate that developers/integrators don't resonate to user needs and requirements since they deal in and are more familiar with design, and thus user needs and requirements don't surface until the details of design are debated. The likelihood is mitigated by some of the risk mitigation features built into the project plan (see discussion below). From a prioritization standpoint this is judged to be the second highest risk and one that will be closely monitored.

Risk Area #3: Stated schedule of drafts is not sufficient

The project schedule describes one draft before a final version of each key deliverable (ConOps, requirements, and design content). Scheduled review times are short there may not be adequate reviews or consensus on the details of any of the deliverables. This is primarily a technical risk and a schedule risk. The magnitude of the risk is judged to be medium, because some of the known issues are complex in nature and reaching consensus may be difficult. However, this risk is mitigated because the management team may schedule additional drafts or review periods if necessary, or create subgroups of the ASC Working Group to expedite a resolution. The likelihood is medium, given the planned approach to technical reviews discussed below. From a prioritization standpoint this is judged to be the second highest risk and it will be closely monitored during the development.

Risk Area #4: Multi-Version Incompatibility

The User Needs and Requirements show that there are many changes requested that could cause Multi-Version Incompatibility (MVI). NTCIP 1202 v02 has a large deployment footprint around the United States, therefore, the ASC Working Group needs to identify a mechanism to address MVI or deal with the potential consequences (if any) for deployers. The likelihood that this will occur is medium. The magnitude should be small as other ITS standards have encountered similar problems and have defined solutions to this problem.

Risk Area #5: Identified User Needs/ Requirements Have Larger Than Expected Design Impact

This is primarily a schedule and cost risk, with some technical risk. Documenting user needs and requirements may exceed the expected time allotted to the documentation process, and to create the design content. The likelihood is low assuming that a majority of the user needs for interval-based controllers is similar to those of phase-based controllers. If it does occur, its magnitude should be small relative to the overall scope of the standard and it will likely affect the schedule and budget as the additional data concepts are developed to support these requirements. From a prioritization standpoint this is judged to be the second highest risk and it will be closely monitored during the development.

Risk Area #6: Resource Availability

This is primarily a schedule risk. The magnitude of the risk is judged to be low, since there are multiple reviews and thus the impact from any one review is diluted, and since multiple contractors have been

assigned to each subtask and each responsibility. The likelihood is low, given the planned approach to technical reviews discussed below. From a prioritization standpoint this is judged to be lowest of the identified risks, but it will be monitored during the development.

3.2.3 Risk Mitigation

For each risk identified, a mitigation strategy needs to be developed. For the six risk areas identified above, here are some initial risk mitigation strategies:

Risk Area #1: Incorrect or Incomplete Inputs on User Needs and Requirements

The four primary mitigations to this risk area are:

a) Include several example operational scenarios in the ConOps to allow readers to gain a clear understanding of user activities. Through these operational scenarios, users may also identify user needs that have not already been identified.
b) The ASC Working Group co-chairs and the contractor team will coordinate with key deployment or standards representatives to clearly identify the information needed and will follow up prior to the User Needs targeted user interviews to ensure they understand and are able to provide the information. If incomplete information is obtained, the ASC Working Group co-chairs or the contractor team will contact and engage the interviewees for a follow-up phone interview.
c) The draft ConOps may be distributed concurrently to solicit broader feedback from other affected stakeholders beyond the ITE and the ASC Working Group.
d) The contractor team will review other documents, such as CTI 4501, SAE J2735, NTCIP 9014, and from the City of Anaheim NTCIP 1202 Standards Testing Project, to confirm that relevant user needs and functional requirements are properly addressed in this standard. Due to the nature of this NTCIP 1202 v04 development (update of an existing standard), the technical experts on the contractor team should have the ability to “fill in” the incomplete areas based upon knowledge of the current standard.

Risk Area #2: User Needs (or Requirements) come in late in the process

This risk will be mitigated if the mitigation strategies for risk area 1 are successful by uncovering a fairly complete set of requirements and needs. The schedule does recognize that some changes in needs/ requirements will occur and has built in effort (from a cost standpoint) to deal with these. If this risk becomes more severe during the design phase (or later under the UCD development), part of the risk mitigation strategy for this risk will be to explicitly address needs and requirements impacts as part of the design discussion and to engage the ASC Working Group in discussion at each meeting about the importance of the suggested changes.

The management team may activate a rapid response team, if necessary, to address any late user needs or requirements that may be received.

Risk Area #3: Stated schedule of drafts is not sufficient

The three primary mitigations to this risk area are:

a) Divide the ASC Working Group and stakeholders into subgroups, with each subgroup responsible for reviewing a complete section of the ConOps, Requirements Content, and Design Content. Each subgroup of experts in a particular area will perform a detailed review of those sections of the standard relating to their expertise and will engage in several teleconferences with the contractor team to identify and resolve issues relating to the subgroup’s area of expertise. As part of this effort the subgroups will closely review the user needs, requirements and the design, allowing detailed comments to be made and recorded on the spot.

b) Invite the full set of affected stakeholders to each technical review, so if one reviewer does not get a full review, there will be others who do. Ultimately, it is the responsibility of the subgroup to fully review their assigned sections or area of expertise, but any interested party may participate in any technical review.
c) Conduct many of the technical reviews by teleconference or webcast or by similar means so the reviewer's physical presence isn't required. This will increase attendance at the reviews, particularly by those parties who are not able to attend face-to-face meetings.

Risk Area #4: Multi-Version Interoperability

NTCIP 1202 v04 MVI with prior major versions will be respected by the contractor team by compliance with NTCIP 8004 and MIB module maintenance procedures as described in SNMP industry textbooks, such as Perkins & McGinnis. Previously, the NTCIP Joint Committee was evaluating MVI to provide backward compatibility between major versions, or at least identify and clearly document known compatibility issues. This work item on a large and extensive NTCIP 1202 v04 MIB will be an important test of SNMP industry maintenance and revision procedures by the contractor team. An effective MVI approach will mitigate this risk.

Risk Area #5: Identified User Needs/ Requirements have larger than expected design impact

The risk mitigation action for this risk will begin with the contractor team making an assessment early in the development of the design whether the defined needs and requirements will have a larger than expected impact on design. The contractor team will advise the ASC Working Group on the prioritization of design areas and seek their direction on areas of concern. A guideline for the contractor team on what user needs and requirements to direct to the ASC Working Group is the objective of this project, outlined in Section 2 of the PMP. The ASC Working Group will determine what needs (and requirements) are essential to the final document, then direct the contractor team to proceed with the design to fulfill the requirements to satisfy those User Needs. This approach will reduce the probability of the risk occurring.

Risk Area #6: Resource Availability

The ASC Working Group shall consider the resource availability at each monthly meeting.

In the area of disposing of UCs, the ASC Working Group will follow strict categorization, prioritization, and triage practice for the maintenance comments. The ASC Working Group will develop a categorization and prioritization scheme to rate each comment.

Finally, the NTCIP Coordinator will utilize a managerial response to replace any non-performing resource, if necessary.

3.2.4 Risk Monitoring

Risk monitoring defines when and how the risks will be monitored. The plan for risk monitoring is to review the risk areas and identify any other risks that may have appeared at monthly project teleconferences. These risk areas include insufficient or late inputs from stakeholders, resource availability, schedule adherence issues including not meeting milestones, and cost overruns. In addition, the SEMP will be updated (if required) after the completion of each subtask (ConOps, Requirements Content, Design Content, UCD, and Recommended Standard) in order to review the basic risk areas and add or delete areas as appropriate. Any members of the ASC Working Group or interested parties also may identify risks that may have surfaced.

If a particular risk is not addressed or an allocated resource is not available, the NTCIP Coordinator will re-allocate resources as necessary.

3.3 Configuration Management Plan

Configuration management is defined as: "A management process for establishing and maintaining consistency of a product's performance, functional, and physical attributes with its requirements, design and operational information throughout its life" (ANSI/EIA 649-1998). This plan for configuration management of the NTCIP 1202 v04 development effort identifies an initial set of outputs that will form the baseline and discusses the planned process for managing the configuration of the baseline outputs.

3.3.1 Baseline Outputs

The following products of the development effort form the initial definition of the baseline that will come under configuration management:

a) **NTCIP 1202 v04**. This represents the various document outputs that will occur during the development process, including the ConOps, Requirements Content, Design Content, Test Procedures.
b) **Traceability files**. This is the file (or files) that defines the traceability of needs to requirements, and the traceability from requirements to design. This is the PRL and the RTM in Microsoft Word and Microsoft Excel. It also includes the report from the Standards Verification Tool (SVT)
c) **ASN.1 MIB** including compiled object definitions.
d) **Project Management Plan**.
e) **Systems Engineering Management Plan**.

All of the documentation created on the project will employ a document numbering scheme that contains document name, version (if applicable), and date of document creation.

3.3.2 Change Control Procedures and Baseline Management

3.3.2.1 Baseline Creation of Comments Database and Comments Traceability

The initial baseline of the proposed revision database (formerly known as the comments database) will be created from the list of current outstanding (unresolved and new comments) of NTCIP 1202 v03.

The proposed revision database will be maintained to track proposed revisions and resolution status, as well as to define the resolution itself and impact on the NTCIP 1202 v04 (specifically, tracing to any section, such as ConOps, Requirements, or Design Content, requiring a change).

The proposed revision database is likely to include most of the following fields:

a) **UC Number**. The proposed revision number assigned by the Systems Engineer. (This field may or may not be included, since some submitters choose to assign their own (sequential) numbers to their proposed revisions (comment). In such cases, it may be practical to assign a single "collective" UC number to all, or it may not be practical to assign unique UC numbers, and it may not be necessary to do so.
b) **Date Received**. Date the proposed revision was received by the Systems Engineer. (This field may not be included, since most of the proposed revisions are likely to be received at the same time (following development of the User Comment draft).
c) **Commenter**. Name of the person providing comment.
d) **Organization**. Organization the Commenter represents.
e) **Document Version**. Version of the document to which the proposed revision applies.
f) **Keyword**. A list of keywords describing the topic of the comment.

g) **Section Number**. Section number and paragraph number (within that section), table, or figure number of the document to which the proposed revision applies.
h) **Status**. Indicates if the proposed revision status is Open or Closed. While some other designations may be used on an interim basis, at the completion of review, the status of each proposed revision should be "closed."
i) **Existing Text**. Existing text (within the document) to which the proposed revision applies.
j) **Proposed Text**. Sometimes referred to as "suggested alternative language," this is the text that the submitter wants included in the document.
k) **Reason**. This text identifies the submitter's brief reason for proposing a revision.
l) **SC Response**. This entry includes: the date the comment was discussed and closed by the ASC Working Group; the action taken by the ASC Working Group (such as Accepted, Accepted as amended (with a description of amended language), Not Accepted (and a reason), Withdrawn (by submitter), or No Longer Applicable.

This information provides a basis for response to the submitter (in cases where the submitter is not a member of the ASC Working Group, or (in the case of a proposed revision that serves as the basis of a negative vote, at the ASC Working Group or SDO level) so that a response to the voter may be provided.

The proposed revision database will be updated and made available to the ASC Working Group and to reviewers after the completion of the UCD stage, and subsequently.

3.3.2.2 Managing Updates to NTCIP 1202

As part of Subtask 5, the following describes the process for addressing proposed revisions and managing updates to the NTCIP 1202:

a) The NTCIP Coordinator receives proposed revision(s) and assigns a proposed revision ID number. Proposed revisions are expected to include: existing text, proposed text, and a reason for the proposed revision. Should commenters provide inputs that do not include these elements, these are likely to be returned to the commentor with a request that missing elements be provided before consideration.
b) The proposed revision is consolidated in an updated proposed revision.
c) The contractor team (consisting of ITE staff, the SE, and/or the SME may propose a resolution "disposition" and identify what standard subsections and technical specifications should be changed.
d) The ASC Working Group provides consensus on the resolution disposition. Some proposed revisions will be presented to the ASC WG for consensus at meetings, either electronically or face-to-face. Editorial proposed revisions, such as grammar or spelling, do not have to be reviewed for consensus by the ASC Working Group.
e) The appropriate document draft version is updated. The minor version number of a document will be updated once prior to each release, whether internal to the consultant team, internal to the ASC Working Group, or publicly released.
f) Once all proposed revisions have been disposed, the proposed Recommended Standard version of NTCIP 1202 v04 will be ready for presentation to the NTCIP JC.
g) When all proposed revisions are resolved, the proposed revisions database will be updated and its file name revised per the file naming conventions.
h) Proposed revisions will be maintained in a database with all proposed revisions throughout the life of NTCIP 1202 v04.

3.3.2.3 Configuration Management Plan for Systems and Related Documentation

As part of Task 2 through Task 4, this section includes the configuration management plan for the system and related documentation, and programmatic documents such as schedules. The baseline outputs that will be put under configuration management are defined in SEMP Section 3.3.1.

The processes for configuration management are described below:

a) **User Form to Submit Proposed Revisions**. Reviewers are expected to provide proposed revisions using an SDO specified form.
b) **Maintenance of the Proposed Revision Database**. A member of the contractor team will be assigned the duty of maintaining and editing the proposed revision database. After the comments database has been updated, as defined in SEMP Section 3.3.2.2, a copy of the proposed revision database provided to ASC Working Group members and others as a precursor to disposition, and as notice of disposition.
c) Standard date and version numbering. The assignment of the date and minor version numbers will be assigned in compliance with NTCIP 8002.
d) **Electronic document package management.** Each minor version of the NTCIP 1202 v04 will be archived in a subdirectory on the ITE project website.

The NEMA NTCIP Coordinator also serves as the Registrar of document numbers, and versions, as well as nodes, external user comments, and other standard NTCIP attributes. As the Registrar, the NEMA NTCIP Coordinator will be responsible for enforcing the Configuration Management plan rules, and will examine controlled documents for CM plan conformance prior to the distribution of those documents to committees and reviewers.

3.4 Verification and Validation Plan

Verification and validation (V&V) of whether the information content of NTCIP 1202 v04 is complete and correct will rely on eight reviews of the pertinent information, summarized in the list below, and detailed in the subsequent Technical Review subsections:

a) The contractor team and the ASC Working Group will perform at least two technical reviews of the ConOps, Requirements, and Design Content.
b) The contractor team and the ASC Working Group will perform a check for completeness and correctness of the User Needs and Requirements wording. The User Needs and Requirements are documented in the ConOps and the SRS. The wording of each User Need will be evaluated as expressing a major capability, being solution free, and capturing intent and rationale. The wording of each Requirement statement will be checked for identifying a necessary attribute, capability, characteristic, or quality of the system in order for the system to have value and utility. This wording check will be presented to the ASC Working Group and other stakeholders as part of respective Walkthroughs.
c) The contractor team and the ASC Working Group will perform a check for logical completeness by performing a requirements traceability and consistency check. Requirements traceability is documented in the PRL and the RTM. This requirements traceability check will be presented to the ASC Working Group and other stakeholders as part of the SRS Walkthrough efforts.
d) The contractor team and the ASC Working Group will perform a Design Content Consistency Check of the new Requirements content to the prior and/or revised design elements. This check will be presented to the ASC Working Group and other stakeholders as part of the SDD Walkthrough.
e) The contractor team will convene the ASC Working Group to review the Draft NTCIP 1202 Test Procedures for Annex C of NTCIP 1202 and adjudicate any comments.
f) The contractor team will compile the 1202 v04 MIB in ASN.1 format prior to the proposed User Comment Draft (UCD) to check the design database for completeness and correctness. The design check will be performed again prior to the proposed Ballot Ready Standard.

g) The UCD version, distributed to all interested parties in the ASC Working Group with an invitation to submit proposed revisions (formerly known as “user comments,” is a customer-based V&V activity.
h) The proposed Ballot Ready Standard, distributed to the ASC Working Group for review, comment and acceptance, is a V&V activity.
i) The SDO Ballot version, approved by the NTCIP Joint Committee, distributed by the SDO organizations to their members, etc., with an invitation to submit ballot comments, is a customer-based V&V activity.

3.4.1 Walkthrough Reviews

Walkthroughs, sometimes referred to as “technical reviews,” or “technical walkthroughs,” provide a structured and organized approach to reviewing project products to determine if they are complete, correct, and accurate. Walkthroughs are used to identify defects (in needs, requirements or design) and identify alternative solutions at specified points in development (such as ConOps, SRS, and SDD). Walkthroughs are also used to clarify outputs (needs, requirements, or data concepts) and create a common understanding among the reviewers of the material. Walkthroughs represent the “control gates” that must be passed before the project can proceed to the next step in the development process. Walkthroughs generally focus on technical “correct-ness” and logical consistency; however, in conjunction with the SRS Walkthrough, requirements traceability (as reflected in PRL) is evaluated; and, in conjunction with the SDD walkthrough, requirements traceability (as reflected in the RTM) is evaluated.

USDOT’s Standards Verification Tool (SVT) software will be used to verify the traceability between Design Content, Requirements, and User Needs, performing logical consistency checks.

Table 3 provides a summary of the planned Walkthroughs for the project. The table does not include the periods of time allocated for ASC Working Group members to perform reviews. The information in Table 3 has been extracted from the PMP and the review dates are per the schedule located in the PMP.

Table 3. Technical Reviews

Task	Technical Reviews Reviewer(s) and Target(s)	Type	Length (days)
2.3.9	Contractor Team, ASC Working Group, and stakeholders does Walkthrough of Draft ConOps	Video Conference	5
3.2.6	Contractor Team, ASC Working Group, and stakeholders does SRS Walkthrough, as well as updates to ConOps for logical consistency and user need traceability.	Video Conference	5
4.2.6	Contractor Team, ASC Working Group, and stakeholders does SDD Walkthrough, as well as updates to ConOps and SRS for logical consistency and requirements traceability.	Video Conference	5
5.5	Contractor Team and ASC Working Group review the Draft NTCIP 1202 Test Procedures.	Video Conference	1
6.1.4	All interested stakeholders review and propose revisions to the pUCP to develop the UCD.	Email	5
6.1.7	NTCIP Joint Committee reviews UCD.	Email	10
6.2.4	NTCIP Joint Committee reviews Ballot Ready Standard	Email	10
6.2.5	SDO members review RS, ballot, and approve email	Various	45

One of the risk mitigation strategies identified was to form subgroups that would focus on a particular area of NTCIP 1202 v04. As such, the ASC Working Group may schedule additional, subsequent reviews, other than those listed in Table 3 to support a review by some or each of those subgroups. If needed, such reviews will be conducted by conference call, possibly with a web element.

At least two weeks prior to each scheduled Walkthrough, the contractor team will develop a draft review output to be used in the conduct of the Walkthrough. This output will include a draft Walkthrough workbook to guide Walkthrough participants in their review for logical consistency, quality of User Need and/or System Requirements, and (for SRS and SDD Walkthroughs) requirements traceability. The contractor team (assisted by the ASC Working Group and stakeholders) will perform a logical consistency check, including a requirements traceability check (See SEMP Section 3.4.2) if appropriate, at appropriate points prior to or following Walkthroughs, using SVT software when appropriate.

The Walkthrough workbook will be used to manage revisions identified during the walkthrough. Officially submitted or external comments received prior to or following the Walkthroughs will be entered into the proposed revision database. Editorial proposed revisions, such as grammar and spelling, do not have to be disposed of during the Walkthrough or entered in the proposed revision database and can be addressed directly by the contractor team. However, as a part of each Walkthrough, any entry in the proposed revision database that may impact the Walkthrough will be brought to the attention of Walkthrough participants for consideration. Any changes to the proposed revision database (new comments and resolutions to old comments) resulting from the Walkthrough will be entered in the proposed revision database, for subsequent consideration. Informal comments, such as those that may arise during a Walkthrough, may not be entered in the proposed revision database; rather, the draft resulting from the Walkthrough serves to capture proposed revisions.

Beyond addressing the comments received, the format of and procedures used for each Walkthrough and subsequent review will vary by subtask and depending on whether the review is of the first draft of ConOps or later walkthroughs. For example, the ConOps Walkthrough may only consist of a page-by- page review of the user needs for correctness and logical consistency; while the SRS Walkthrough should consist of a review for correctness and logical consistency, as well as requirements traceability. The SDD Walkthrough will review content from the design document as part of its logical consistency and traceability check, which may result in revision of the ConOps. Or, at later stages, only content that has changed since the ConOps

Walkthrough may be subjected to logical consistency and requirements traceability checks. Regardless, IEEE 1028-2008's Section 7 will be used as a reference to design and conduct the Walkthrough, and the format and procedures to be used for that walkthrough shall be included in the draft review output prior to the Walkthrough.

3.4.2 Requirements Traceability and Logic Check

One of the key control and validation activities of the development is tracing requirements. This tracing will occur in two directions — backward to the User Needs defined in the ConOps, and forward to the specification of data concepts.

Two types of traceability will be managed throughout the development process:

a) User Needs to Requirements traceability, called a Needs to Requirements Traceability; and
b) Requirements to Design traceability, called a Requirements Traceability.

The User Need, Requirement, and Interface Dialog identifiers will use the identification scheme defined in NTCIP 8002, Annex B1. The Government has instructed the SDOs that to promote usability, the automatically-numbered section heading numbers are required to make the standards publications easier to use for acquisitions, implementations, and testing.

3.4.2.1 User Needs to Requirements Traceability and Logic Check

The ASC Working Group and stakeholders will review and comment on the check of needs and requirements performed by the contractor team to ensure that all user needs are defined and that the requirements stated satisfy a particular user need. The User Needs to Requirements traceability is documented in the PRL. The PRL forms the basis for this check and its review by the stakeholders.

The contractor team anticipates holding at least one Walkthrough in Washington, D.C. to enable the participation of all SDO staff and the ITS JPO support staff.

The PRL lists all the user needs in the ConOps and is used to verify that all the User Needs have been satisfied by at least one Requirement. The PRL will be created after the completion of the ConOps, and then will be updated at each remaining step of the development process. The logical association of the User Needs and their supporting Requirements will be tested. Illogical associations will be eliminated, or statement wording will be revised.

The goals and technical approach of the logical consistency check is to ensure that the organizational list of the concepts (the UNs and Functional Requirements (FR)) make a logical framework that makes sense to traffic management engineers. While software (such as SVT) may be used for Requirements Traceability purposes, it is anticipated that logical consistency checks are the responsibility of the contractor team, the ASC Working Group, and stakeholders, as part of the ConOps and SRS Walkthroughs. The concepts should flow from broad to narrow, or in some other easily-recognized framework. The technical approach can include listing in a table (e.g., the PRL), organizing, diagramming, charting, or using other graphical techniques to build and visualize a framework. Walkthrough workbooks are anticipated for both the ConOps and SRS Walkthroughs to guide review of technical correctness and traceability.

Key fields from the PRL are shown below.

a) **User Need ID.** The unique number assigned to the user need statement.
b) **User Need.** A short descriptive title identifying the user need.
c) **FR ID.** The unique number assigned to the functional requirement statement.
d) **Functional Requirement.** A short descriptive title identifying the functional requirement.

e) **Conformance.** Indication if the requirement is mandatory or optional to support the specified User Need.
f) **Support.** User selectable to indicate yes or no to the requirement.
g) **Additional Specifications.** Identifies other requirements that must be satisfied, such as Performance Criteria. Performance is defined as a quantitative measure characterizing a physical or functional attribute relating to the execution of a process, function, activity, or task; and includes such measures as quantity, timeliness, and readiness. Performance Criteria are established using the words “must” or “must not.” [rev in G.01, from INCOSE and NASA references]

The layout of the PRL is presented in Table 4.

Table 4. PRL Fields

User Need ID	User Need	FR ID	Functional Requirement	Conformance	Support	Additional Specification
User Need Identifier	Title of the User Need	Requirement Identifier	Title of the Requirement	If requirement is required to support the User Need	Allows a user to select the requirement	Identifies other requirements to be satisfied.

Upon completion of the PRL, the contractor team will perform a traceability check of NTCIP 1202 v04 between Requirements and User Needs. If new Requirements cannot be traced to User Needs, then the Requirement will be deleted. If the Requirement was previously published in NTCIP 1202 v03, then the Requirement will be deprecated.

3.4.2.2 Requirements to Design Traceability and Logic Check

As part of Task 4, during the SDD Walkthrough, the contractor (development) team, the ASC Working Group, and stakeholders will review and comment on the mapping of requirements to design elements (data concepts) to ensure that all requirements are satisfied by the design elements. The Requirements to Design traceability will be documented in the RTM. The RTM forms the basis for this check and its review by stakeholders. In this way, the RTM will be used to verify and validate that a dialog satisfies one or more information exchange requirements. A Walkthrough workbook is also anticipated prior to the SDD Walkthrough to guide review.

The RTM will map from requirements to dialogs, data object, and block objects. Each requirement will map to one and only one dialog with its associated objects and block objects. The RTM will be created after the completion of the requirements content, then will be updated at each remaining step of the development process.

Key fields for the RTM follow:

a) **FR ID**. The unique number assigned to the functional requirement statement.
b) **Functional Requirement**. A short descriptive title identifying the functional requirement.
c) **Dialog ID**. The number assigned to the dialog description.
d) **Object ID.** The number assigned to the data or block object.
e) **Object Name.** The actual object name used in the design database.
f) **Additional Specifications.** Identifies other requirements that must be satisfied, including user selectable range values. (i.e., duplicated text from PRL, plus object range definitions for each sub-ranged object.)

The layout of the RTM is presented in Table 5.

Table 5. RTM Fields

FR ID	Functional Requirement	Dialog ID	Object ID	Object Name	Additional Specification
Requirement Identifier	Title of the Requirement	Dialog Identifier	Object Identifier	Name of the Object	Identifies other requirements that must be satisfied

In addition, while software (such as SVT) may be used for Requirements Traceability purposes, it is anticipated that logical consistency checks remain the responsibility of the contractor team, the ASC Working Group, and stakeholders, as part of the SDD Walkthrough. The contractor team will provide periodic reminders to ASC Working Group and stakeholders, so that this responsibility is not overlooked.

Upon completion of the RTM, the contractor team will perform a traceability check of NTCIP 1202 v04 for any orphan objects that may have been overlooked as part of the preceding Walkthroughs, i.e., any dialogs, data objects, or block objects that have not been mapped to a requirement. Those orphan objects will be reviewed with the NTCIP 1202 v04 to determine if any User Need and Requirement can be identified that the objects can be mapped to. If no User Need and Requirement can be identified for new object, that object will be deleted. If no User Need and Requirement can be identified for object previously published in NTCIP 1202, that object will be deprecated.

When the project is at Task 5, each Systems Engineering (SE) element will have been considered during at least one walkthrough, and during at least one walkthrough, participants will have considered a “logical consistency check” signified by a question for each SE element in a walkthrough workbook. For each SE element, participants are asked a question of the form: “Is the [systems engineering element] logically consistent with [the related systems engineering element(s)]?” The logical consistency check is, by its nature:

a) **Subjective**—requiring a moment of critical thinking by each walkthrough participant, regarding each Systems Engineering element (user need, requirement, SDD, or test case); and
b) **Incremental**—conducted as part of each walkthrough.

To restate, it is anticipated that, logical consistency for each SE element is evaluated:

a) When new SE elements are developed, or when existing SE elements are revised, by the Systems Engineers;
b) During at least one walkthrough, as SE elements are developed and traced (when walkthrough participants consider the question “is this SE element logically consistent?”); and finally,
c) At this stage, logical consistency is evaluated for SE elements, to ensure that SE elements are “clear, concise and properly constructed ensuring proper communication is translated into the document, and reflected in the design” is verified. (See CMII.)

APPENDIX A – REFERENCED DOCUMENTS

The following documents are referenced in this SEMP to develop the ASC Working Group Standard:

"NTCIP 8002, v01.08 NTCIP Standards Publication Format," 2005.
"NTCIP 8007, v01.21 NTCIP Testing and Conformity Assessment Documentation within NTCIP Standards Publications," 2008.
"NTCIP 9014, v01.20 NTCIP Infrastructure Standards Security Assessment (ISSA)," 2021.
"CTI 4501, v01.01 Connected Intersections Implementation Guide," 2022
"SAE J2735, JUL2020 V2X Communications Message Set Dictionary," 2022
"INCOSE Systems Engineering Handbook Version 3.2," International Council on Systems Engineering, January 2010.
"ANSI/EIA 649-1998, National Consensus Standard for Configuration Management." NASA Goddard Space Flight Center, Software Assurance Technology Center, "Requirements Engineering" 146-page briefing, author Rosenberg; not dated.
"IEEE Guide for Information Technology – System Definition – Concept of Operations (ConOps) Document," IEEE Std 1362-1998.
"IEEE Standard for Application and Management of the Systems Engineering Process," IEEE Std 1220-2005.
"IEEE Standard for System and Software Verification and Validation," IEEE Std 1012-2012.
"IEEE Standard for Software Review and Audits," IEEE Std 1028-2008.
"IEEE Recommended Practice for Software Design Descriptions," IEEE Std 1016-1998.
"IEEE Recommended Practice for Software Requirements Specifications," IEEE Std 830-1998.
"CMII for Business Process Infrastructure," Vincent C. Guess, 2006, Pages 50, 55-56.
"*Systems Engineering Guidebook for Intelligent Transportation Systems Version 3.0*," USDOT, November 2009.

APPENDIX B – GLOSSARY, ACRONYMS AND ABBREVIATIONS

Term	Definition
AASHTO	American Association of State Highway and Transportation Officials
ASC	Actuated Signal Controller
ConOps	Concept of Operations
FR	Functional Requirement
IEEE	Institute of Electrical and Electronics Engineers
INCOSE	International Council on Systems Engineering
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
JPO	Joint Program Office
MVI	Multi-Version Incompatibility
NTCIP	National Transportation Communications for ITS Protocol
PMP	Project Management Plan
PRL	Protocol Requirements List
pUCD	Proposed User Comment Draft
PWS	Performance Work Statement
RTM	Requirements Traceability Matrix
SDD	System Design Details
SDO	Standards Development Organization
SE	Systems Engineer
SEP	Systems Engineering Process
SEMP	Systems Engineering Management Plan
SME	Subject Matter Expert
SRS	System Requirements Specification
SVT	Standards Verification Tool
TBD	To Be Determined
TMC	Traffic Management Center
TOPR	Task Order Proposal Request
UC	User Comment
UCD	User Comment Draft
UN	User Needs
USDOT	United States Department of Transportation
V&V	Verification and Validation
Walkthrough	A step-by-step presentation by the author of a document in order to gather information and to establish a common understanding of its content.