Program Management
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RTD FasTracks 2016 Lessons Learned

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INTRODUCTION

2016 was a big year for the District with the opening of three new corridors. It also introduced many new challenges to RTD that have carried into 2017. RTD prides itself as a learning organization, so we will assess what went well, and what can be improved, to craft our business practices for the future. RTD has much to be proud of in 2016, but we continue to learn and improve. This report is just a sampling of the many things we learned in 2016.

It should be noted that while every attempt is made to objectively document these lessons, they sometimes reflect a singular point of view, which may not represent a consensus from all stakeholders. In the interest of promoting greater participation in this effort, we are willing to accept that. Also, the lessons presented herein may not be applicable in all circumstances. Our team will review them within the context that they were documented, and apply them to other projects when practical.

It is our intention to report on our Lessons Learned annually, so that we can continuously improve upon our delivery of transit projects.

Bill Van Meter
AGM, Planning

Henry J. Stopplecamp, P.E.
AGM, Capital Programs
Lessons Learned Basics

Lessons Learned (LL) are general statements that describe good practices or innovative approaches that are captured and shared to promote repeat application. They may also be descriptions of adverse practices or experience that are captured and shared to avoid recurrence. Typical sources of Lessons Learned include:

- Improvement Actions
- Contract Changes
- Value Engineering Studies
- Partnering Reports
- Meeting Minutes
- Interviews
- Opinion Surveys
- RTD Board Actions
- Dispute Resolution Findings
- Claims/Lawsuits/Bid Protests
- FTA Lessons Learned Program
- Other Transit Agency Programs

Each lesson will include the same base information: Title, Overview, Background, and Lesson. This will be supplemented by additional information to provide context, querying, and reporting such as: Project, Phase, Additional Project Information, and Major Asset Type.

To facilitate the continuous collection, analysis, and sharing of Lessons Learned, the RTD FasTracks project team has deployed a web-enabled database application called, “The Lessons Learned Module” which is used to capture, review and approve Lessons Learned at the time and point where those lessons are realized.

The following pages were compiled from information collected in the database. It is sectionalized by project for the readers benefit.
FasTracks Program Wide

2016 Lessons Learned
Annual QMO Survey Participant List

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Overview

The distribution list for the Annual QMO Program Survey varied from 2014 to 2015. This led to data comparison issues.

Background

The QMO Program survey began in 2014 and has been conducted annually through 2016. The survey is designed to gather participant feedback on several aspects of the QMO program including training, assessment software modules, quarterly management reviews, improvement actions, priority planning, lessons learned, performance matrix, internal auditing, and general comments.

In 2014, the survey was sent to RTD personnel who were active participants in the QMO program (100 total). In 2015, the survey was sent to the entire FasTracks e-mail distribution list (337 total). It was later discovered that this list had grown to include not only RTD staff, but members of the contractors’ Public Information teams and other stakeholders who had no understanding of the QM O program or its goals. In 2016, the list was again refined to include personnel active in the program (148 total) based on their recent activity within the QMO database or participation at QMO related meetings.

Because the 2015 distribution list was so broad, analyzing the data that was collected via the survey has led to several inconsistencies including:

- Skewed responses since a lower percentage of people were actually involved and/or knowledgeable of the QMO program in the 2015 audience (i.e. responses of those involved appear smaller since there is a larger set of not involved).
- Inaccurate responses, because many of the responders indicated that they were not involved in the QMO program in 2015, but then proceeded to answer specific questions for which they had no practical knowledge.

Lesson

Carefully select the target audience to be included in surveys and replicate the list year after year to produce data that can be compared and analyzed properly.

Steps to Implement

In future QMO Surveys, the list of responders will continue to be selected from active participants in the QMO program based on their roles within the program, their participation in QMO meetings, and their recent activity in the QMO database.
EAGLE PROJECT

2016 Lessons Learned
Overview

During the design/build phase of the Eagle Project, RTD entered into agreements with the Cities of Westminster and Arvada to construct parking garages at the South Westminster and Olde Town Arvada commuter rail stations. The Cities were responsible for design and construction of the garages’ infrastructure, including conduits for emergency telephones and closed-circuit television cameras, while RTD retained responsibility for pulling wire through the conduits and providing interfaces with the equipment. However, coordination of details and scheduling of work presented challenges to successful completion of these projects.

Background

RTD provides and monitors security at all of its transit facilities, including parking garages at park-n-Rides. Infrastructure associated with security monitoring includes emergency telephones (etels) and closed-circuit television (CCTV) cameras. The agreements RTD made with the Cities of Westminster and Arvada stated that the cities would design and install a basic conduit system (a “backbone”), which in practice was performed by an electrical subcontractor, while an RTD on-call contractor would pull wire through the conduits and provide the interfaces for the actual telephone and camera equipment.

On both projects, RTD experienced challenges with the Cities’ contractors in the areas of design coordination and work occurring on schedule. Conduit design drawings are often schematic and the design review process was not able to detect aspects of the systems which would not be satisfactory to RTD. On the construction side, the conduit systems are a small percentage of the overall costs of the garages, and RTD’s perspective was that this work was made a low priority by the Cities and their contractors, to the point where the work was incomplete and not ready for handover to RTD’s contractor, when the Cities were representing that the work was complete.

Lesson

Third parties have found it challenging to design and construct security monitoring infrastructure for RTD’s transit facilities, which meets RTD’s technical and schedule requirements. Difficulties with meeting technical requirements can very easily result in schedule delays.

Steps to Implement

Consider implementing stronger design review requirements for etels and CCTV, such as submittal milestones and/or technical work group sessions, in third party agreements. Also consider reviewing RTD’s own requirements, such as design criteria and technical specifications, for areas of possible clarification, for the third parties’ benefit. Consider implementing stronger contract requirements, such as penalties, for not meeting RTD’s schedules for opening transit facilities.
Parking Garage Coordination – Bus Facility Design

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Overview

RTD entered into an agreement with the City of Arvada to design and construct a parking garage near the Olde Town Arvada commuter rail station, which would also include a bus transfer facility for RTD’s Bus Operations and their passengers. Although RTD reviewed design plans for the garage, the processes used by the City’s contractor introduced changes which resulted in the placement of an overhead drain pipe in the bus transfer facility, which conflicted with the necessary movement of RTD’s buses.

Background

Design and construction of parking garages involves many technical disciplines such as structural, mechanical, and electrical. Design documentation is often complex and inter-disciplinary review is challenging, to the point where 3-D modeling technology (BIM systems) is the most effective method for doing so.

For Arvada’s Olde Town Transit Hub project, RTD’s Eagle Project and Bus Operations staff reviewed the garage’s design and provided comments to the City. Subsequently, and as part of a value-engineering design change, the City’s contractor revised the design of the stormwater detention storage system, which resulted in the placement of an overhead drain pipe through the portion of the garage’s lowest level which was intended for use as RTD’s bus transfer facility. RTD was planning to bring a bus to the garage during the latter stages of construction, to verify safe and efficient operations and identify any adverse conditions (a practice described in RTD’s 2015 Lessons Learned report), but prior to doing so, the vertical clearances over the pavement were measured and the conflict with the overhead pipe was discovered.

At the request of the contractor and the City, the RTD Eagle Project and Bus Operations staff met on site to evaluate solutions. Modified configurations of the bus bay geometry were laid out and tested with actual buses to ensure proper circulation could be maintained. The curb line was modified permanently based upon the field verifications. An agreement between RTD and the City over costs for the modifications has not yet been reached at the time of this writing.

Lesson

RTD bus facility designs can be difficult to review, even when not incorporated with third party projects. The designers need to have a strong understanding of the design requirements, in particular the dimensions of the buses and their turning characteristics. Design changes, including those proposed by construction contractors and the processes for RTD review and approval, also need to be clearly defined, particularly on third party projects. Once constructed, designs which are discovered to be inadequate are often expensive to remedy and can result in schedule delays.

Other facility elements related to bus operations and passenger accessibility, which may be difficult to design and properly locate, include overhead signs and bollard lights.

Steps to Implement
Consider strengthening the design review requirements for bus facilities, such as submittal milestones and/or technical work group sessions, in third party agreements such as Intergovernmental Agreements (IGAs). Also, review the requirements and procedures for design changes and value engineering proposals in the third party agreements with their contractors, to ensure that RTD will have the opportunity to review for any impacts on our facilities.

Consider reviewing the RTD Bus Transit Facility Design Guidelines for areas of possible clarification, such as bus turning templates, to verify that they accurately capture the movement of the rear end of the bus. The Guidelines and turning templates should also be reviewed and updated as appropriate each time new bus models are added to the RTD fleet.
Artwork Installation Coordination

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Overview

Incorporating artwork features into the transit infrastructure at RTD’s rail stations, park-n-Rides, and on structures is important for integrating unique characteristics to reflect the identity of local communities. On the Eagle Project, a diverse collection of artwork from multiple artists was incorporated into the commuter rail stations and on some structures. There were challenges largely associated with coordination between RTD, the artists, stakeholders, and contractors that had to be overcome to achieve successful incorporation of artwork into the transit infrastructure.

Background

The selection of artists and artwork is managed by RTD at the FasTracks program level, with a coordinator serving as an interface between the artists, the RTD project staff, and the contractors responsible for constructing the primary transit infrastructure (Denver Transit Partners in the case of the Eagle Project).

Coordination between the artists and DTP was necessary during design and construction of the Eagle project. For example, one category of artwork was the canopy windscreen glass on the station platforms. The artwork design had to be coordinated with the design of the canopies, and construction schedules coordinated to ensure timely installation. The artists also had to coordinate with DTP on issues such as construction safety and site access procedures, since their crews had to cross the tracks during the testing of trains to reach some of the locations where the artwork would be installed.

Another example was the need for coordination among many contractors which involved the scheduling of artwork installation by an artist, with the installation of landscaping work related to the artwork being performed by a different contractor.

Another challenge faced on the Eagle Project was that although many of the artists were local to the Denver area, at least one artist was based out-of-state, which made coordination with an RTD on-call contractor difficult.

Lastly, there were some artwork features that were under consideration, but ultimately not able to be incorporated into the project. For example, specialized lighting features were contemplated for a pedestrian bridge which crosses both the commuter rail tracks and a major freight railroad yard. Installation would have entailed extensive and difficult coordination with the railroads to minimize impacts to their operations, and maintenance of the features (by DTP’s operations entity) would have been difficult for similar reasons.

Lesson

Early coordination between RTD, the artists, stakeholders, and contractors is important to achieve successful incorporation of artwork into the transit infrastructure. Appropriate engagement of stakeholders is essential to identify the decision-makers and manage expectations. The artists must also be actively engaged with and responsive to contractors’ design teams and field crews, to avoid design conflicts and errors, and construction scheduling or site access issues, any of which can result in delays and increased costs for the artists and contractors.
Construction and installation procedures, utility requirements, and ongoing maintenance of the artwork are also important considerations in the selection and approval of designs, and there may be locations where these efforts would be complicated enough to rule out some proposed features.

**Steps to Implement**

Consider identifying a project team member with allocated time for artwork coordination, who will also have awareness of other issues on the project, which may be difficult for a program-level coordinator to track. Ensure that this team member has an understanding of RTD’s procurement requirements, including where to obtain guidance should questions arise.

Consider implementing a process to clearly identify the scope of artwork installations and aesthetic betterments with stakeholders, and also define the review and approval processes for artwork designs and construction work. The process should also identify all stakeholders (including utilities and freight railroads) that would be impacted by the installation of the artwork, and its ongoing maintenance.

Consider reviewing the requirements for artist coordination with RTD and contractors, particularly if selection of artists who are not local to the Denver area is contemplated.
System Performance Demonstration Oversight

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Overview

The Eagle Project Concession Agreement required Denver Transit Partners to perform a comprehensive demonstration of each commuter rail corridor as the culmination of the integrated testing program. These demonstrations are called System Performance Demonstrations, and their objectives are to test the complete integrated commuter rail network, including subsystems, operating personnel and operating procedures, in order to confirm readiness for entry into revenue service. The RTD project team developed several strategies to oversee these demonstrations to verify DTP’s reporting and identify incomplete work elements.

Background

Denver Transit Partners was responsible for preparing a management plan and testing procedures for the System Performance Demonstration (SPD), which required RTD’s approval. The SPD allows DTP to have the opportunity to demonstrate that they have provided a system capable of satisfying the performance requirements of the Concession Agreement reliably. The SPD included conducting failure scenarios (simulations of the failure of various system components in order to test the organization’s response) and, generally, performing all inspection, maintenance, and administrative functions that will ultimately be required during normal revenue service operations.

The RTD project staff, under the direction of the Systems Integration Manager, organized a committee to oversee the SPD, which engaged in the following activities:

- Test train witnessing – staff performed the role of passengers on the test trains and recorded observations such as departure and arrival times at stations, and onboard conditions such as the functioning of audio and visual announcements
- Station inspections – staff documented the conditions at stations, such as completion status of signage and railings, and the functioning of grade crossing warnings, lighting, audio and visual announcements
- Grade crossing observations – staff documented train movements and the functioning of the grade crossing warning systems, including traffic signals and gate-down times
- Coordination meetings – staff met weekly with the Systems Integration Manager to review observations and identify trends and issues in need of escalation

Additionally, the QMO Management Plan Review module was used to review the SPD plan and test procedures prior to their implementation, and Management System Audits were performed on the first two demonstrations.

Lesson

While the primary responsibility for developing and implementing the System Performance Demonstration belonged to the Concessionaire, Denver Transit Partners, the RTD project staff was able to develop a systematic approach for monitoring and documenting key aspects of the demonstration, such as on-time performance of the trains, status of audio and visual announcements, and the functioning of grade crossing warning systems.
The RTD staff attempted to witness the demonstration from a passenger’s point-of-view, providing a complementary perspective to the reports being prepared and submitted by DTP. To obtain an even broader perspective, representatives of RTD’s Bus Operations and Marketing teams participated in the oversight effort.

The RTD staff was able to communicate to DTP and realize some improvements from the SPD for the University of Colorado A Line, to the SPD for the B Line. For example, during the SPD for the A Line, train operators were not opening the train doors while stopped at stations (as they would do as part of normal revenue service), but operators did open the doors at Westminster Station during the SPD for the B Line. Also, DTP was able to make pronunciation corrections to the onboard, automatic PA announcements based on RTD’s feedback.

RTD’s oversight of the two demonstrations to date has not ended, since DTP has yet to fully satisfy the demonstrations’ contractual requirements and performance targets. One staff member is still making weekly trips to document trip departure and arrival times, and station dwell times, to compare against DTP’s own reporting.

**Steps to Implement**

Consider implementing a similar oversight program for future System Performance Demonstrations, prior to future commuter rail project openings. Develop a project specific oversight procedure for inclusion in the project procedures manual or quality management oversight plan to describe the process or strategy for specifically overseeing System Performance Demonstrations or similar important processes.
NORTH METRO PROJECT

2016 Lessons Learned
Structure Design Criteria – Other Structures

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**Overview**

Structure design requirements included in the contract are adequate for bridges. However, other structures, such as station canopies, need more concise structural requirements included in the contract. It is noted that the North Metro project is being delivered using a design-build project delivery approach whereby the contractor is responsible for the design of structures to meet RTD’s design criteria and any project specific design requirements.

**Background**

Volume II, Attachment 4 Design Construction Requirements, Section 10.0 of the Conformed Contract outlines the general structural requirements for "bridges and structures". However, the requirements are more applicable to bridges and retaining walls than other structures that are designed (e.g. station canopy foundations or OCS pole foundations). This proved difficult during North Metro design reviews since there were no specific requirements that could be verified during reviews of certain other structures.

**Lesson**

Volume II, Attachment 4 Design Construction Requirements, Section 10.0 of the Conformed Contract and the RTD Commuter Rail Design Criteria do not have sufficient structural requirements for structures other than bridges.

**Steps to Implement**

The RTD Commuter Rail Design Criteria Manual should be reviewed and revised accordingly to reflect the specific design criteria that transit structures should be designed to meet RTD’s expectations, regulatory requirements, and Stakeholder requirements. For specific project requirements (such as Volume II, Attachment 4, Section 10.0 of the Conformed Contract), the RFP should be reviewed for any additional project specific structural requirements prior to issue to ensure that all transit structures are fully defined to accommodate the design-build project delivery mechanism.
"Good Industry Practice" in Contracts

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**Overview**

The terms "Good Industry Practice" or "Standard Engineering Practice" need to be included in multiple sections of Volume II, Attachment 4 of conformed contracts.

**Background**

The term "Good Industry Practice" is found in Volume II, Attachment 4, Section 1.3 of the North Metro Conformed Contract. Section 1.3 is a general section and not specific to particular portions of the design. The RTD North Metro design reviewers found it difficult to apply this requirement to specific designs, such as structures and stations. This led to instances where the designer and the RTD reviewer disagreed with a calculation approach but the designer felt that they did not have to prove that their method met "Good Industry Practice".

**Lesson**

Adding the term "Good Industry Practice" or "Standard Engineering Practice" to each applicable section of Volume II, Attachment 4 Design and Construction Requirements will help RTD design reviewers require designers to prove that their calculations meet standard practice.

**Steps to Implement**

Volume II, Attachment 4 of contracts needs to be marked up to include "Good Industry Practice" or "Standard Engineering Practice" where applicable. Mark-ups can then be provided to RTD contracting personnel who can edit the template contract for the next RFP.
**Geotechnical Discipline Code**

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**Overview**

A geotechnical design submittal package discipline code needs to be added to the CDRL discipline code list to more easily locate geotechnical reports on Aconex and in the QMO.

**Background**

The North Metro document control team has organized design submittal packages into a coding system based on area codes and discipline codes. There are currently 8 discipline codes of which "Geotechnical" is not included. Since there is no geotechnical code, project personnel have found it difficult to locate geotechnical reports on both Aconex and the QMO.

**Lesson**

Including a "Geotechnical" discipline code for the North Metro design submittal packages CDRL numbers would have enhanced the CDRL organization and made it easier to locate geotechnical reports on Aconex and the QMO.

**Steps to Implement**

Discuss with document control personnel and have this code added to the Volume II, Attachment 8 Contract Data Requirements template for the next proposal.
Managing CDRLs with a Database (Aconex)

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Overview

The Aconex Supplier Documents module has been successfully utilized on the North Metro Rail Line (NMRL) project. Use of the module was required in the contract based on the NMRL project controls team's closeout struggles on a previous project, the West Corridor.

Background

Several members of the NMRL RTD Project Controls team worked on the West Corridor project. Acceptance and closure of the West Corridor project proved challenging due to the tracking issues with the CDRLs. The RTD team and the Contractor had difficulty determining what CDRLs had been submitted, what CDRLs were outstanding, and what CDRLs had yet to be approved by RTD.

Members of the West Corridor team that subsequently worked on the NMRL project implemented some contractual changes for NMRL to improve the tracking of CDRLs. The contract for NMRL requires joint RTD and contractor use of a database to manage CDRLs - Aconex Supplier Documents in this case. The team pre-populated Supplier Documents with the list of submittals, or CDRLs. The list was then revised as necessary by RTD and the contractor. Using the module, the RTD team can quickly determine the status of CDRLs. This has been helpful with managing design submittals and is already helping facilitate acceptance/closure.

Lesson

Using a joint use (owner and contractor) database to manage CDRL requirements allows real-time status updates on CDRLs. This is beneficial to the project controls team since the closure requirement to submit all CDRLs can be monitored throughout the life of the project. This should expedite closure.

Steps to Implement

Include a requirement in future contracts for a joint RTD and contractor use of a database to manage CDRLs. Note that this requirement was subsequently added to the Southeast Rail Extension (SERE) project based on NMRL experience.
Contractor Overhead Costs in Claims

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Overview

Contractor overhead costs were not negotiated between RTD and RRP prior to RRP submission of claims on the North Metro Rail Line (NMRL) project. This has led to unreasonably high amounts for claims.

Background

Several members of the NMRL Project Controls team worked on the West Corridor project where contractor overhead costs, to be used for claims, were negotiated and agreed to prior to submittal of any claims. Examples of costs negotiated include the allowed personnel on the project management team, allowed personnel on the quality team, rental costs, and utility costs. Since these costs were negotiated, there were no surprises when claims were submitted, and thus the submittal to award process was efficient.

However, the contractor overhead costs were not pre-negotiated on the NMRL project. Claims by RRP have included unreasonable costs, such as too many personnel included in project management. Resolution of claims has been a more challenging process than if overhead costs were previously agreed upon.

Lesson

Contractor overhead costs/rates (e.g. contractor project management team members, quality team members, rental rates, utilities etc.) should be included in the bid proposal. This will prevent the contractor from submitting unreasonable overhead costs in claims.

Steps to Implement

Add a new section to future RFPs/contracts that requires the contractor's bid proposal to list overhead costs/rates and what constitutes these costs/rates.
I-225 RAIL LINE

2016 Lessons Learned
Baseline Schedule Best Practices – Updating the Current Baseline Schedule

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Overview

The project contract does not have specific guidelines for when and how approved change orders, fragmentary networks, and other changes should be incorporated into the Current Baseline Schedule, causing confusion and missed opportunities to hold the contractor accountable to baseline targets.

Background

The contract addresses that approved change orders need to be incorporated into the Baseline schedule and used as a basis of progress measurement and earned value progression payments. Yet, the how and when that needs to happen is not specifically addressed, and has caused confusion for both the Contractor and the RTD Project Manager. The contract also addresses when incorporation in the Current Progress Schedule is to occur, but falls short of defining when and how they need to be incorporated into the Current Baseline Schedule.

On the I-225 project, Kiewit Infrastructure Corp. (KIC) often added only one activity to capture the change order cost; a hammock activity that spanned existing construction activities. Other times, they did appropriately cost load the approved fragmentary network with change order dollars; however, this often occurred in the timeframe that the change order was approved and not when the fragmentary network was approved/planned to be worked. Therefore, the timeframe for earning the change order was not accurately captured for performance tracking.

Additionally, change order activities were often only incorporated into large “Rebaseline global change efforts” and not as they were approved. Therefore, the Schedule Performance Indicator (SPI) value and Performance Curves submitted by the contractor in the monthly progress reporting were never an accurate accounting of all project scope and performance to date against that scope.

Lesson

To ensure that project performance tracking is accurate, the following needs to be addressed by the contract language on future projects:

1. The Baseline Schedule is to be void of project progress. This includes the Original Baseline Schedule and all subsequent updates for the Current Baseline Schedule. If the Original Baseline Schedule has been progressed prior to approval, then the Contractor is to “back out” the earnings in the schedule, leaving the approved schedule activities, durations, and planned dates to match the actual activities, durations, and dates as of the time of approval.
2. The Baseline schedule is never “Calculated,” that is, the data date remains the start of the project.
3. As fragmentary networks are approved for inclusion in the project schedule, they are to be added to the Current Baseline Schedule within 7 days of approval.
   a. This is to be done using the “Update Baseline” feature within Primavera P6, applying a filter so that ONLY the newly approved fragmentary network is added to the baseline schedule. All other baseline activities should retain their original nomenclature, resource assignments, durations,
dates, logic ties, etc. The new fragmentary activities are to be positioned in time to their approved
dates/durations.

b. Once the change order is approved, then the dollars associated with that change order are to be
cost-loaded onto the respective fragmentary network activities in the Current Baseline Schedule
within 7 days of approval. Note that no dates/durations are to change as a result of cost loading
the fragmentary network.

c. Any other changes to activity durations/logic/cost loading/resource loading need to be proposed
via the Budget Transfer form for approval. Within 7 days of approval, these need to be updated in
the “Current Baseline Schedule” in addition to the Current Progress Schedule.

   i. This is to be done using the “Update Baseline” feature within Primavera P6, applying a filter
so that ONLY the newly approved activities/durations/planned dates are added to the
baseline schedule. All other baseline activities should retain their original nomenclature,
resource assignments, durations, dates, logic ties, etc.

   ii. Activities should not be deleted from a baselined schedule. Deleting an activity may disrupt
schedule logic and complicate efforts to compare the current schedule to the baseline. If the
activity is no longer valid, its duration should be zeroed out and the activity marked as
completed. If some portion of the activity has been completed, the remaining duration of the
activity should be zeroed out and a record kept of the completed portion. In addition, a note
should be added to the schedule to document why the activity’s duration or remaining
duration was removed

   iii. The baseline and current schedules should be subjected to a change control process. A
control process governs when and how technical and programmatic changes are applied to
the baseline, as well as the content of the current progress schedule. A proper change
control process helps ensure that the baseline and current schedule are accurate and
reliable. All updates to the Current Baseline Schedule are to be documented through a
Change Control Process. Undocumented or unapproved changes hamper performance
measurement and may result in inaccurate variance reporting, inconsistent stakeholder
versions of the plan, and unreliable schedule data. Moreover, if changes are not controlled
and fully documented, performance cannot be accurately measured against the original
plan.

   iv. Changes to the baseline schedule should be limited to revisions for new or reduced scope or
for formal replanning. A rebaselined schedule should be rare (not to be confused with
updating the current baseline with new or reduced scope change orders, a rebaselining is an
“overhaul” of a large majority of remaining work). However; in the event that a larger
replanning effort is required, leading to a “Rebaseline” rather than just an update to the
“Current Baseline,” then only the planned activities from the “Rebaseline” approval date and
forward can be rebaselined. All historical dates/durations/resources/etc. are to remain
unchanged.

Resources:

pages 140-15.

Steps to Implement

Add the above language to the standard contract.
Summary of Quantities for Design-Build Projects

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Overview

Though the I-225 Design-Bid Contract requires the Contractor to provide reports verifying the quantities of materials received, a stronger requirement used as a design deliverable and/or CDRL would increase the likelihood that these quantities are submitted to RTD. By providing a summary of quantities for materials to be used in the design drawings, the RTD project team could more easily validate that the Contractor has met testing frequencies, which is a closeout requirement. Identifying a CDRL item to list all material quantities requiring inspection and testing to be provided could more efficiently facilitate the acceptance and closeout process.

Background

Though a summary of quantities is a common deliverable for Design-Bid-Build projects, most Design-Build projects do not require design drawings to show this information. During the I-225 project acceptance and closeout phase, the project team is having trouble validating testing frequencies of various materials used on the job due to the lack of information regarding quantities.

Lesson

The Contractor is currently not required to provide a summary of quantities as a design deliverable or CDRL for Design-Build projects, though the contract requires the Contractor to provide reports verifying quantities of materials. As part of project closeout, RTD would like to validate that the Contractor is meeting material testing frequencies, but without a summary of quantities of materials such as asphalt, aggregate, pipe run, and conduits, validation is very difficult.

Steps to Implement

Consider creating a CDRL item and/or design deliverable for a summary of quantities sheet for identified materials to be provided by the contractor in the design drawings so proper validation of testing frequencies by RTD during project acceptance and closeout can occur. In addition, Process Audits conducted by RTD staff could be performed to calculate quantity takeoffs and review associated test records to determine an adequate level of testing.
Overview

The RTD LRT design criteria does not stipulate design preferences for OCS Insulated overlaps, so understandably the most economic feeder arrangement option is utilized. During field inspections a cleaner, safer installation was identified as a preferred method to feed traction power at the insulated overlaps at TPSS locations. Some of the design options for this feed route the traction power feeder cables across the overlap insulators to feed a wire section. Feeder cables routed across the section insulators are at risk for reduced sectioning reliability resulting in safety, operational, and maintenance concerns. The preferred method is not to route these feeder cables across a section insulator wherever possible, thus eliminating the risk of improper power feed.

Background

For Light Rail Vehicle operations, each Traction Power Sub Station (TPSS) provides a set of feeders that travel underground and connect to the overhead contact system (OCS) to power the trains through the pantograph. The OCS is separated into individual wire segments by using insulated overlaps. These insulated overlaps allow pantographs to transition from one energized TPSS section to the next under power. One TPSS feed typically connects to a messenger wire to feed power in one direction and the other TPSS feed connects to another messenger wire to feed power in the other direction. One insulator is located on each end of the overlap dictating where the power goes. One purpose of the insulators is to prevent power from one feed be able to enter a wire section of another feeder. Routing a feeder cable across these insulators adds risk of defeating the purpose of these insulators.

Lesson

For operations, maintenance and safety reasons, OCS insulated overlaps should be evaluated early in the design phase to avoid bridging insulators on OCS insulated overlaps wherever possible. Having a liaison from RTD’s Rail Operations greatly helps coordinating this effort and others with the rest of the design team.

Steps to Implement

- Consider updating the LRT Design criteria to provide guidance.
- Advise designers/engineers of this preference.
- Review new design drawings with this goal in mind.
Project Acceptance and Closeout Documentation

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Overview

The I225 Project used a tool known as Aconex Supplier Documents to manage the I-225 project acceptance and closeout process. It has been effective as an interactive tool to review and approve substantial completion packages submitted by the contractor by managing requirements for acceptance and closeout.

Background

Based on feedback from others' experiences on project acceptance and closeout, the I-225 team agreed to develop an approach to the acceptance and closeout process using Aconex Supplier Documents. Similarities between historical acceptance and closeout processes and the process being used in Aconex Supplier Documents include the following:

- Contains quality management information collected by contractors or RTD;
- Verifies that quality records from all sources support the decision to accept the work;
- Reviews information for adequate coverage of all work products, verifying that nonconformances have been corrected to RTD's satisfaction, and ensuring agreement between RTD and the contractor on remaining work activities that must be complete prior to final acceptance;
- Graphically depicts status of acceptance information to assist all FasTracks participants in reviewing the current status of contract deliverables as they progress toward final acceptance (see attachment for Segment 1, as an example); and
- Assists RTD Project Management in timely resolution of outstanding issues so that the work can be accepted on-time and at an acceptable quality level

Weekly project acceptance and closeout discussions with the Contractor resulted in an organized approach using Aconex to track and manage Substantial Completion packages by using placeholders of substantial completion evidence for the Contractor to submit. Organized per area and project-wide at the asset level, contractual requirements for each package were identified by discipline leads and a system of workflows was established to review and approve packages submitted by the Contractor. At any time, members of RTD's and Contractor's project teams could view a snapshot of the substantial completion tracking dashboard to display progress. Progress is tracked through the percentage of documentation provided by the Contractor. Package summaries show progress and have links to all documents submitted within each package. Functional areas can be drilled down for submission status as well.

Lesson

The I-225 project team was able to develop an effective and efficient project acceptance and closeout process using Aconex Supplier Documents to manage and track the substantial completion process, currently underway. Tracking progression using a tool such as this cuts down on the amount of work and allows one to see links to the evidence submitted, enhancing the overall process.
Steps to Implement

Consider using a similar tool to help manage and facilitate project acceptance and closeout on future projects.
SOUTHEAST RAIL EXTENSION

2016 Lessons Learned
Material Testing Frequencies

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Overview

The RTD conformed contracts and LRT Design Criteria reference several national standards to follow for materials testing (e.g. AREMA, AASHTO). Testing frequencies and requirements need to be tailored to RTD projects.

Background

The RTD conformed contracts and LRT Design Criteria require materials testing to be completed by the Contractors. These documents reference several national standards to follow for materials testing such as AREMA and AASHTO standards. The RTD SERE team learned from the I-225 project that several of the standard requirements need to be tailored. Examples include the ballast gradation testing frequency and the rock LA Abrasion test result requirement. These tests were adjusted early in the SERE project, prior to actual testing, which helped avoid future issues and potential project delays.

Lesson

Testing frequencies from National standards (e.g. AREMA, AASHTO) required by RTD conformed contracts need to be tailored for each RTD project.

Steps to Implement

In future contracts, materials testing requirements need to be specifically called-out in the contract rather than simply referencing RTD Design Criteria or national standards. This way the materials testing requirements can be tailored to the project.

To implement this lesson, contracting personnel and future project teams need to be aware of the lesson. Perhaps require a mandatory review of lessons learned reports prior to the drafting of contracts.
RTD Design Criteria Updates

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<td>Date Submitted:</td>
<td>1/6/2017</td>
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**Overview**

Some of the criteria from the LRT Design Criteria Manual and the Facilities Maintenance Criteria/Equipment Manual are awaiting updates and are not captured in the current versions of the manuals, which are referenced in the SERE conformed contract. Without proper definition of contractual requirements, compliance cannot be enforced. This has led to issues with the design-builder pursuing potential change conditions.

**Background**

RTD Maintenance of Way (MOW) and Facility personnel reviewed design documents during the SERE project. Some of their comments specified requirements that are not included in any RTD design criteria manual. For example, the RTD LRT Design Criteria states that track under-drain cleanouts must be installed but does not specify the spacing. The spacing was therefore determined by the designer. MOW personnel then commented that the proposed spacing was not sufficient and must be revised. The design-builder could potentially submit a change notice since RTD has no specific requirement listed in the design criteria.

**Lesson**

All applicable RTD parties should participate in the revision of RTD design criteria prior to release of a request for proposal (RFP). This was not done for the RTD LRT Design Criteria and the Facility Maintenance Criteria/Equipment Manual prior to release of the SERE RFP and has led to potential change conditions.

**Steps to Implement**

Identify all recommended changes to the Design Criteria documented through Design Variances, Alternative Technical Concepts, Nonconformances, or project experience. Present these to the RTD Manager of Configuration Control and Chief Engineer for consideration by the design criteria task force and potential revision to the criteria manuals.
Design/Build Requests for Information

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Overview

The SERE contract states that the Contractor shall submit any questions regarding plans or specifications to the RTD Representative in the form of an RFI. This is a very general statement and since this project is being delivered using a Design/Build (D/B) contract delivery model it is unclear which party has the responsibility for answering RFIs, the Contractor and RTD or Contractor and Designer of Record. The current Contract language does not explicitly clarify the roles for answering and/or overseeing RFIs. Therefore, this causes confusion. Additionally each Contractor may interpret this language differently when executing the D/B Agreement with RTD.

Background

As part of D/B delivery, the Contractor has a direct relationship with the Designer of Record they have under contract. RFIs can be intended for the Designer of Record and the Contractor as well as for RTD and the Contractor and/or Designer of Record. The current Contract language does not differentiate or clarify this and each Contractor may interpret this language differently when executing the D/B Agreement with RTD.

Lesson

On the SERE Project, the Contractor has elected to not include RTD during the RFI response process to enable effective oversight with regard to RFIs intended for the Contractor and Designer of Record. RTD has requested to be a part of the RFI process between the Contractor and Designer of Record from the start and only providing comment or interjection when absolutely necessary. The Contractor has stated they will copy RTD on RFIs only after the process has been completed. This has resulted in work being completed in the field based on RFI responses that are not in compliance with the Contract. A nonconformance is issued to track, but could have been prevented through proactive means.

Steps to Implement

Consider revisiting the Contract Language used on other corridors to describe the level of detail expected and/or required of the D/B ‘two part’ RFI process, allowing RTD to be included from the start of the RFI process between the Contractor and Designer of Record. RTD would interject in this process only when necessary and in an effort to avoid any potential project issues.
Project Permit Matrix

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Overview

The SERE Design/Build (D/B) contract states that the Contractor shall identify all required permits at NTP 1 & NTP 2 and that they shall obtain all required permits prior to the start of the construction phase [D/B, Section 3.1(a)(iv)]. This broad language allows the Contractor to provide the bare minimum information to RTD, which provides the potential for permits to be missed or overlooked and potentially impact the Project Schedule.

Background

The Contract Deliverable Requirements List (CDRL) identified project permits as a Contract Deliverable (04-041). Exhibit A reflects the Contractor’s interpretation of the Permit requirements of Section 3.1(a)(iv).

The RTD Project Team requested a Permit Tracking Matrix be submitted to include, but not limited to, the following level of detail: Permit Type (Specific Permit Name), Governing Agency (Local, State or Federal), Design or Construction Phase Permit, Permit Trigger (Project Function, Area or Scope of Work), any RTD requirements for application, Anticipated or Required Application Date, Schedule Tie, Duration or Life of Permit, Actual Date of Permit Acquisition/Execution, any Inspections associated with Permits, Close-out Requirements or Certifications, Date of Permit Termination or Handover.

Exhibit B reflects the Permit Tracking Matrix created by the RTD Project Team to fulfill the FTA’s request during the grant application process. This Permit Tracking Matrix was provided to the Contractor as an example, see attached Exhibit B.

Lesson

Identification, Acquisition and turnover of the various permits are difficult to verify or track in the beginning of the project. Requiring a specific and detailed project Permit Tracking Matrix would aid the Contractor in performing its due diligence to identify and verify project permit requirements as early as possible in the project. It would aid in monthly reporting requirements identified in D/B Contract, Attachment 3, Section 1.9 (a) (xx). Also, it would assist in project closeout as identified in D/B Contract Section 32 (c) & (d). Lastly, it would satisfy the any FTA requirements for providing a Permit Tracking Log for the project.

Based on current contract language, the Contractor is submitting a general or vague list that makes it difficult to identify all permits needed and track the status throughout the project.

Attachment 3, Section 1.7(w) requires the Contractor to submit copies of all permits obtained for the Project. Initially permits are submitted to RTD with a document status of “open”, and once a permit is closed it is resubmitted to RTD with a document status of “closed”, which helps to facilitate the closeout and acceptance of the project. Although it can be difficult to identify if all permits have been submitted to RTD in a timely manner throughout the project, having a comprehensive Permit Tracking Matrix will allow interim audits to verify all permits have been submitted throughout the project.
Steps to Implement

Develop enforceable contract language to describe level of detail expected and/or required of the Permit Tracking Matrix. Include an example form for the Contractor to reference in Attachment 11 – Appendix A Forms. Add the Permit Tracking Matrix to the CDRL – Attachment 8, Annex 1. Require monthly updates of the Permit Tracking Matrix to be submitted concurrently with the Monthly Progress Report. Conduct interim audits of the document register against the updated Permit Tracking Matrix throughout the course of the project.

Exhibit A

SERE Project

Identification of Anticipated Permits

- CDPHE Construction Stormwater Permit (greater than 1 acre disturbance)
- City of Lone Tree Grading, Erosion & Sedimentation Control (GESC) Permit
- City of Lone Tree Right-of-Way/Construction Permit
- City of Lone Tree Temporary Access Permit
- Variance Request from Lone Tree if proposed hours of operation might be outside of allowed limits (7A-7P M-F, 8A-6P weekends & holidays).
- Site Improvement Plans approvals and Building Permits for the three stations (Sky Ridge, City Center & Ridgegate Stations). SIPs and Building Permits will be as required through Community Development (Planning & Building Departments).
- CDOT and/or FHWA Permits associated with crossings on Lincoln Avenue and possibly Ridgegate Parkway and for crossing I-25.
## Exhibit B

<table>
<thead>
<tr>
<th>Agency</th>
<th>Agency Contact</th>
<th>Category/Source</th>
<th>Permit</th>
<th>Permit Trigger</th>
<th>Permit Description/Information</th>
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<tr>
<td>United States Army Corps of Engineers</td>
<td>Denver Regulatory Office 9307 5 Wadsworth Blvd Littleton, CO 80120-6901</td>
<td>Jurisdictional Waters and Wetlands</td>
<td>Individual Permit</td>
<td>Fill in waters of the U.S</td>
<td>SERP Project does not currently need this</td>
<td>Contractor</td>
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<td>FEMA/Urban Drainage Flood Control District</td>
<td>Floodplain/ Floodway</td>
<td>Conditional Letter of Map Revision (CLUDMR)</td>
<td>Rise in flood elevation</td>
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<td>Rise in flood elevation</td>
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</table>
| Colorado Department of Public Health and Environment | Water Quality | MS4 Phase II Stormwater Management for Non-Standard Permit Holders | • Required on CDOT ROW for disturbance of more than one acre.  
• Replacement in kind for any permanent BMPs in place.  
• If local municipality has stricter NDAD compliance requirements, these more restrictive measures will apply | Discharging water                  |                                                                                              | Contractor     |
| Colorado Department of Public Health and Environment | CDPHE Water Quality Control Division | Construction Water Discharge      | Construction Dewatering Industrial Wastewater Discharge Application |                                                                                         |                                                                                              | Contractor     |
| Colorado Department of Public Health and Environment | CDPHE Water Quality Control Division | Water Quality                     | Section 431 Water Quality Certification | USACE Individual Permit for Fill in Waters of the U.S. |                                                                                              | Contractor     |
| Colorado Department of Public Health and Environment | CDPHE Water Quality Control Division | Stormwater Permits                | Colorado Discharge Permit System - Stormwater Construction Permit (CDG SCP) | • SWMP - Each corridor must develop a specific SWMP for that corridor. There is no single SWMP that can be used for the whole FasTracks program.  
CDOT will need to review each corridor’s SWMP if the project is in CDOT ROW  
CDOT’s Consent order needs to be complied with when project is in CDOT’s ROW (Standard Specifications 101197-206)  
Colorado Discharge Permit System permit for construction will be required and issued by CDPHE. |                                                                                              | Contractor     |
# Design/Build Design Development

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**Overview**

Additional Preliminary Design significantly helps minimize project risks and ensures a final design which better meets RTD’s needs.

**Background**

Prior to the acquisition of funding, RTD's plan was to develop 100% of the design in-house to use as construction-ready plans for a future Design/Bid/Build project. For most Design/Build projects, a set of 30% Final Preliminary Engineering is furnished in the RFP. During the SERE project development, the design was taken to a full 60% design prior to RFP.

**Lesson**

A full 60% design set of drawings was provided to the prospective bidders during the RFP process. This level of design was able to provide a better defined scope for the contractors to bid while still allowing the efficiencies in the design/build process to occur. Further design development also resulted in a better defined scope from stakeholders with fewer changes being realized after the fact. Other benefits of taking design to a more advanced level included a better understanding of RTD’s expectations, capturing design expectations not explicitly detailed in the design criteria, and fewer opportunities for misunderstandings.

The extra money spent up front on the design effort has minimized risk to both RTD and the Contractor. This, in turn, resulted in a competitive price during RFP and reduced the potential of costly change orders that have arisen on other corridors which used only a 30% level of design for the RFP.

**Steps to Implement**

Future major projects should consider progressing initial design documents to a full 60% level prior to RFP.
Timeliness of Donated Right-of-Way

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Overview

Though the SERE project benefitted greatly from donated ROW, the process wasn’t as simple as what the IGA and contract stated. Fortunately, the extra time needed to acquire the donated ROW didn’t become an issue as good partnering efforts allowed the SERE Contractor (BBII) to access parcels to perform early work through temporary construction easements.

Background

The SERE Project is unique in that a majority of the land required to implement the project is donated from local stakeholders, both public and private. RTD has IGAs with three public stakeholders that govern the distribution of the donated public parcels. In addition, RTD has entered into a Purchase and Sale Agreement with a private land owner governing the distribution of the private donated parcels.

Contractually and per the IGAs, donated ROW was to be transferred to RTD 30 days after NTP 2. In reality, ROW turnover rates took much longer as the final design milestone was needed to determine need, perform survey work, and perform appraisals. While the donated ROW process eliminated the offer and negotiation phases of acquisition, the process wasn’t as simple as what both the IGA and contract stated.

Lesson

Have the contract allow for more time than 30 days after NTP 2 to complete the ROW acquisition process. Though the offer and negotiation phases were eliminated, final design, survey, and appraisals are needed for ROW turnover.

Steps to Implement

Consider revising the contract to reflect the time frames realistically needed to complete ROW turnover based on anticipated dates for final design, survey, and appraisals.
**CDRL/Submittal Document Review and Approval via Workflows**

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**Overview**

A document management program known as Aconex was utilized as the document management system for the Eagle, I-225, NMRL, and SERE projects. However, the Aconex Workflow application option is being used on the NMRL and SERE projects unlike the I-225 project to track the submittal, review, and approval process of all CDRL/submittal records. This has proven to be beneficial.

**Background**

RTD project personnel are responsible for reviewing numerous documents/submittals throughout the course of a project. For the I-225 project, Aconex was used as the document management system but the Workflow application was not used to manage reviews. For the SERE project, the Aconex Workflow is being used which has provided the following benefits:

1. Project administration personnel are spending less time determining the review status of documents since the Aconex Workflow provides the information real-time.
2. Document reviewers are spending less time determining what they are responsible to review and in what timeframe.
3. Document reviewers are being held more accountable since the number of submittals to be reviewed and the time overdue can quickly be displayed and reported to management for corrective action.
4. Document reviewers are more confident that they are reviewing the most recent version of a document since it is linked to the workflow. Previously, the reviewer would have to locate the document in Aconex and assume they had the latest version.

The Eagle project attempted to utilize workflows, but found them to be cumbersome due to the complexity of the workflow structure. A simple workflow was designed for SERE based upon the levels of authority as delegated by the Project Manager.

**Lesson**

Simple document/submittal review workflows managed by a software application save RTD project personnel time during the review cycle. They should be used to help manage the document control process.

**Steps to Implement**

- Revise the FasTracks Program Management Plan to include the requirement to use a document management system with a workflow option.
- Develop procedures detailing the processes in order to implement.