PS.1357

Schedule Update Analysis: Retained Logic versus Progress Override

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Abstract— Construction industry standard schedule specifications most often require retained logic as the schedule calculation setting when updating the schedule. Use of this calculation setting can sometimes prove problematic when out of sequence progress occurs and result in inaccurate information and artificially impacted float values.

The progress override calculation setting can also be problematic because using this method ignores predecessor schedule logic for activities in progress. Owners prefer retained logic and contractors prefer progress override. These differing viewpoints can impact the validity of the project schedule.

This paper will evaluate the pros and cons of using each calculation method, typical scheduling specification language, and give industry examples. The impact of using each method will be evaluated for proper schedule updates and delay claim analysis. Finally, recommendations will be offered for use of progress override when correcting out of sequence schedule logic is not possible.

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Introduction

Schedule development is a process where activities are identified and then network logic is applied before duration estimation occurs. Schedule logic identifies the dependency relationships between activities within a schedule and thus the work sequence to be followed while executing the project. There are four possible relationships between activity start and end and those of other activities[1].

- Finish-to-Start (FS): First activity must finish before second activity can start
- Start-to-Start (SS): Two activities start at the same time
- Finish-to-Finish (FF): Two activities must complete at the same time
- Start-to-Finish (SF): Activity must start before second activity can finish

Activities can be linked with Hard Logic or Soft Logic. Hard logic is utilized where activities must follow a prescribed sequence and is often dictated by physical restraints such as footings must be constructed before walls or columns. Soft logic represents preferential logic relationships that are not physically required but are preferred and often carried out in a different order upon execution. [2]

Sometimes soft logic linked activities begin without following predecessor schedule logic. When actual schedule progress occurs for activities that should not logically start based upon predecessor logic, this is termed "out-of-sequence progress"[3]. There could be various reasons for out of sequence progress, such as an error in the relationship of the original plan or the successor activity started early to provide steady work flow to equipment and crew. Out of sequence often occurs on construction projects, thus management methods must be developed to address the situation.[4] Oracle Primavera P6™ has different schedule calculation options including retained logic, progress override and actual dates.

[1] AACE International Recommended Practice No. 10S-90, Cost Engineering Terminology
[2] AACE International Recommended Practice No. 24R-03, Developing Activity Logic

[3] AACE International Recommended Practice No. 49R-06, Identifying the Critical Path
[4] Scheduling Best Practices by Warner Consulting. Retrieved off world wide web at http://warnercon.com/wp-content/uploads/2012/07/Article-9-Handling-Out-of-Sequence-Progress1.pdf

These settings are shown below:

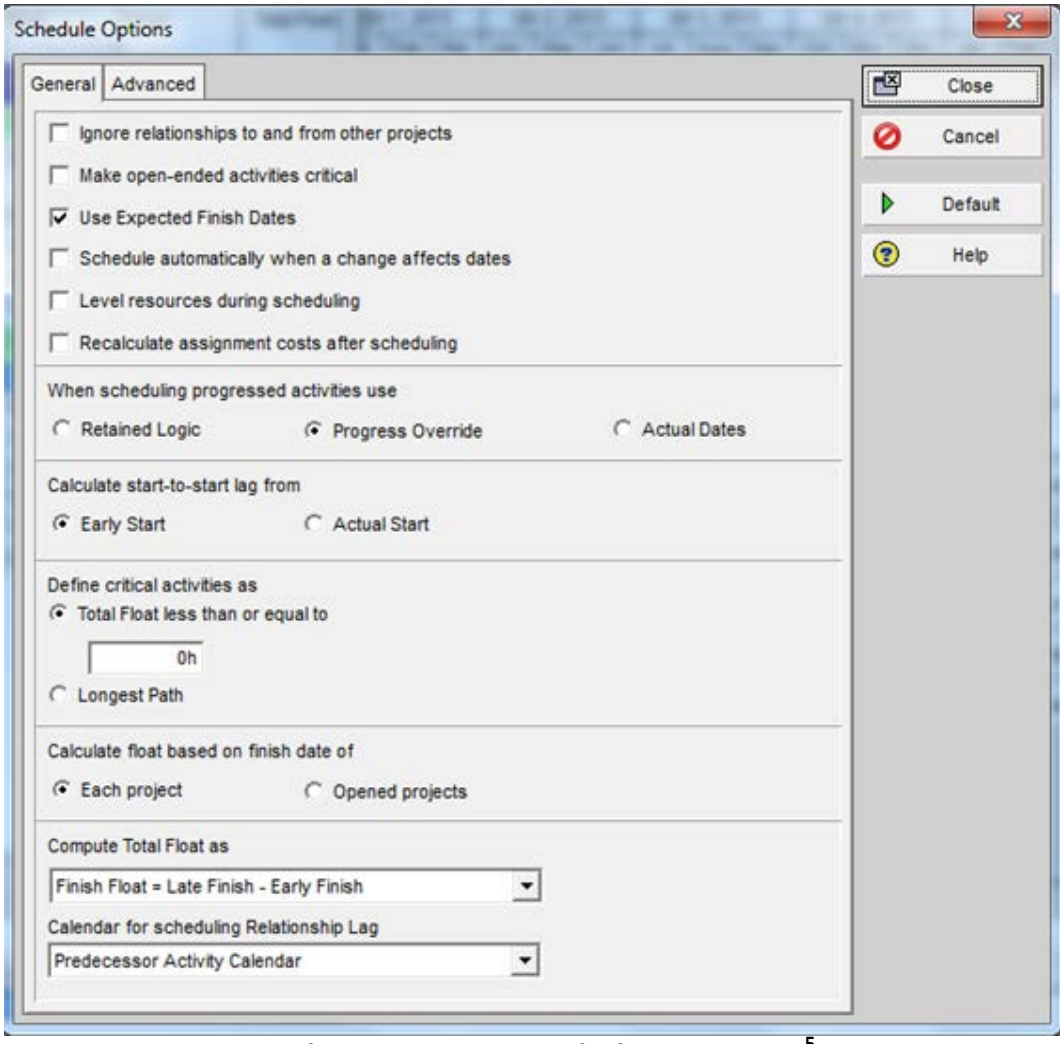
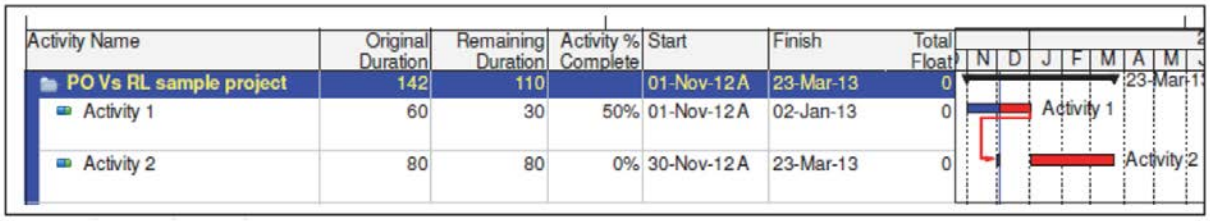


Figure 1 — Oracle Primavera P6™ Calculation settings[5]

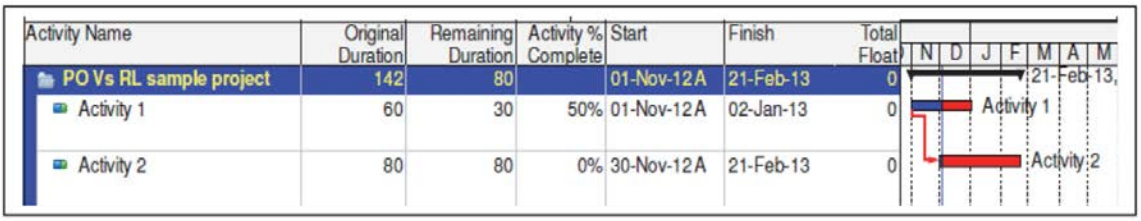
As long as schedule progress occurs as planned there is no difference in schedule calculation results comparing the three methods. When actual progress is not consistent with planned schedule logic, then out of sequence occurs and there could be notable difference between schedule calculation options. Methods are required for managing retained logic or progress override as these calculation options will cause differing results and could result in inaccurate dates and impact delay analysis of in progress schedules.

Analysis

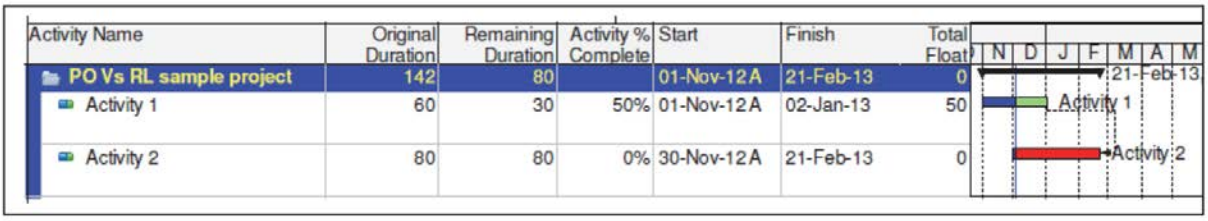
Retained Logic (RL): The retained logic schedule calculation setting holds schedule logic constant during calculation of in progress schedules. The calculation adds activity remaining duration in the forward pass calculation for early dates and waits until activity predecessors are completed. Below is a demonstration of RL option results with different logical relationships.



RL with FS Relationship



RL with SS Relationship

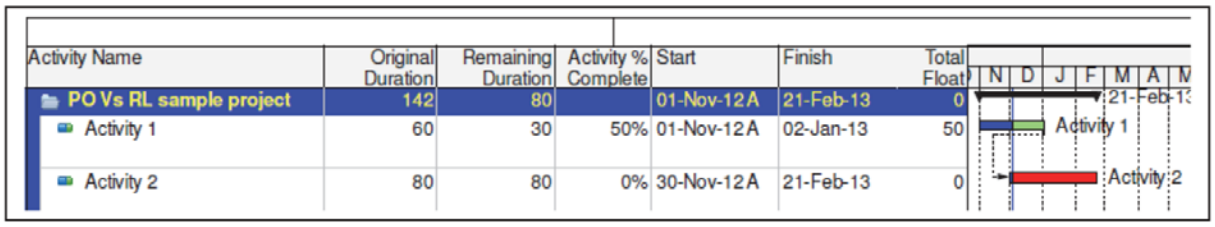


RL with FF Relationship

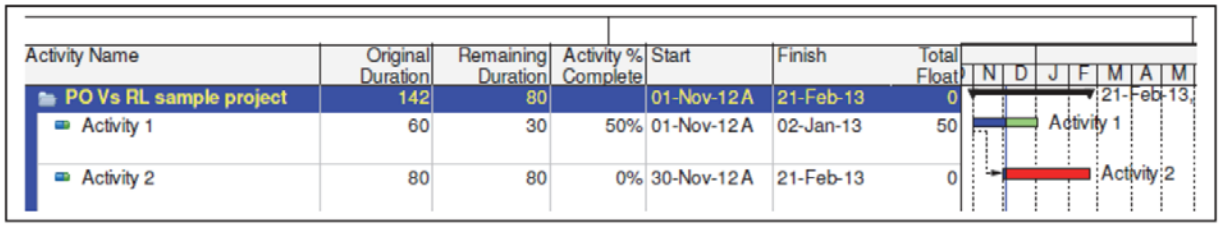
Figure 2 — Demonstration of Retained Logic Option Calculations

Figure 2 illustrates that when the retained logic calculation setting is utilized that it has impact on completion the date of activity 2 when using the FS relationship. For both SS and FF relationships there is no effect on the remaining early start and completion date of the Activity 2. The completion date of activity 2 is calculated based on its own remaining duration. However when utilizing a FF relationship, Activity 1 is rendered not critical and has total float equal to difference between early finish dates of Activity 2 and Activity 1.

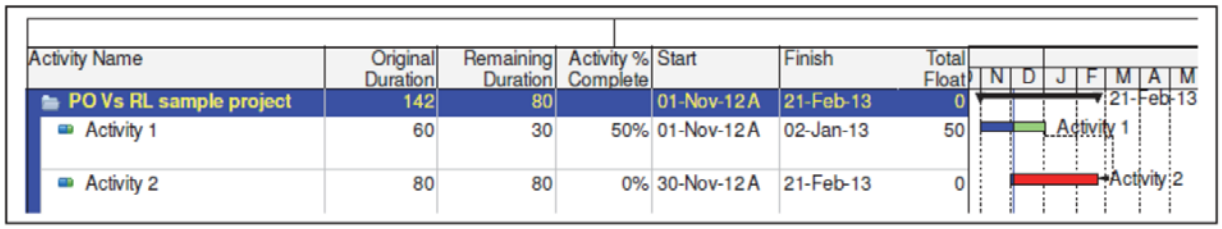
Progress Override (PO): When the progress override schedule calcluation option setting is utilized, Oracle Primavera P6™ ignores the predecessor activity relationships and calculates the activity completion date based on its own remaining duration.



PO with FS logic



PO with SS logic

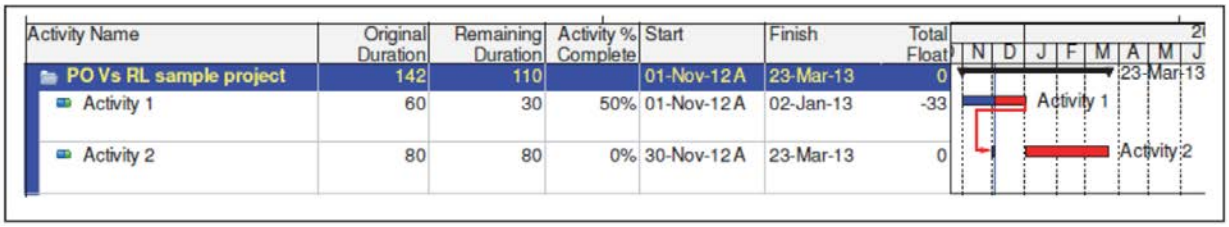


PO with FF logic

Figure 3 — Demonstration of Progress Override Schedule Calculations Option

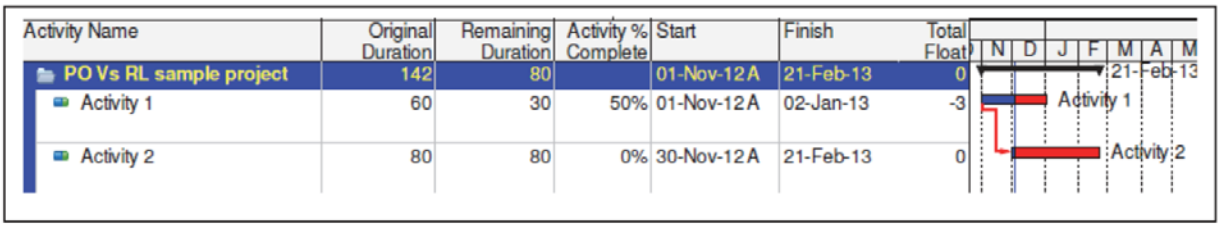
Figure 3 displays when the progress override option is selected that all predecessor logic for the out of sequence activities is ignored for every relationship type and the remaining early start of Activity 2 is equal to the data date. Activity 1 and Activity 2 remaining start and finish dates are calculated solely by adding remaining duration to the data date. Also in all cases Activity 1 is no longer critical and has total float equal to the difference between early finish dates of Activity 2 and Activity 1.

Actual Dates (AD): When the actual dates schedule calcluation option setting is utilized, Oracle Primavera P6™sets the late finish date of the predecessor activity one day before the actual start of the out of sequence activity. This normally creates negative float to predecessor activities.



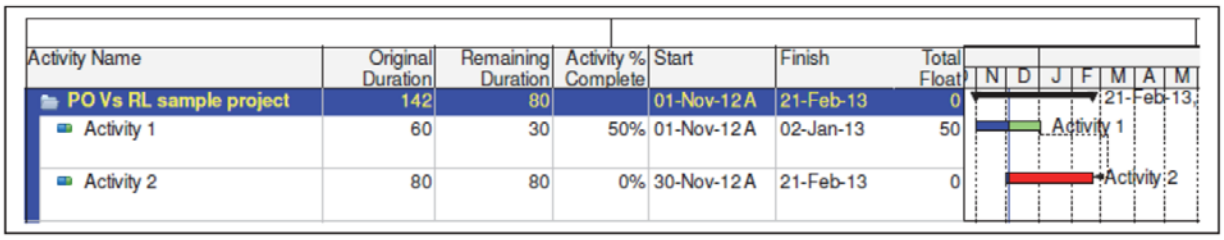
Activity Name	Original Duration	Remaining Duration	Activity % Complete	Start	Finish	Total Float
PO Vs RL sample project	142	110		01-Nov-12 A	23-Mar-13	0
Activity 1	60	30	50%	01-Nov-12 A	02-Jan-13	-33
Activity 2	80	80	0%	30-Nov-12 A	23-Mar-13	0

AD with FS logic



Activity Name	Original Duration	Remaining Duration	Activity % Complete	Start	Finish	Total Float
PO Vs RL sample project	142	80		01-Nov-12 A	21-Feb-13	0
Activity 1	60	30	50%	01-Nov-12 A	02-Jan-13	-3
Activity 2	80	80	0%	30-Nov-12 A	21-Feb-13	0

AD with SS logic



Activity Name	Original Duration	Remaining Duration	Activity % Complete	Start	Finish	Total Float
PO Vs RL sample project	142	80		01-Nov-12 A	21-Feb-13	0
Activity 1	60	30	50%	01-Nov-12 A	02-Jan-13	50
Activity 2	80	80	0%	30-Nov-12 A	21-Feb-13	0

AD with FF logic

Figure 4 — Demonstration of Actual Date ScheduleCalculations Option

The above examples illustrate that the actual dates option is creating negative float for the predecessor activity in case of FS and SS relationships. However in the case of a FF relationship the finish date of the predecessor activity is 1 day before its successor activity. The actual date calculation on FF relationships removes the activity from the critical path and results in 50 days of total float. This schedule calculation setting is not widely used due to its tendency to create negative float in both FS and SS relationships.

Both retained logic and progress override schedule calculation settings are universally utilized across many industries. It is imperative to understand that each of these schedule calculation settings will yield a different result and most especially for out of sequence progress activities. In case of out of sequence progress AACE RP-49R-06 suggests the use of retained logic schedule calculation because progress override can create orphaned predecessor activities and disregard logical constraints. Further AACE RP-49R-06, recommends if the retained logic method produces poor or inaccurate results, then the schedule network logic must be corrected. In some cases it is not practical to make changes to schedule logic before every schedule update submission for various reasons including specification requirements requiring approval of changes, large number of activities, and insufficient resources.

Schedule Specifications

The scheduling specification defines schedule development and update mechanics. Typically they are prepared by the owner and distributed to the contractor. Industry practice in the west is for scheduling specifications to become contract documents. However in other areas of the world scheduling specifications are issued as a guideline to follow without any contractual implication.

In western contracts, schedule calculation settings are commonly specified for construction projects within the bid documents and can be found in the schedule specification. In this case it is common for owners to specify the use of retained logic and correction of logic for out of sequence progress. Review of schedule specifications in other areas of the world does not consistently reflect inclusion of schedule calculation requirements. When specifically mentioned these specifications favor retained logic over progress override. Los Angeles Metropolitan Transportation Authority (LA Metro)[5] requires that schedule networks must use retained logic CPM precedence diagram methods of scheduling. When activities are worked out of sequence compared to the logic of the Baseline CPM Schedule, this logic will need to be revised as necessary in schedule update submissions. All logic revisions must be explained in the written narrative. Western owners also typically specify the requirements for approval of schedule changes whereby schedule logic changes must be pre-approved. LA Metro requires that any schedule changes, including changes to the logic sequence or activity durations and the impacts to the overall Contract must be explained and that the contractor must meet monthly prior to schedule submission for purposes of explaining changes to the schedule. Both of these clauses are quite commonly found in western owner schedule specifications and cause for concern of contractors.

Schedules that utilize the retained logic calculation when not managed properly will reflect erroneous completion dates especially if out of sequence progress is not corrected. In these cases the calculated early dates of successor activities following the out of sequence activities will have incorrect dates.

In Middle Eastern countries most of the schedule specifications do not cover handling out of sequence progress. Some specifications specify the use of retained logic but do not require logic correction of out of sequence activities. Kahramaa (Qatar General Electricity and Water Corporation)[6] and Limitless (Dubai UAE) schedule requirements do not mention handling out-of-sequence activities. The Lusail Development schedule specification[7] in Qatar does mention retained logic but again is silent with reference to out-of-sequence activities and any required logic corrections.

[5] Standard Schedule Specification - 01 29 76-Cost Schedule Integration System, Los Angeles Metropolitan Transportation Authority

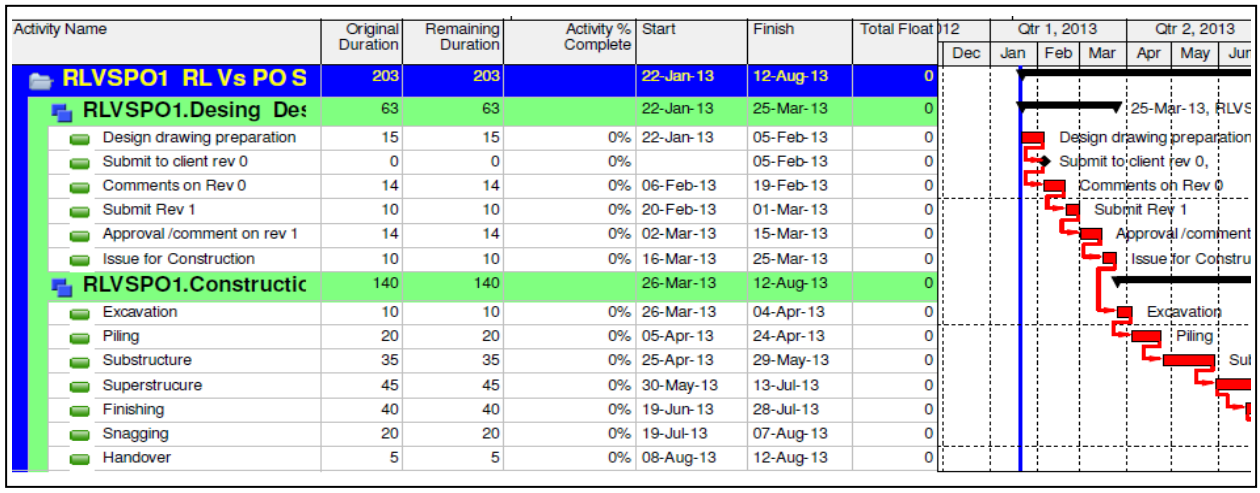
[6] Kahramaa Planning and Progress Monitoring Guidelines – Phase 10 Projects

[7] Lusail Development Projects Design-Build contracts Tender Appendix F, Administrative Procedures

Industry Examples

Example 1

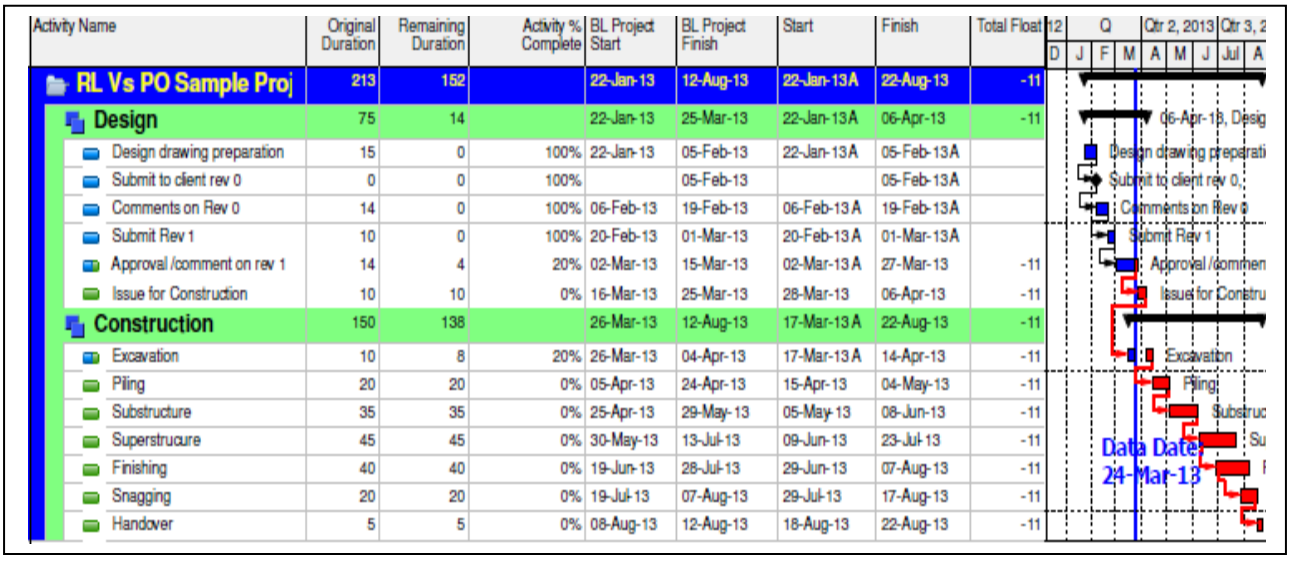
RL Vs PO Impact on Schedule Updates: Below is an industry example of a schedule baseline and subsequent update comprising a few activities to demonstrate the different schedule calculation results based on the retained logic and progress override calculation settings.



Activity Name	Original Duration	Remaining Duration	Activity % Complete	Start	Finish	Total Float
RLVSPO1 RL Vs PO S	203	203		22-Jan-13	12-Aug-13	0
RLVSPO1.Desing Des	63	63		22-Jan-13	25-Mar-13	0
Design drawing preparation	15	15	0%	22-Jan-13	05-Feb-13	0
Submit to client rev 0	0	0	0%		05-Feb-13	0
Comments on Rev 0	14	14	0%	06-Feb-13	19-Feb-13	0
Submit Rev 1	10	10	0%	20-Feb-13	01-Mar-13	0
Approval /comment on rev 1	14	14	0%	02-Mar-13	15-Mar-13	0
Issue for Construction	10	10	0%	16-Mar-13	25-Mar-13	0
RLVSPO1.Constructic	140	140		26-Mar-13	12-Aug-13	0
Excavation	10	10	0%	26-Mar-13	04-Apr-13	0
Piling	20	20	0%	05-Apr-13	24-Apr-13	0
Substructure	35	35	0%	25-Apr-13	29-May-13	0
Superstrucure	45	45	0%	30-May-13	13-Jul-13	0
Finishing	40	40	0%	19-Jun-13	28-Jul-13	0
Snagging	20	20	0%	19-Jul-13	07-Aug-13	0
Handover	5	5	0%	08-Aug-13	12-Aug-13	0

Figure 5 — Industry Example Sample Baseline

In Figure 5 the schedule fragnet comprises design and construction activities. According to baseline project start date is 22-Jan-13 and Completion date is 12-Aug-13. Schedule logic is applied where no construction activity will start unless construction drawings are issued

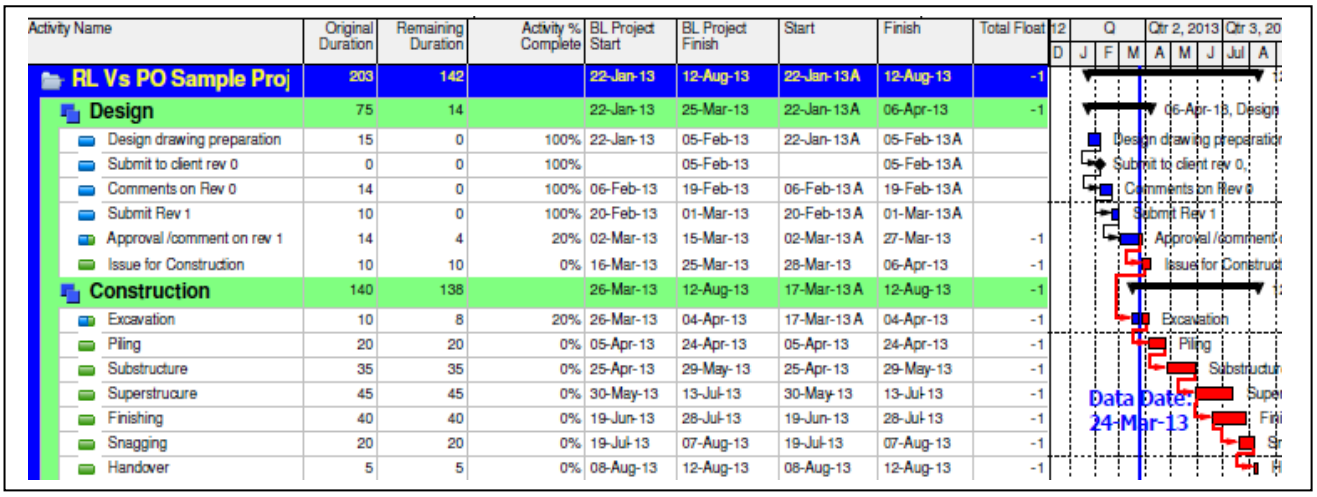


Activity Name	Original Duration	Remaining Duration	Activity % Complete	BL Project Start	BL Project Finish	Start	Finish	Total Float
RL Vs PO Sample Proj	213	152		22-Jan-13	12-Aug-13	22-Jan-13 A	22-Aug-13	-11
Design	75	14		22-Jan-13	25-Mar-13	22-Jan-13 A	06-Apr-13	-11
Design drawing preparation	15	0	100%	22-Jan-13	05-Feb-13	22-Jan-13 A	05-Feb-13 A	
Submit to client rev 0	0	0	100%		05-Feb-13		05-Feb-13 A	
Comments on Rev 0	14	0	100%	06-Feb-13	19-Feb-13	06-Feb-13 A	19-Feb-13 A	
Submit Rev 1	10	0	100%	20-Feb-13	01-Mar-13	20-Feb-13 A	01-Mar-13 A	
Approval /comment on rev 1	14	4	20%	02-Mar-13	15-Mar-13	02-Mar-13 A	27-Mar-13	-11
Issue for Construction	10	10	0%	16-Mar-13	25-Mar-13	28-Mar-13	06-Apr-13	-11
Construction	150	138		26-Mar-13	12-Aug-13	17-Mar-13 A	22-Aug-13	-11
Excavation	10	8	20%	26-Mar-13	04-Apr-13	17-Mar-13 A	14-Apr-13	-11
Piling	20	20	0%	05-Apr-13	24-Apr-13	15-Apr-13	04-May-13	-11
Substructure	35	35	0%	25-Apr-13	29-May-13	05-May-13	08-Jun-13	-11
Superstrucure	45	45	0%	30-May-13	13-Jul-13	09-Jun-13	23-Jul-13	-11
Finishing	40	40	0%	19-Jun-13	28-Jul-13	29-Jun-13	07-Aug-13	-11
Snagging	20	20	0%	19-Jul-13	07-Aug-13	29-Jul-13	17-Aug-13	-11
Handover	5	5	0%	08-Aug-13	12-Aug-13	18-Aug-13	22-Aug-13	-11

Figure 6 — Industry Example Schedule Update

Figure 6 reflects actual progress of the same schedule fragnet displaying that as of 24-Mar-13 the contractor received comments on rev0 drawings and submitted rev 1 as per schedule. However the in-progress activity is delayed. The contractor commenced excavation on 17-Mar-

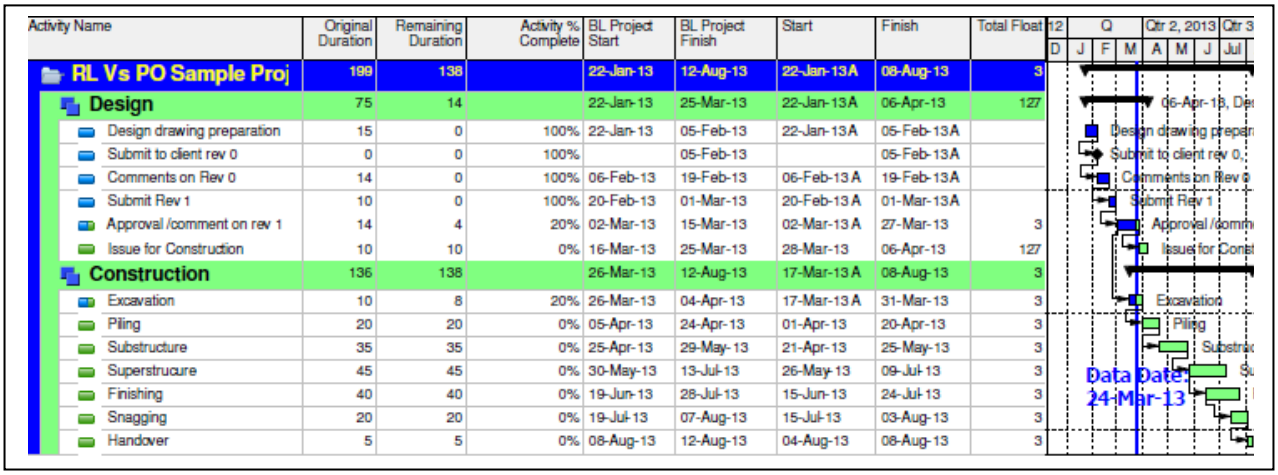
13 out of sequence and ahead of schedule compared to the baseline. Schedule logic has not been revised to reflect the out of sequence progress and as a result reflects 11 days of delay.



Activity Name	Original Duration	Remaining Duration	Activity % Complete	BL Project Start	BL Project Finish	Start	Finish	Total Float
RL Vs PO Sample Proj	203	142		22-Jan-13	12-Aug-13	22-Jan-13 A	12-Aug-13	-1
Design	75	14		22-Jan-13	25-Mar-13	22-Jan-13 A	06-Apr-13	-1
Design drawing preparation	15	0	100%	22-Jan-13	05-Feb-13	22-Jan-13 A	05-Feb-13 A	
Submit to client rev 0	0	0	100%		05-Feb-13		05-Feb-13 A	
Comments on Rev 0	14	0	100%	06-Feb-13	19-Feb-13	06-Feb-13 A	19-Feb-13 A	
Submit Rev 1	10	0	100%	20-Feb-13	01-Mar-13	20-Feb-13 A	01-Mar-13 A	
Approval /comment on rev 1	14	4	20%	02-Mar-13	15-Mar-13	02-Mar-13 A	27-Mar-13	-1
Issue for Construction	10	10	0%	16-Mar-13	25-Mar-13	28-Mar-13	06-Apr-13	-1
Construction	140	138		26-Mar-13	12-Aug-13	17-Mar-13 A	12-Aug-13	-1
Excavation	10	8	20%	26-Mar-13	04-Apr-13	17-Mar-13 A	04-Apr-13	-1
Piling	20	20	0%	05-Apr-13	24-Apr-13	05-Apr-13	24-Apr-13	-1
Substructure	35	35	0%	25-Apr-13	29-May-13	25-Apr-13	29-May-13	-1
Superstrucure	45	45	0%	30-May-13	13-Jul-13	30-May-13	13-Jul-13	-1
Finishing	40	40	0%	19-Jun-13	28-Jul-13	19-Jun-13	28-Jul-13	-1
Snagging	20	20	0%	19-Jul-13	07-Aug-13	19-Jul-13	07-Aug-13	-1
Handover	5	5	0%	08-Aug-13	12-Aug-13	08-Aug-13	12-Aug-13	-1

Figure 7 – Industry Example Reflecting Out of Sequence Progress Correction

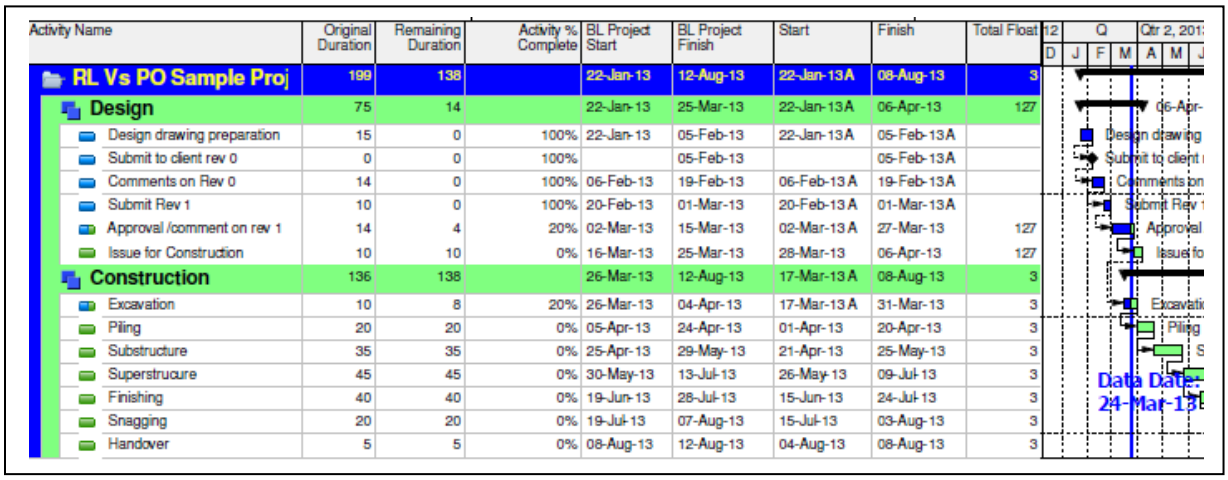
Figure 7 depicts the change in schedule calculation when corrections are made to the out of sequence schedule progress activity prior to scheduling. Schedule logic corrections could include either changing the relationship type between drawing approval and excavation from FS to SS or removing the relationship in its entirety. In this case the remaining early start date of excavation activity will change to 28-Mar-13 and so the completion of this activity became 10 days prior but still showing negative float of -1. If excavation is delinked from the issue for construction activity, and linked to the approval/comment on rev 1 activity with a FS link then the same calculation result occurs and the remaining early start date will be the same (28-Mar-13).



Activity Name	Original Duration	Remaining Duration	Activity % Complete	BL Project Start	BL Project Finish	Start	Finish	Total Float
RL Vs PO Sample Proj	199	138		22-Jan-13	12-Aug-13	22-Jan-13 A	08-Aug-13	3
Design	75	14		22-Jan-13	25-Mar-13	22-Jan-13 A	06-Apr-13	127
Design drawing preparation	15	0	100%	22-Jan-13	05-Feb-13	22-Jan-13 A	05-Feb-13 A	
Submit to client rev 0	0	0	100%		05-Feb-13		05-Feb-13 A	
Comments on Rev 0	14	0	100%	06-Feb-13	19-Feb-13	06-Feb-13 A	19-Feb-13 A	
Submit Rev 1	10	0	100%	20-Feb-13	01-Mar-13	20-Feb-13 A	01-Mar-13 A	
Approval /comment on rev 1	14	4	20%	02-Mar-13	15-Mar-13	02-Mar-13 A	27-Mar-13	3
Issue for Construction	10	10	0%	16-Mar-13	25-Mar-13	28-Mar-13	06-Apr-13	127
Construction	136	138		26-Mar-13	12-Aug-13	17-Mar-13 A	08-Aug-13	3
Excavation	10	8	20%	26-Mar-13	04-Apr-13	17-Mar-13 A	31-Mar-13	3
Piling	20	20	0%	05-Apr-13	24-Apr-13	01-Apr-13	20-Apr-13	3
Substructure	35	35	0%	25-Apr-13	29-May-13	21-Apr-13	25-May-13	3
Superstrucure	45	45	0%	30-May-13	13-Jul-13	26-May-13	09-Jul-13	3
Finishing	40	40	0%	19-Jun-13	28-Jul-13	15-Jun-13	24-Jul-13	3
Snagging	20	20	0%	19-Jul-13	07-Aug-13	15-Jul-13	03-Aug-13	3
Handover	5	5	0%	08-Aug-13	12-Aug-13	04-Aug-13	08-Aug-13	3

Figure 8 - Industry Example Reflecting Retained Logic and Correction of Out of Sequence Progress

Figure 8 illustrates the updated schedule activities with the excavation activity linked to the approval/comment on rev 1 activity with a SS relationship. In this case the schedule reflects mitigation efforts by the contractor and provides 3 days float to future activities.



Activity Name	Original Duration	Remaining Duration	Activity % Complete	BL Project Start	BL Project Finish	Start	Finish	Total Float
RL Vs PO Sample Proj	199	138		22-Jan-13	12-Aug-13	22-Jan-13 A	08-Aug-13	3
Design	75	14		22-Jan-13	25-Mar-13	22-Jan-13 A	06-Apr-13	127
Design drawing preparation	15	0	100%	22-Jan-13	05-Feb-13	22-Jan-13 A	05-Feb-13 A	
Submit to client rev 0	0	0	100%		05-Feb-13		05-Feb-13 A	
Comments on Rev 0	14	0	100%	06-Feb-13	19-Feb-13	06-Feb-13 A	19-Feb-13 A	
Submit Rev 1	10	0	100%	20-Feb-13	01-Mar-13	20-Feb-13 A	01-Mar-13 A	
Approval /comment on rev 1	14	4	20%	02-Mar-13	15-Mar-13	02-Mar-13 A	27-Mar-13	127
Issue for Construction	10	10	0%	16-Mar-13	25-Mar-13	28-Mar-13	06-Apr-13	127
Construction	136	138		26-Mar-13	12-Aug-13	17-Mar-13 A	08-Aug-13	3
Excavation	10	8	20%	26-Mar-13	04-Apr-13	17-Mar-13 A	31-Mar-13	3
Piling	20	20	0%	05-Apr-13	24-Apr-13	01-Apr-13	20-Apr-13	3
Substructure	35	35	0%	25-Apr-13	29-May-13	21-Apr-13	25-May-13	3
Superstrucure	45	45	0%	30-May-13	13-Jul-13	26-May-13	09-Jul-13	3
Finishing	40	40	0%	19-Jun-13	28-Jul-13	15-Jun-13	24-Jul-13	3
Snagging	20	20	0%	19-Jul-13	07-Aug-13	15-Jul-13	03-Aug-13	3
Handover	5	5	0%	08-Aug-13	12-Aug-13	04-Aug-13	08-Aug-13	3

Figure 9 – Industry Example Reflecting Progress Override

Figure 9 reflects a schedule update as calculated with progress override and no schedule logic corrections. In this case the excavation activity which is occurring out of sequence ignores logic of its predecessor and is progressed as work is occurring on site. Amazingly the results are same as the results we got utilizing retained logic by linking excavation the approval/comment on rev 1 activity.

Example 2

The following examples are from a project in progress in Qatar regarding substation construction. In this case schedule specifications are silent on utilization of retained logic or progress override and the contractor is free to choose. Schedule specifications are stringent regarding submission of monthly updates and pre-approval of schedule logic changes. In order to obtain approval of schedule logic changes the contractor must follow a prescribed and lengthy process. The contractor is working on out of sequence in effort to complete the project earlier than planned.

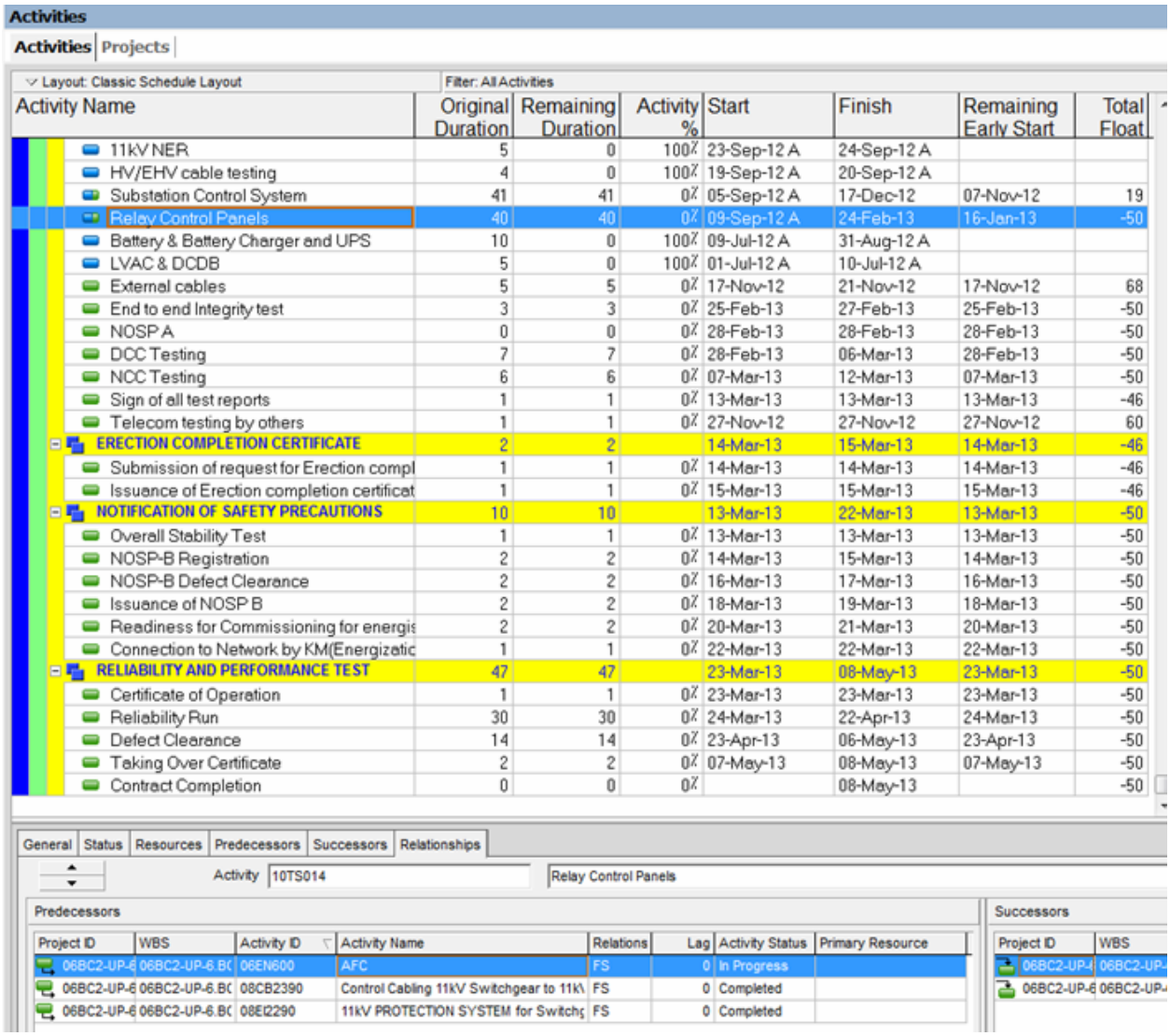


Figure 10 — Industry Example 2, 25-Oct-12 Update with Retained Logic Calculation

Figure 10 displays the October 25, 2012 schedule update from the contractor utilizing retained logic without revision of out of sequence progress. This update reflects that the 'Relay Control Panels' activity is occurring out of sequence and is driving the project completion date. This activities predecessor is incomplete for activity 'AFC'. This schedule displays incorrect early date calculation for all downstream activities on the critical path to project completion and reflects critical path delay of -50 days. In an effort to mitigate the relay control panels activity has started early but mitigation efforts are not shown by calculated dates because out of sequence progress logic was not corrected.

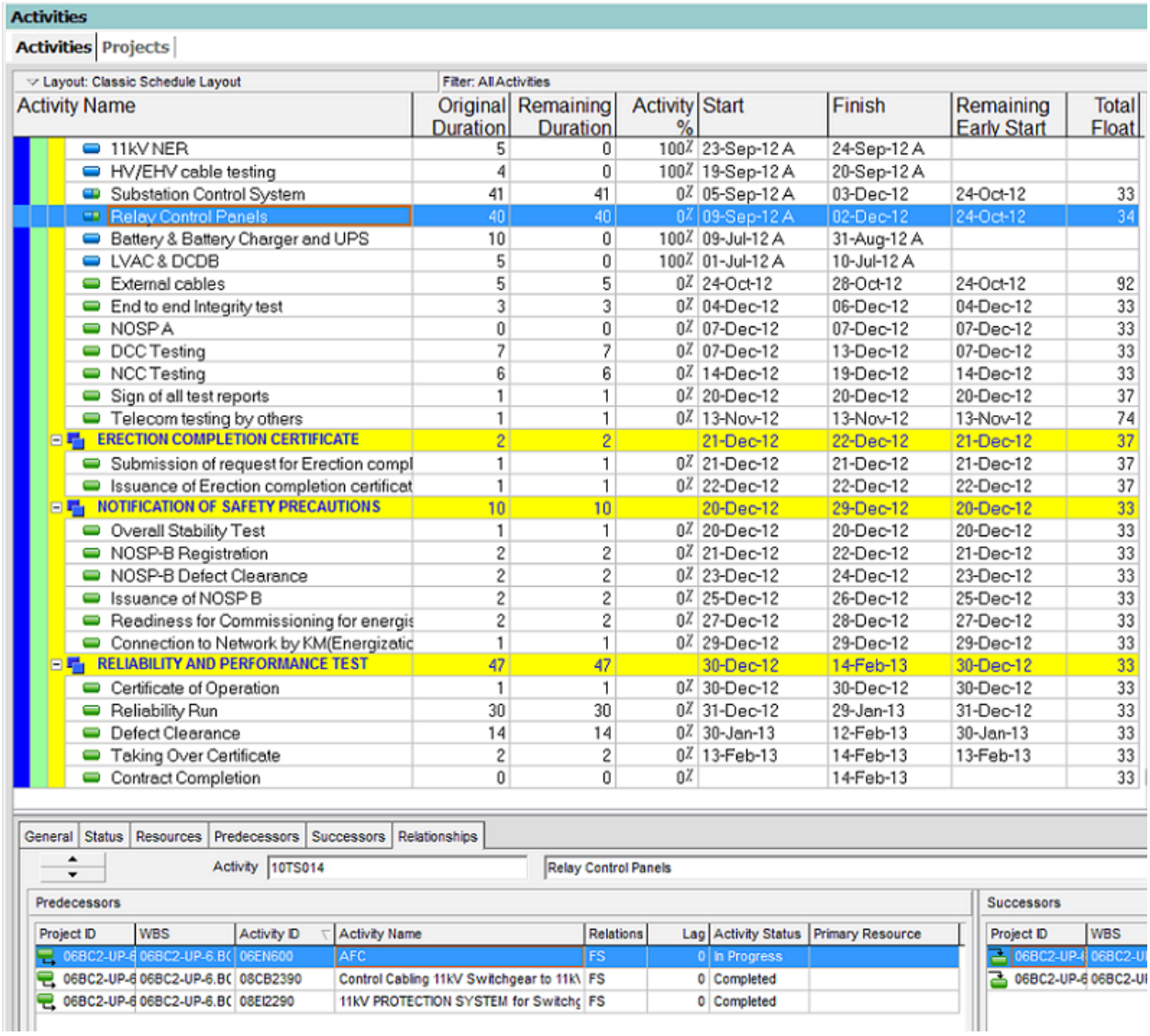


Figure 11 — Industry Example 2, 25-Oct-12 Update with Progress Override Calculation

Figure 11 displays the October 25, 2012 schedule update utilizing progress override calculation. The 'Relay and Control Panel' activity which has started out of sequence has its remaining early dates calculated by ignoring incomplete predecessor logic. The schedule mitigation results are shown and the contract completion reflects early completion by 33 days.

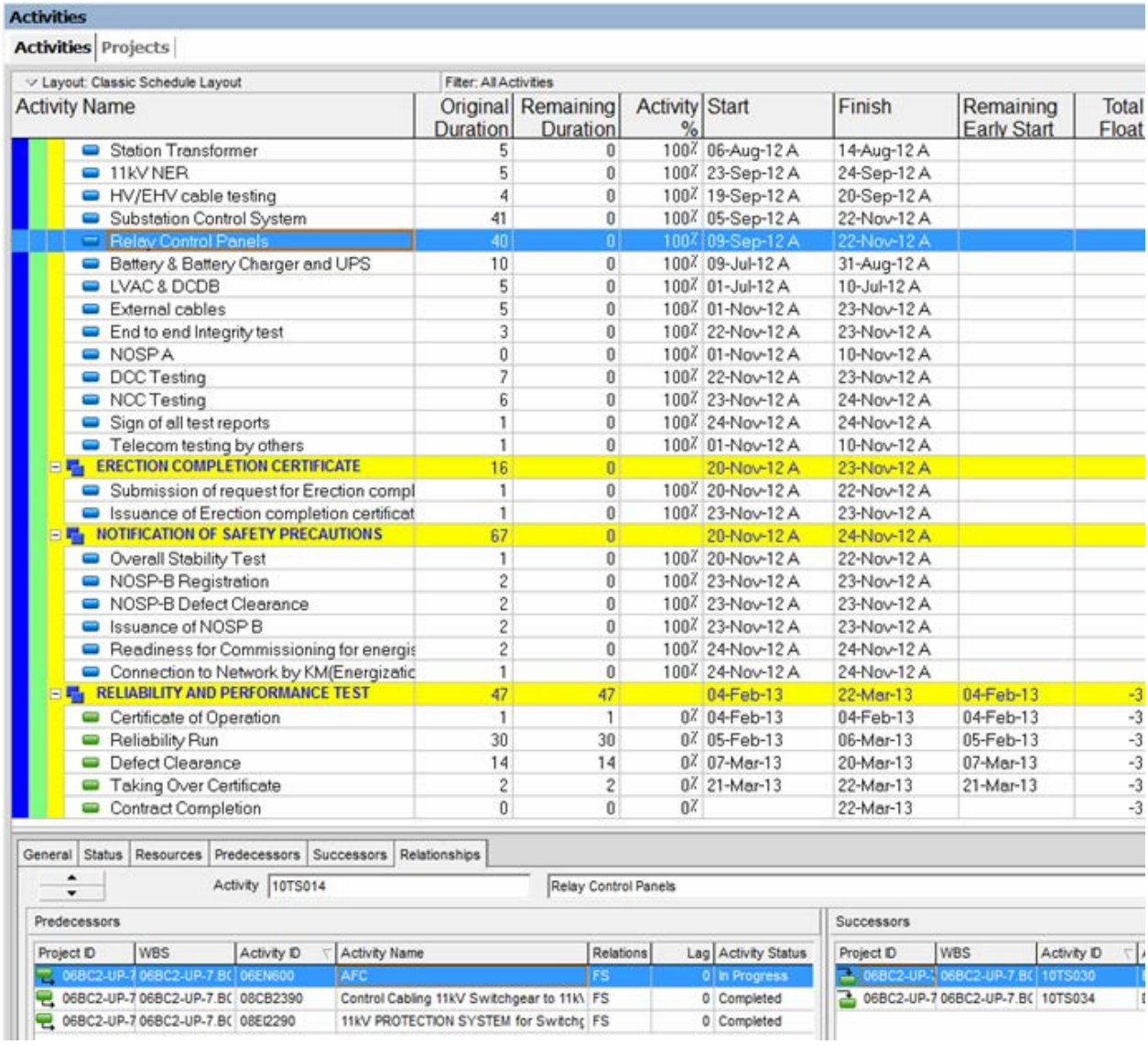


Figure 12 — Industry Example 2, 25-Nov-12 Update with Retained Logic Calculation

Figure 12 displays the November 25, 2012 update utilizing retained logic calculation. The 'relay control panels' activity and many of its successors that were driving the project completion date are completed, however the 'AFC' predecessor is still in progress and delaying the project completion by 3 days.

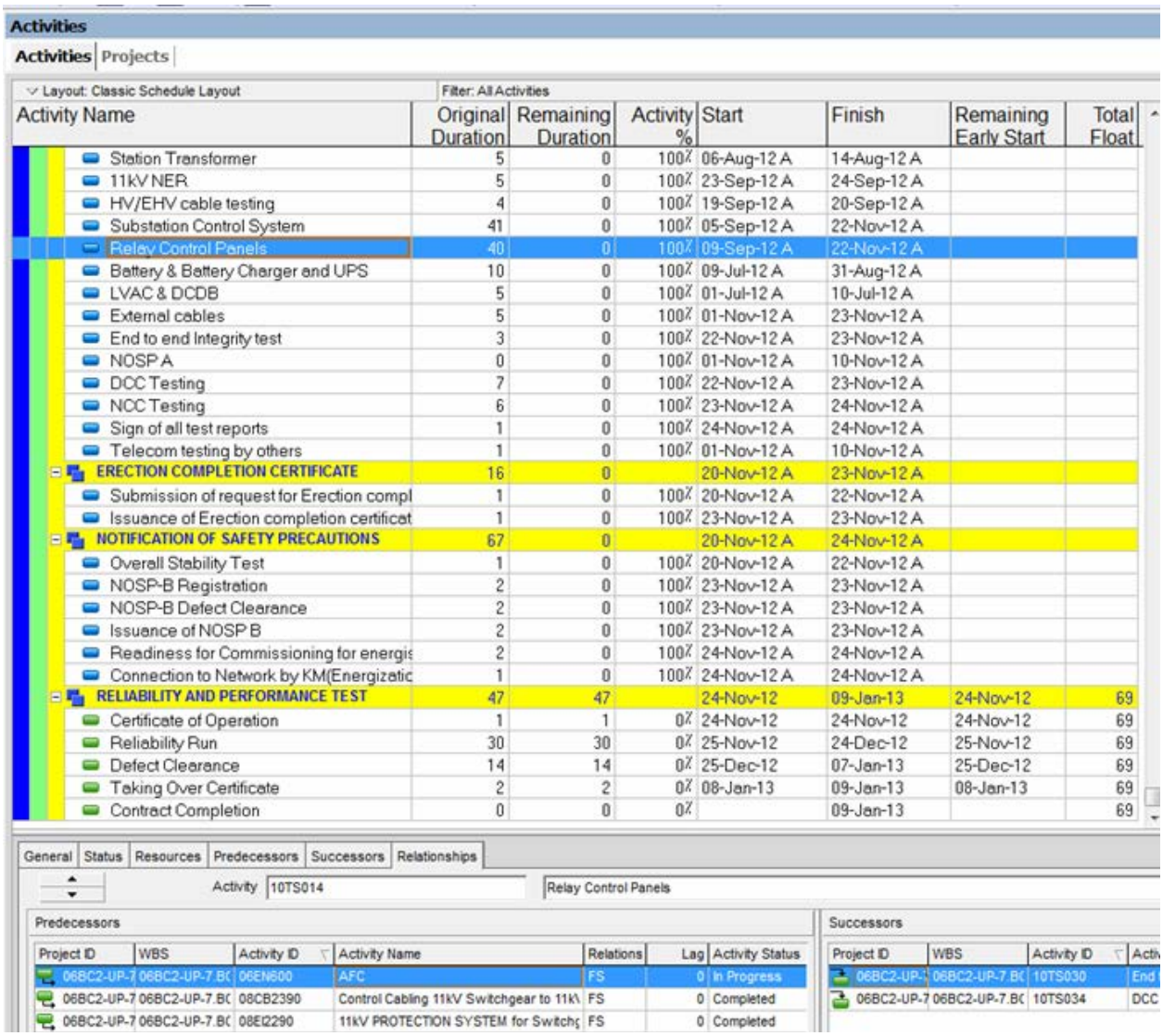


Figure 13 — Industry Example 2, 25-Nov-12 Update with Progress Override Calculation

Figure 13 displays the November 25, 2012 update utilizing progress override calculation. Incomplete predecessor logic is ignored and the completion date is calculated based upon the remaining duration of in progress activities and their successors. Contract completion reflects an early completion of 69 days.

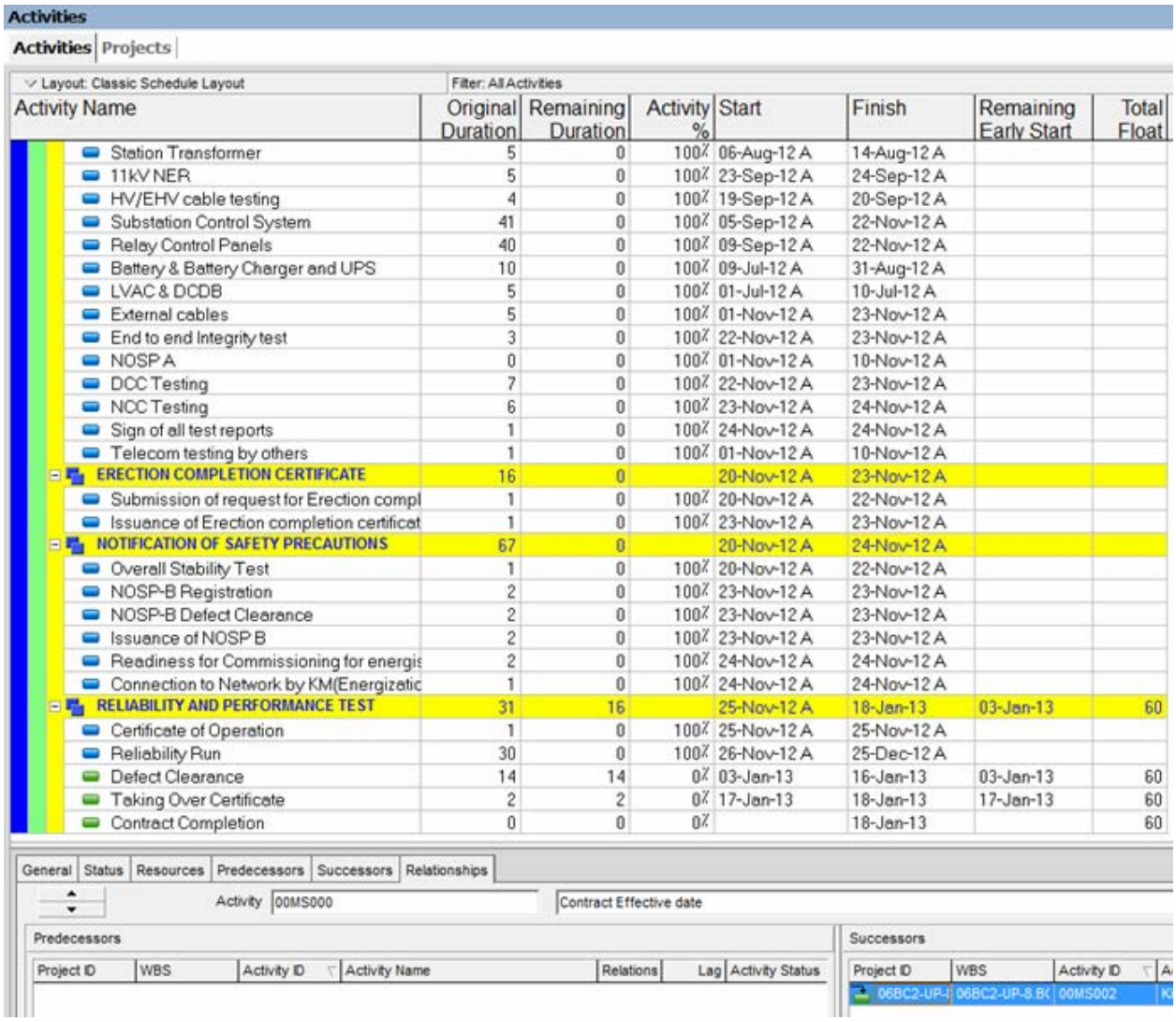


Figure 14 — Industry Example 2, 25-Dec-12 Update with Retained Logic Calculation

Figure 14 reflects the December 15, 2012 with retained logic calculation. Most activities are completed so out of sequence progress is not a factor. The schedule that was showing delay the prior month now reflects early completion by 60 days.

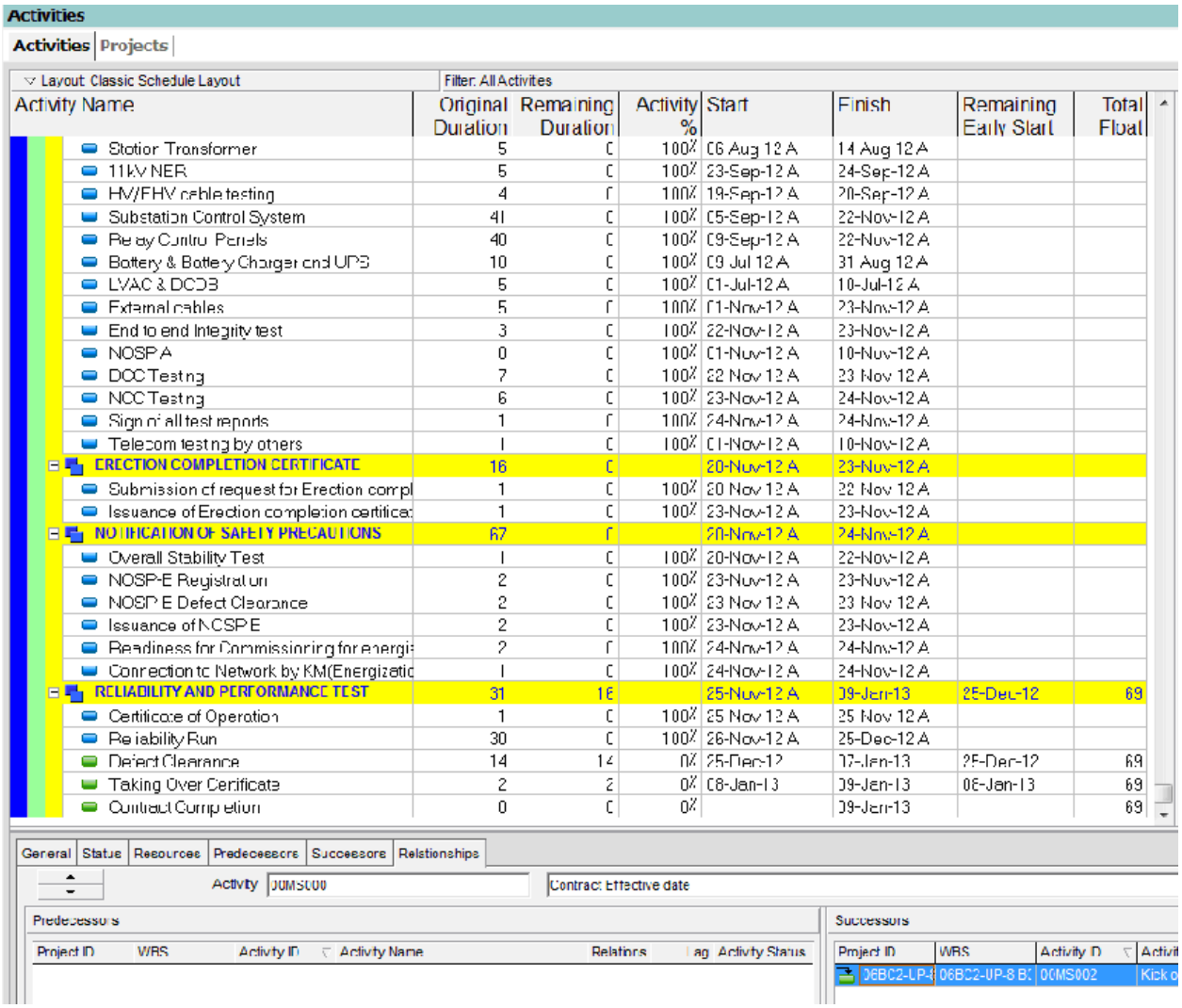


Figure 15 — Industry Example 2, 25-Dec-12 Update with Progress Override Calculation

Figure 15 displays the December 15, 2012 update utilizing progress override calculation. Again incomplete predecessor logic is ignored and the completion date is calculated based upon the remaining duration of in progress activities and their successors. Contract completion reflects an early completion of 69 days.

All of these examples illustrate the vast difference in calculated dates that are possible when using retained logic versus progress override schedule calculation most especially when out of sequence progress is not corrected. When utilizing the retained logic calculation there were false delays reflected for two updates and then suddenly reversed when nearing project completion. In each example where progress override calculation was utilized a projected early finish for the project was reflected.

Pros and Cons of Using Retained Logic vs Progress Override

Pros	Cons
Retained Logic is the most preferred method because logical relationships of activities are respected. When out of sequence logic is corrected the retained logic calculation option gives the most accurate results than any other option.	Retained logic reflects an inaccurate display of activity early dates where out of sequence activity logic is not corrected. This may also result in changing the project critical path based upon incorrect calculation. The out of sequence progress on the critical path could also reflect an inaccurate delayed project completion. From the contractor's point of view too much time is required to identify and address out of sequence activities and especially for large schedule networks. Correcting schedule logic becomes tedious and may not be limited to out of sequence activities. Further, schedule results may not be enhanced appreciably especially when compared against providing all scheduling resources necessary to correct the out of sequence logic.
Progress override allows out of sequence progress by ignoring predecessor relationship logic. Contractor's support that the same schedule calculation results are gained utilizing progress override without expending unnecessary resources to correct out of sequence logic. It is an easier approach with minimal extra efforts required to deal with out of sequence activities.	Progress override disregards the activity original logic. It also adds total float to the predecessor activities by ignoring the logic with out of sequence activities. In cases of critical path activities progress override will increase float available and offset delays.

Table 1 — Retained Logic Versus Progress Override

RL vs PO Impact on Claim Analysis:

Understanding implications of retained logic versus progress override is very important regarding delay analysis. The following discusses forensic scheduling options as outlined in AACE RP 29R-03.

A) **Planned Vs Actual or Plan Vs As Built:**
This is the simplest method of delay analysis in which the actual progress is compared with planned and the difference considered. Often this is a post mortem analysis prepared after delay events to identify the difference between planned and actual. Normally the use of either retained logic or progress override calculation options will not impact delay evaluation since primarily the delay is analyzed based upon the difference between planned duration and actual duration of either an individual activity or project.

B) **Impacted Baseline or Impacted As Planned:**
In this delay analysis method the delay event is inserted in the as planned schedule to identify its impact on the overall completion date. This delay analysis method may establish good results especially when there is not much deviation between planned and actual progress. However, when actual progress differs from as planned and activities occur out of sequence then this method will likely produce inaccurate results. This delay analysis method is also not adversely impacted by retained logic or progress override as it often is a post mortem analysis reviewing the baseline without impact of out of sequence progress.

C) **Collapsed As-Built or As-Built Less Delay:**
This delay analysis method utilizes the as-built schedule for evaluation of delays. Delay events are subtracted from the schedule to review impact on progress of work. This method considers how original logic changed compared to baseline logic[8]. When developing the as built schedule it is very important to correct out of sequence logic to obtain accurate results.

D) **Window Analysis or Contemporaneous Period Analysis:**
This delay analysis method uses the project schedule updates to quantify the loss or gain of time along logic paths and identify activities responsible for critical path impacts. Although this method is retrospective, it relies on the forward-looking calculations made at the time the updates were prepared and to the right of the data date. Schedule updates are taken at an interval based on the frequency of updates on the project and as data are available. This technique does not involve the insertion or deletion of delays but instead is based on observing the behavior of the schedule network from update to update and measuring schedule variances based on unaltered, existing schedule logic.

This method relies on comparing the critical path of one update to a subsequent update. In this case correction of out of sequence logic for retained logic calculations is required to obtain accurate results. The AACE recommended practice does allow minor changes to the contemporaneous schedule and modifying logic for out of sequence activities.

E) **Time Impact Analysis**
The TIA is a 'forward-looking,' prospective schedule analysis technique that adds a modeled delay to an accepted contract schedule to determine the possible impact of that delay to

[8] AACE recommended Practice 29R-03, Forensic Schedule Analysis

project completion[9]. In this method of analysis, a fragnet of delay events is created and inserted in the schedule update that is closest to the delay event. After adding the fragnet of delay events into the schedule, the schedule is analyzed to determine the difference between the un-impacted schedule and impacted schedule. Any difference is established as the effective delay.

Retained logic calculation and correction of out of sequence progress logic is required to analyze the pure delay between the two schedules. AACE recommended practice 52R-06 discusses the importance of out of sequence schedule logic correction and the effect of retained logic on CPM calculations. Progress override will ignore predecessor schedule logic and introduce additional float into the calculated schedule. It is imperative to correct out of sequence schedule logic to obtain true date calculation when using retained logic to analyze delays throughout the progress of the project.

Recommendation

As established in several examples out-of-sequence progress is a common occurrence and schedule quality control procedures and specifications are needed to address the matter. When schedule specification language does not exist problems pursue and differing stakeholders posture to benefit. The industry examples provided illustrated that when out of sequence work is not managed the scheduling calculation results do not reflect actual progress and logic corrections are required to accurately reflect the true picture. Where out of sequence schedule logic corrections are not made then progress override may be utilized to obtain better calculated date results. However, scheduling industry best practice recommends use of retained logic and correction out of sequence progress.

For delay analysis purposes it does not matter what calculation options are chosen when using the planned versus actual and impacted baseline or collapsed as built analysis methods. However, when performing contemporaneous delay analysis using either the windows technique or time impact analysis the retained logic calculation and out of sequence progress logic correction is required.

Conclusion

Schedule calculation options for both retained logic and progress override are important and when not managed properly can result in inaccurate results for in progress schedules. Scheduling best practice requires the utilization of both the retained logic calculation and correction of out of sequence progress schedule logic.

[9] AACE Recommended Practice 52R-06, Time Impact Analysis – As applied in construction.

Schedule specification language is required to identify the schedule calculation method and correction of out of sequence progress logic. It is important to understand the impact of retained logic or progress override calculation options when performing delay analysis contemporaneously when using the windows or time impact analysis methods.

Contractors may fail to correct out of sequence schedule logic due to personnel skill sets, availability of resources, and contract clauses requiring protracted schedule logic approval processes. Where out of sequence progress schedule logic corrections are not made then progress override calculation is advised to obtain more realistic calculated date results.

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