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Schedule Delay Analysis

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Robert M. D’Onofrio, P.E., Chair

John C. Anderson, P.E.

David Arditi, Ph.D.

Jesus M. de la Garza, Ph.D.

Thomas J. Driscoll

Brian J. Furniss, P.E., PSP, CFCC

David W. Halligan, P.E.

John P. Lamutt, P.E.

Frank J. Regnery, P.E.

Mark Sanders, P.E.

Ted M. Scott, III, P.E.

Chapter 1

Introduction

Critical path method (CPM) techniques, properly prepared and maintained, have made it possible to demonstrate, with reasonable certainty, the impact that can occur as a result of delays on a project. Delays can be reasonably identified, isolated, and quantified, and concurrent delays segregated. CPM networking techniques can be of evidential value to demonstrate liability and causation and also to apportion delays when concurrent delays occur.

It is important for project participants to understand not only the techniques of scheduling but also that a project schedule can serve as a basis for delineating the respective rights, obligations, and warranties flowing from the schedule. There are a number of key issues associated with a project schedule that have legal implications.

Also, it is important to keep the project schedule properly updated and the contract completion date timely adjusted for excusable delays. It is equally important for all parties to settle any delays and cost issues associated with changes contemporaneously. The project schedule should be revised to reflect actual performance, major changes, and delays as they occur. The contract completion date also should be adjusted for contemporaneous time extensions.

There are a number of schedule delay analysis methods used in the industry. Any method used should follow the industry guidelines identified in this standard.

The 36 guidelines included in this standard generally reflect best engineering principles associated with schedule delay analysis and reflect standard of practice in the United States construction industry. However, individual cases may not follow the general standard. Parties should check the construction contract carefully for notice provisions, exculpatory clauses, and requirements for proof of delays. Less preferred risk averse contracts attempt to shift the risk of delays and time extensions to one party, which can lead to disputes in contrast to the equitable and fair risk allocation.

This standard should be used in accordance with the schedule practitioner's professional experience and knowledge, along with facts specific to the reference project. Any legal cases referenced in this standard are for additional information only, and their relevance or application to a specific project or jurisdiction requires consultation of a duly licensed legal professional.

Chapter 2

Scope

The 36 guidelines in this standard allow for segmentation of responsibility for delay to intermediary milestones and to the project completion date. They also enable delay damages or liquidated damages to be calculated by utilizing critical path techniques and preparing a schedule delay analysis. The guidelines in this standard are based on principles of schedule delay analysis in the following categories:

- Critical path,
- Float,
- Early completion,
- Chronology of delay,
- Concurrent delay,
- Responsibility for delay,
- Changing schedules after the fact, and
- Acceleration.

The application of such principles should be based on the terms of the contract, good contract administration, consistency in application, and legal precedence.

These standard guidelines provide commentary, support for, and explanations of this ASCE standard committee's list of guidelines. The definitions of terms is included for reference.

Chapter 3

Definitions

Apportionment—The act of dividing and assigning a share or responsibility for controlling delay or cost.

Concurrent—Happening at the same time; existing side by side; operating at the same time.¹

Concurrent delay—Delay to the project critical path caused concurrently by multiple events not exclusively within the control of one party.²

Contract completion date—The date required by contract for substantial completion of the contract. The contract may attach liquidated damages to failure to meet the contract completion date. In a schedule, the scheduled completion date typically is constrained to the contract completion date.

Contract milestone—A contractually required date for partial completion of the work, which is also referred to as an intermediary milestone. The contract may attach liquidated damages to failure to meet intermediary contract milestones.

Critical delay—A delay that causes an impact to the project completion date.

Critical path—Work that must be progressed to prevent delays to the contract completion date or intermediary milestones. There can be more than one critical path in the schedule.

Critical work—Activities with zero or negative float in a current adjusted schedule.

Current adjusted completion date—A contractually required completion date adjusted to reflect prior excusable delay.

Current adjusted schedule—A schedule updated to reflect progress, with the current adjusted completion date reflecting prior excusable delay through the current schedule status date.

Delay—To impede the process or progress (work).³

¹ Black's Law Dictionary (2004).

² Bruner & O'Connor on Construction Law § 15:67 (May 2007).

³ Dictionary.com (2014).

Float—The contingency that exists on a path of activities. It is measured by comparing the early and late dates on a start or finish basis. It is possible when using precedence networking that there can be a difference between the early and late start and finish dates for an activity.

Longest path—Critical path through a logic driven schedule reflecting the anticipated or scheduled completion of the work. This also is referred to as the most critical path.

Offsetting delay—A delay that may occur when a contractor is behind schedule and the owner later causes a delay to the contract completion date. Time entitlement and damages are dependent on the measure of delay caused by each party.

Paths of criticality—Work that must be progressed to prevent delays to the contract completion date or intermediary milestones. There can be multiple paths of criticality in the schedule.

Scheduled completion date—The anticipated or predicted date that estimates when work on the project will be complete. This date may differ from the contract completion date depending on schedule progress and delay.

Chapter 4

Critical Path

Typical construction contracts require that delays be critical to justify a time extension. How the critical path is defined influences quantification of delay and ultimately whether a party was damaged by a delay. The critical path may change during the course of the project. Activities that were critical at one point on the project may later become not critical and vice versa. The following guidelines are intended to assist schedule experts in evaluating and determining the critical path in a schedule delay analysis.

4.1 The critical path is dynamic and may often change during the course of the project depending on when the project status is evaluated and completion is forecasted.

Critical path method (CPM) techniques are often the industry's preferred practice for planning how to best complete a project. They are also extremely useful in determining the effects of delays and changes to the project. As a result, the critical path may shift throughout the course of construction on the basis of delays, progress, and circumstances resulting in changes to the plan at different times on the project. These changes are intended to be identified and tracked in contemporaneous project schedules. Because the critical path is dynamic, delays should be evaluated based on the critical path during each delay.

4.2 Contemporaneous schedules should be maintained to reflect actual performance, the plan to complete the work, and delay, should it occur.

An accurate status of the project may be assessed primarily if the schedules are kept up to date, reflecting work taking place in the field, delays, and the sequence of remaining work to be performed. Contemporaneous schedule updates should be maintained reflecting all changes and should include changes to the critical path, the creation and consumption of float, baseline adjustments, changes based on contemporaneous decisions made by the participants, and the plan to complete all remaining work.

4.3 Delay must be critical to the current adjusted completion date for consideration of a time extension.

When assessing a delay that has occurred, one needs to consider prior and pending entitlements as a new delay is being assessed for entitlement. When anticipating a delay, it is recommended to check schedule updates to determine the completion date and any pending excusable delays that need to be considered. The delay could be critical at the project level or for a certain contractor's scope of work depending on established contractual milestones.

Different contract milestones may have an excusable delay to each milestone, which needs to be evaluated separately for criticality. Excusable delays to contract milestones that are not the contract completion date typically will not provide a contractor with additional compensation for delay; only an excusable time extension will be granted to offset liquidated damages to that milestone. However, there may be exceptions where the contractor incurs separate costs tied specifically to that milestone.

4.4 Delay should generally be measured by the change to the scheduled completion date caused by the delay.

Delay should generally be evaluated by comparing the schedules before, during, and after the delay.⁴ Critical delay can be shorter or longer than the delay (impacting event). Examples of critical delays shorter than the impacting event are when the impacting event absorbs float or succeeding activities are able to progress without further effects from the impacting event. Examples of critical delay longer than the impacting event can include when the impacting event pushes the contractor into a constrained work period or requires reordering of long lead time

⁴ See, e.g., *George Sollitt Const. Co. v. U.S.*, 64 Fed. Cl. 229, 252 (2005) "The better methodology for a critical path delay analysis is to use the updated CPM schedules, not the baseline schedule prepared before construction began. See *Blinderman*, 39 Fed.Cl. at 585 (stating that 'the only way to accurately assess the effect of the delays alleged . . . on the . . . project's progress is to contrast updated CPM schedules prepared immediately before and immediately after each purported delay'); *Fortec*, 8 Cl.Ct. at 505 (stating that 'if the CPM is to be used to evaluate delay on the project, it must be kept current and must reflect delays as they occur'); *Sollitt Br.* at 44 (admitting that Sollitt prepared the updated analysis 'in recognition of the widely accepted practice of using the updated schedules for the analys[i]s')."

materials. The effects of a critical path delay also may affect the progress of work on noncritical paths.⁵

In the event that there are major concerns with the accuracy of the schedules, expert analysis may be required after the fact to determine whether adjustments are necessary or an alternative method for evaluating delay is to be used.

Measuring changes to the projected completion date between updates accounts for ordinary mitigation efforts that may have been made to reduce any prior delay in the schedule. Acceleration measures that require additional cost may be identified separately from the delay quantification.

4.5 Excusable delays are typically events outside the contractor's control and entitle the contractor to a time extension.

Excusable delays typically include third-party events, force majeure events, unusually severe weather, and owner-caused delays. Excusable delays mean that the contractor is entitled to a time extension to a contractual completion date. Excusable delays may be noncompensable or compensable depending on the provisions of the contract. Typically, delays outside the control of both the owner and the contractor are excusable but noncompensable.

4.6 In situations where the completion date is adjusted properly for change orders and the contractor is behind schedule, owner delays that occur thereafter on a separate path may have a mitigating effect on assessment of damages.

In certain situations when the current, as adjusted contract completion date has passed or the current, updated schedule is projecting a completion date that is later than the contract completion date, owner-responsible delays occurring thereafter may mitigate the assessment of liquidated damages. This type of delay is referred to as "offsetting delay," recognizing that an owner-caused delay may result in recognizing a noncompensable time extension to offset all or a portion of any potential liquidated damages.

Delay damages can be measured and determined by the effect of each path of activities that impact the current contract completion date, based on chronology of delay, responsibility for delay, magnitude of delay, and how both contractor and owner delays affect the current contract

⁵ In some cases, delay analysis to separate milestone dates may be required.

completion date at specific times. Such situations may affect the assessment of owner damages previously projected as a result of the contractor's late performance and the owner's right to assess damages for late completion.

4.7 For a delay to be compensable, it should be the sole cause of delay.

Typically, owner-caused delay is required to qualify as compensable delay. However, third-party delay may be compensable depending on the provisions of the contract. For compensable delay, the delay should extend the scheduled completion date of the project. For example, activities with float can fall on the longest path because of schedule constraints and multiple calendars (e.g., weekend nonwork restrictions), and critical activities can fall on paths of work that are not the longest path (again because of constraints and multiple calendars).

Delay to intermediary contract milestones typically do not result in additional delay costs, because the contractor would have been on site until completion of the project, and as a result, delays are not typically compensable to the contractor. However, liquidated damages attached to intermediary milestones by contract may be assessed for failure to meet each milestone and may be cumulative.

Chapter 5

Float

There are several types of float, including “total float” and “free float.” The most useful for delay analysis is total float. Float generally refers to total float unless specified otherwise. Generally, total float is the amount of time an activity can be delayed before it delays the completion date in the CPM network.⁶ Total float is the mathematical difference between late dates and early dates for each activity.⁷ The calculated early dates (early start and early finish) track the earliest dates each activity can take place by the logic in the schedule. The late dates (late start and late finish) are the latest scheduled finish dates each activity can take place while still finishing by the constrained completion date,⁸ and proceeding backward, i.e., “the backward pass,” through the CPM network until it reaches the earliest activity. Total float tracks completion in relation to the latest scheduled finish date in the CPM network.⁹ When the constrained completion date is earlier than the earliest finish date of the network, total float becomes negative. The following guidelines reflect general use of float in a schedule analysis.

5.1 Activities with float are not critical.

Generally, just because an activity falls on the longest path does not necessarily mean it is critical. Activities with float can fall on the longest path, and critical activities with no float can fall on paths that are not the longest path.¹⁰ For example, the use of multiple calendars may result

⁶ Absent multiple constraints in the schedule.

⁷ However, the start float and finish float may be different as a result of schedule constraints and logic ties.

⁸ In an unconstrained schedule, the latest scheduled activity date is used, and there would be no negative float in the schedule.

⁹ For example, if the latest scheduled finish date in the CPM network is Activity 500, *Project Completion*, then the total float values are relevant to prioritizing time for *Project Completion*. If the latest scheduled finish date in the CPM network is Activity 600, *1-Year Landscape Maintenance*, then the total float values are relevant to prioritizing time for *1-Year Landscape Maintenance*.

¹⁰ For additional examples and explanation, see D’Onofrio, R. M. (2009). “Can there be float on the critical path?” *Under Construction*, 11(3) 1, 4–5. See also Furniss, B. J., and Trauner, T. J. (2010). “The critical path: Definition vs. understanding, *Construct!* 19(1) 2–5.

in additional float on activities that fall on the longest path, and cause fluctuation between float values along a continuous path of work.

5.2 Float is owned by the project.

In the absence of contract language shifting float “ownership,” float is owned by the project. This means that float goes to the first party to use it. Other methods of allocating float to different parties are available but should be specified by the contract for use in delay evaluation. Whereas contract provisions may make float only available to one party, it may be difficult to recover damages from the other party when delays solely absorb float with no impact to the completion date.

5.3 Excessive constraints on activities that interfere with a logic-driven critical path should generally be avoided.

In a constrained schedule, total float may be driven by constrained dates instead of the project end date. This becomes even more confusing when multiple constraints are used in the schedule, because which constrained date the total float value relates to must be determined, as there may be several in the CPM network. As a result, the use of constraints complicates the use of total float as a time-prioritizing tool. Particularly, the use of specified constraints on individual activities or specifying float values on individual activities may interrupt a logic-driven critical path and is not preferred.

5.4 If multiple milestones have damages associated with them, a separate delay analysis should be performed for each milestone.

Float values are affected by different constraints in the CPM network. In instances where the schedule contains milestone constraints, it may be more accurate to identify the critical path through the subject milestone or the activities that must be progressed to keep that milestone on time.

Chapter 6

Early Completion

Generally, the contractor has the right to finish early. The owner gains the benefit of early project use, and the contractor gets off-site and no longer incurs general conditions costs. The additional contractor cost savings of early completion also are reflected in a lower bid price anticipating early completion. Although the owner should not have to spend additional costs to meet a contractor's early completion schedule, the owner should not interfere with the contractor's ability to finish early.

6.1 A plan to finish early should be reasonable.

Parties should address early completion as early in the project as possible. It is good practice for the contractor to inform the owner that the contractor plans on finishing early. An owner should review and validate the potential of the contractor to finish early. If an owner takes exception, the owner should inform and discuss this with the contractor before making a decision to acknowledge the contractor's intent. For the contractor recover compensation for compensable delays prior to the contract completion date, the contractor's plan to perform the work and finish prior to the contract completion should be reasonable.

6.2 Generally, the contractor may be allowed to collect delay damages to an early completion schedule but may not collect an excusable time extension until the scheduled completion date exceeds the contract completion date.

If entitlement and responsibility are shown, a contractor should generally be able to collect delay damages for compensable delay to an early completion schedule. However, a contractor would not be granted an excusable time extension until the scheduled completion date exceeds the contract completion date. If the parties intend otherwise, they should agree on how to assess delays to the early finish date.¹¹

¹¹ This includes whether the buffer between early completion and contract completion is available for the contractor's exclusive use. If it is not, parties should consider a change order adjusting the completion date or adding a "contractor schedule contingency activity with a duration equal to the difference between the early finish and the

Any delay to the early completion date that is still prior to the contract completion date and beyond the control of the contractor should be addressed and documented contemporaneously using delay analysis procedures and providing supporting documentation. The owner should inform the contractor of delays in a timely manner for which the contractor is responsible, document the delay, and address and resolve, also in a timely manner.

contract schedule completion date. Critical contractor delays reduce contingency until it expires. Owner critical delays adjust both the early finish date and the contract completion date.”

Chapter 7

Chronology of Delay

The chronology of delay is defined as the order in which delays should be considered in a schedule evaluation. Chronology of delay is an important part of a critical path analysis as the basis for segregation of delays to allow related costs and time impacts to be attributed to the parties involved. A chronological evaluation is critical in determining when events occurred, their impact on the contemporaneous project schedules, and the contemporaneous decisions made by the parties, emphasizing the importance of keeping project records and schedule updates throughout the project. The schedule is not static and changes continually on the basis of events as they unfold on a project, and this must be reflected in a proper evaluation of project delays. This discussion is complicated by when an analysis is being performed: prospectively, retrospectively, or in some combination of the two during the course of a project.

The following guidelines reflect an understanding of the chronology of the delays and potential mitigation efforts that can be incorporated in a contract or specification to mitigate uncertainty in evaluation method.

7.1 Delays should be evaluated as they occur in chronological sequence.

Generally, delays should be evaluated chronologically and cumulatively in the order in which they occur on the project. The delay recognized to have started first in time that affects the schedule will be fully evaluated until that delay is resolved. This may have no impact on the critical path or directly affect or change the critical path. It may absorb float on one or more paths and/or create float on others. Likewise, changes to the work through change orders should be incorporated into the schedules as they occur, whether they have a direct overall schedule impact to the critical path or they only reflect the absorption of float.

7.2 A schedule delay analysis should reflect an analysis of prior entitlement so as to reflect a current adjusted schedule prior to evaluating delay.

Typically, engineering and construction decisions regarding delays are made as each occurs, and the delay analysis should follow the same logic. Each delay evaluation is based on the then current conditions, which would include any schedule impacts from the first, along with any schedule revisions on the project. Decisions on a project are made with the available

information at the time. Evaluation of impacts caused by prior delays should be included in the schedule delay analysis to be able to distinguish the impact of the current delay from prior impacts.

Using a current, updated, and adjusted schedule prior to delay evaluation is consistent with the critical path and concurrent delay principles outlined in Chapters 4 and 8. Delays considered in sequence are evaluated chronologically. Similarly, the schedule needs to be updated and adjusted prior to evaluating concurrent delays. For more information on evaluating concurrent delays, see the guidance in Chapter 8.

7.3 Consideration should be included as to how delays were evaluated by the participants during the project.

Schedule delay evaluations generally should reflect the mind-set and information available to project participants at the time of the delay. That information may define the actions of the various parties with regard to decisions made on the project. Actions taken by the participants during the project could have a direct impact on the schedule, determination of damages, and the right of one party over the other to recover damages.

Although delay events should be recognized and measured during the project as the project progresses, in practice they are not always identified contemporaneously. During expert analysis, the more common industry practice is to measure the delays in an after-the-fact analysis, which more accurately defines the delay events that occurred on a project. Although this process may reveal what may be considered bad decisions with hindsight, contemporaneous decisions affecting project delay still may be justifiable.

7.4 Analysis or decisions regarding the evaluation of delay chronology should be documented with contemporaneous records.

Recognizing the start and end dates of delay events is a critical aspect of delay analysis. Common issues documenting the chronological order of delays may include the following:

- Schedule updates are dependent on the dates put into them, which may be subjective, and
- Schedule activities tend to show continuous work when there may be gaps and may not accurately portray when the work was accomplished.

An overriding criterion should be what delay events were causing the participants to change their actions, as contemporaneously documented. Whether a particular delay is

compensable or to whom responsibility is attributable should not be the controlling factor on which delay is evaluated first.¹²

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¹² For more information on changing project schedules for a delay analysis, see Chapter 10, Changing Schedules After the Fact.

Chapter 8

Concurrent Delay

In general terms, concurrent delay can be described as a situation where two or more critical delays are occurring at the same time during all or a portion of the delay time frame in which the delays are occurring. Concurrent delay is a position often taken by both contractors for avoidance of liquidated damages and owners for mitigation of contractor claims for compensable delay.

Whether such delays are excusable depends on the terms of the contract, chronological sequence of the delays involved, cause of delays, responsibility for delays, timing and duration of the delays, availability of float (contingency time in critical path analysis), and the effect any delay has on a contract milestone or the project completion date.

The guidelines in this section reflect an understanding of concurrent delay, how it can have differing effects, and how it can be apportioned.

8.1 Concurrent delay can be described as a situation where two or more critical delays are occurring at the same time during all or a portion of the delay time frame in which the delays are occurring.

There are different situations in which concurrent delays may occur. First, there is the situation with two separate delays by an owner and a contractor (two parties), each simultaneously delaying work on separate critical paths. Second, one party can be concurrently delaying the project completion date on two separate critical paths. Third, in the use of multi-prime situations or the use of multi-sub on a project, there can be more than two parties concurrently delaying a contract milestone or the project completion date.

8.2 Concurrent delays do not need to have the same start or finish dates.

When delays occur at the same time, they can have differing effects. For example, one party can be delaying a path of criticality that results in impacting the project completion date. Whereas the other delay occurs on a separate path of activities, it can have a positive float position; the result has a differing effect. Entitlement is dependent on whether the owner or the contractor is responsible for the controlling delay to the project critical path.

8.3 Concurrent delay typically is excusable but noncompensable, meaning a time extension is given but no costs are incurred by either party.

For the purposes of assessing liquidated damages, the general rule is that contractors will not be charged for critical delays they cause that are concurrent with owner-caused critical delays of equal time (concurrency) that cannot be apportioned in terms of responsibility and damages.

Likewise, an owner will not be responsible for a contractor's delay damages when the contractor simultaneously caused critical delay that is concurrent with owner-caused critical delay of equal time that cannot be apportioned.

8.4 Concurrent delay should be apportioned where possible.

Conditions that allow concurrent delays to be apportioned include situations where there is overlapping of concurrent delays on the start or finish of either delay or both. Another is when one or both of the two delays that are concurrent are absorbed partially by available float on an activity path before they become critical. A further example is when one or both of the concurrent delays have different start or finish dates and one or both are on a different negative path of criticality.

To consider apportionment of concurrent delays, consideration needs to be given to facts, criticality, timing, responsibility for delay, duration of delay, method used to measure delay, and ability to mitigate.

Chapter 9

Responsibility for Delay

After the impact of a delay event has been quantified, determining which party was responsible for the delay event often falls to a schedule expert. This assessment is ultimately necessary for determining entitlement and aiding in determining quantum.

9.1 A schedule expert typically can identify the party responsible for a delay from the contemporaneous records, interviewing project personnel, and reading deposition testimony, and may rely on technical experts or fact witnesses in opining on liability.

Responsibility for delay can be classified as

- Owner-caused,
- Contractor-caused, or
- Beyond the control of the parties involved (i.e., third-party-caused).

Determination of responsibility requires a review of the contract and also may require outside expertise on specific issues or a legal opinion. Examples of owner responsibility for delay may include directed or other changes that have merit, late approvals (shop drawings, schedule, changes, etc.), late owner-furnished equipment, late site access, delay in acquiring right of way, suspension of work, or actions or the lack of actions of the owner's agents (architect, engineer, construction manager, or specialty consultant), and regulatory and sponsor agencies.

Contractor-caused delays may include late performance, defective and corrective work, late shop drawings, late equipment or material deliveries, poor subcontractor performance or financial failure, labor issues, or failure to schedule and coordinate subcontractors.

There are also delays beyond the control of the parties. Examples include some types of differing site conditions, unusually severe weather,¹³ or force majeure events. The excusability and compensability of these issues may depend on the contract.

¹³ Ordinary weather is typically the responsibility of the contractor, and adverse weather must be unusually severe to warrant a time extension as outside the control of either party.

9.2 During a project, the contractor should provide the owner with a notice of delay for excusable delays, followed by a request for a change in accordance with the contract.

Determination of delay responsibility on a contemporaneous basis is essential for owners and contractors to manage a project successfully. When a contractor believes a delay is occurring or has occurred and for which that contractor has no responsibility, the contractor has the burden of proof to support a request for additional time (and potentially, additional cost) by preparing a time extension analysis using the project schedule to demonstrate the delay (causation).

9.3 Responsibility analysis should be supported by a factual chronology based on the contemporaneous project performance records and referencing the remedy granting clause of the contract.

Determination of delay responsibility also can occur on an after-the-fact basis. Typically this is achieved as part of an overall and comprehensive schedule and delay analysis prepared for pursuing or defending a claim involving delay, impact, disruption, acceleration, cumulative impact, or liquidated damages. Proof of delay generally requires an overall determination of excusable and non-excusable delay, compensable and noncompensable delay, identifying any concurrent delay that is involved and mitigating compensability, proof of any acceleration claimed, or any determination of liquidated damages.

The chronology generally should be supported by project records. Some examples of project records include daily logs, RFIs, photographs, change directives, drawings and specifications, schedules, or test reports. The schedule expert should check the construction contract carefully for provisions related to the delay event. Typical provisions include the notice, changes, differing site conditions, and force majeure clauses.

It should be noted that it is not always expected for the schedule expert to assess liability on an after-the-fact basis. Therefore, a schedule expert should confer with legal counsel before opining in this regard.

9.4 The schedule expert should attempt to discuss the issue with the individual directly involved and who has factual knowledge of the delay issue.

Generally, it is good practice to discuss an issue with project personnel who are directly involved in dealing with that issue during the project for knowledge and background information

on the associated issue. This information often is helpful in preparation of the delay analysis and associated determination of causation and responsibility.

9.5 If the delay event involves a technical engineering or constructability issue, care should be taken so that the schedule experts do not opine beyond their expertise. If necessary, a technical expert should be engaged on whose opinion the schedule expert can rely.

Schedule experts typically can identify the party responsible for a delay from the contemporaneous project records and by discussing the issue with the individuals directly involved and those who have factual knowledge of the delay issue.

However, in some instances, the determination of liability will require technical engineering or constructability expertise (e.g., differing site conditions, structural calculations, etc.). In such cases, schedule experts should take care not to opine beyond their capabilities and instead rely on the opinion of other technical experts or even fact witnesses.

When these technical issues arise, professional expertise should be engaged to conduct an investigation and fact finding of the issue to determine the contractual and legal basis for identifying responsibility and to identify the particulars that will be required to establish and prove such responsibility.

9.6 Once a technical expert's finding as to which party was liable for the delay event is formed, a legal review may be made with counsel consistent with legal precedence in the project jurisdiction.

Once a technical expert has conducted an investigation and formed an opinion, a legal review should be made with counsel to determine whether the legal basis being pursued is sound and whether the elements of proof required to support the issue or theory are present and fully supported by proper documentation and consistent with legal precedence. If these conditions are met, then the schedule expert can rely on the findings and opinions of the technical expert in assessing liability.

Chapter 10

Changing Schedules after the Fact

Changes to schedules made after the fact, such as after project completion, should be limited to special circumstances. Changes to the schedules may include changing activity durations, logic, as-built dates, constraints, or other schedule information often kept in the schedule software. Generally, there is a rebuttable presumption of correctness attached to the contemporaneous CPM schedules the parties used on the project. Therefore, the burden of proof of changing the schedules after they are prepared and used during the project lies with the party making the changes. As a result, any changes made after the fact should be made with good justification, be carefully documented, and explained. Although changes are situation specific, the following guidelines are intended to help clarify when the schedules should or should not be changed from the version that was submitted and used during the project.

10.1 The schedules should be presumed correct as they were used during the project, unless otherwise shown to be inaccurate.

Critical path method (CPM) schedules used by project management to manage a project best reflect the plan the parties used to perform, manage, and monitor the work. CPM schedules with regular updates typically are required by contract. Schedules that are created and updated during the course of contract performance determine which activities are critical and which have float at different points on the project. The schedules can be used to plan work, allocate resources, track progress, and make time-related decisions. As such, the contemporaneous project schedules generally are considered one of the best tools for measuring delays in an after-the-fact analysis. Courts and boards typically attach a presumption that contemporaneous CPM schedules are correct.¹⁴

¹⁴ See, e.g., *Appeal of Santa Fe, Inc.*, VABCA No. 2168, 87-3 B.C.A. (CCH) ¶ 20104 (Aug. 25, 1987)

“We do not find that the November revisions were necessary to “correct” the October CPM. Rather, the November CPM merely reflected a different plan for further prosecution of the work which differed from the previous plan. However, the adoption of an alternate method of performance in the later CPM does not, of itself, contradict the existence of a delay as shown in the preceding CPM. There is a rebuttable presumption of correctness attached to CPM's upon which the parties have previously

10.2 After-the-fact changes to schedules used during the project should be minimized and only made where necessary.

Although keeping the contemporaneous CPM schedules unchanged is preferred, there are situations where changes may be appropriate. When significant errors are found in the schedule, after-the-fact schedule adjustment to fix the errors may be allowable.¹⁵ For example, logic errors, missing scope, or palpable incorrect durations may have to be adjusted before utilizing the schedule for delay analysis purposes.¹⁶ The need for after-the-fact schedule changes is fact and situation dependent and may require the support of expert opinion.

10.3 Any changes made to the contemporaneous record of project schedules should be carefully identified and documented.

After-the-fact changes to the schedules used on the project typically are greeted with skepticism.¹⁷ Therefore, if changes are made to the contemporaneous project schedules, the preferred practice is to document both the schedule change and the reasons for the change.

mutually agreed. In the absence of probative evidence, not present in this appeal, that the delay shown was not in fact sustained we will rely on the October CPM for the period it was in effect, i.e., through the end of November 1981. For the subsequent period, we will rely on the November CPM. To put it another way, in the absence of compelling evidence of actual errors in the CPM's, we will let the parties "live or die" by the CPM applicable to the relevant time frames."

¹⁵ See, e.g., *Neal & Company, Inc. v. U.S.*, 36 Fed. Cl. 600 (1996) analysis accepted where government's expert prepared a new baseline schedule after the project to add in logic ties for labor that were missing, then re-updated the schedule.

¹⁶ See, e.g., *Appeals of States Roofing Corp.*, ASBCA No. 54860, 10-1 B.C.A. (CCH) ¶ 34356 (Jan. 12, 2010) "In any event, the credible evidence supports the finding that the adjustments [contractor's expert] made were exactly as he described them: minor corrections to logic errors relating to submittals. The Navy did not dispute that there were such logic errors in the schedule and, to the extent there were, we consider correction of them to be in keeping with good scheduling practices."); *Hensel Phelps Constr. Co.*, ASBCA 49270, 99-2 BCA ¶ 30,531 (1999) (changes were considered appropriate when the contemporaneous CPM schedules developed and updated by the contractor were unreliable because they hid work that would not have been completed in the allowable time period.

¹⁷ See, e.g., *J. A. Jones Construction Co.*, ENGBCA No. 6252, 97-1 B.C.A. ¶ 28,918 (1997)

"The more a contractor departs in litigation from its contemporaneously-prepared schedules, the greater the need to explain and justify the reasons and assumptions underlying such departures."

10.4 When possible, the preference for dealing with inaccurate schedules after the fact is to make corrections, rather than abandon the schedules, subject to the nature and scope of the corrections.

Generally, there is no “perfect” schedule that exactly matches project performance on the project and the plan to perform the work at any given update. Schedules typically reflect best estimates for performance of the remaining work. Most errors are minor and may have minimal effect on the schedule. The parties often have had an opportunity to object or identify errors contemporaneously during the project. A schedule with errors still reflects information that the parties used and acted on during the project. As a result, most schedules can be used, with some modification, to reflect the intentions of the parties. Generally, to abandon the schedules and exclude them from a schedule delay analysis, they must have significant flaws. The decision regarding whether the errors in the schedules require them to be abandoned or corrected may require expert opinion.

10.5 Changes to schedules generally may be made to correct necessary physical or contractual constraints but typically not the contractor’s preferential sequencing.

Generally, there are three categories of constraints that define the logic relationship among activities and in a schedule: physical constraints,¹⁸ contractual constraints,¹⁹ and preferential constraints.²⁰

¹⁸ Physical constraints are those that are a physical necessity in the sequence of construction of the project. For example, the third floor of a building cannot be constructed until the second floor is constructed.

¹⁹ Contractual constraints are those required by the contract. For example, if the contract specifications in a road construction project do not allow asphalt paving during winter months, scheduling paving activities outside those months constitutes a contractual constraint. Other examples of common contractual constraints include

- Site access restrictions;
- Federally mandated nonwork periods, such as endangered species breeding nonwork periods;
- Noise or vibration restrictions at different times of the day; and
- Required settlement compaction waiting periods.

²⁰ Preferential constraints reflect the contractor’s discretionary plan to perform the work. These constraints typically include crew sequencing and nonwork periods where the contractor could work but elects not to do so, such as weekends and other voluntary calendar restrictions. Preferential sequencing typically is identified in the baseline schedule as part of the contractor’s plan to perform the work in accordance with the bid.

For schedule delay analysis, CPM schedules generally should be modified only after the fact to correct errors in physical constraints or contractual constraints where the contract could not have been constructed as planned in the original CPM schedules. The contractor's preferential sequencing typically should not be changed after the fact.

Additional schedule issues that may or may not necessitate correction depending on the circumstances include leads and lags,²¹ mandatory start dates, finish dates, and float values,²² and use of retained logic or progress override.²³ Fixing constraints and out of sequence work in the schedule may be necessary to achieve a logic-driven critical path that reflects the way work actually proceeded on the project. However, changes to the schedules that the parties used on the project are still situation dependent and after-the-fact modifications may require expert opinion.

²¹ Leads and lags may result in incorrect progress tracking if delays prevent the project from being performed as-planned. A preferred alternative to leads and lags is to break activities up into smaller segments and use finish-to-start relationships.

²² These constraints affect the CPM calculations for that path of work and limit the functionality of a CPM schedule.

²³ Normally corrected by breaking activities and logic ties down to additional activities to more accurately reflect the sequence of work performed on the project.

Chapter 11

Acceleration

Acceleration is the process of expending additional resources and/or costs to expedite contract performance. Typical examples of acceleration include adding crews, adding equipment, increasing work hours, increasing work days, increasing resources, and expediting material delivery times. During the project, it is preferable to communicate anticipated acceleration plans to achieve time savings on the project. The communication of acceleration plans should focus on being open and proactive, identifying the steps necessary to execute the plan successfully, identifying potential risks, and noting the additional costs resulting from the acceleration plan. Opportunities to accelerate may be missed when parties do not communicate effectively the need to accelerate the essential steps needed to achieve the acceleration, or when a party fails to take action within a time frame necessary to execute the acceleration plan.

Acceleration generally is segregated into three types: voluntary, directed, and constructive.

11.1 Parties should have the right to voluntarily accelerate.

Voluntary acceleration occurs when a party accelerates to take advantage of weather, finish earlier than planned, or recover its own delays and acknowledges responsibility for its own costs. Voluntary acceleration typically is undertaken by a contractor or subcontractor but may also be undertaken by an owner.²⁴ Each party on a construction project generally has the right to recover its own delays through voluntary acceleration, where possible.

11.2 For owner-directed acceleration, the parties should agree on the acceleration plan prior to implementation. The right to direct acceleration unilaterally should be addressed by contract.

Directed acceleration occurs when an owner requires a contractor to accelerate work.²⁵ For directed acceleration, the parties should agree on the compensation and revised completion

²⁴ For example, owners may expedite review or inspection times to recover their own delay.

²⁵ Directed acceleration also applies to the contractor–subcontractor relationship.

date ahead of accelerating. If no agreement is reached and an owner plans on unilaterally requiring or directing a contractor to accelerate, such a right should require contractual authority. If an owner prefers to pay for acceleration to recover its own delay instead of paying delay costs, it should request an alternative proposal from the contractor. Parties that desire the receipt of an alternate acceleration plan when receiving time extension requests should include such a provision in the contract.

11.3 Constructive acceleration can be proved.

Constructive acceleration may occur when an owner requires a contractor to accelerate work but the parties disagree on whether the acceleration is a change to the contract. As such, most acceleration disputes arise from alleged constructive acceleration issues.

Constructive acceleration may be proved by showing that (1) the contractor encountered an excusable delay, (2) the contractor made an appropriate time extension request, (3) the owner denied the time extension request or failed to act on it within a reasonable time, (4) the owner insisted the earlier completion date must be met or insinuated liquidated damages, and the contractor notified the owner that the alleged acceleration order was regarded as a constructive change, or (5) the contractor expended additional costs to accelerate performance.

11.4 When implementing an acceleration plan, acceleration of multiple critical paths in the schedule may be required.

Accelerating the schedule involves careful thought and focus on implementation. The acceleration focus should be on the items necessary to improve the scheduled finish date—items on the most critical, or longest, path. However, after reduction of the longest path, other lesser critical paths may become the longest path and impede further recovery of time in the schedule. As a result, the contractor may need to accelerate all critical (or negative float) paths to recover all delays and get back on schedule.

Where different parties are responsible for delays to different critical paths, an acceleration effort may require each party to be responsible for recovering its own delay, depending on the timing and sequence of the delays.

Chapter 12

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