



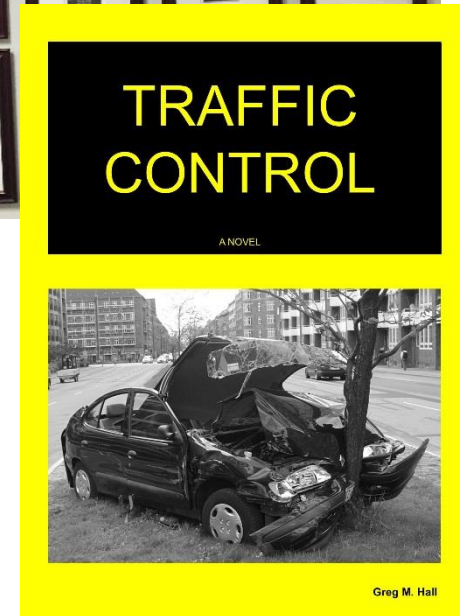
The Nuts and Bolts of Collapsed As-Built

Greg M. Hall, Kiewit Corporation



Greg M. Hall

- Native of Morse Bluff, NE (pop. 140) and kid #3 of 7
- Started with Kiewit in 1991 (P3 ver. 3.0 for DOS)
- 1/3 of career has been scheduling and claims; 1/3 has been engineer and superintendent; 1/3 has been trainer
- I write fiction (novels and short stories; my claims and delay analysis reports are all nonfiction)



What We'll Discuss

- When would Collapsed As Built (CAB) be used?
- General CAB Process
- Creating the Pre-Collapse Schedule
- General and Staged Collapse
- Compiling and Presenting Results



CAB Uses

CAB Uses

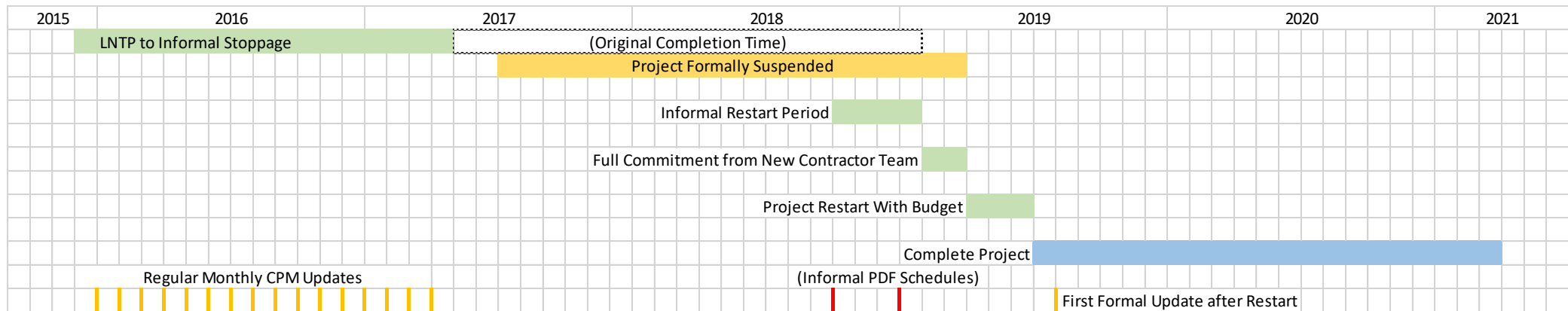
- 2nd Opinion / Back Check of an analysis performed with different method
- High confidence in as-built dates (alternate job records); low confidence in contemporaneous schedules
- “Blackout” in schedule maintenance for a portion of the project
- Where selected as method of choice by both parties of a dispute

CAB Uses: Case Study Project

- E/P/C expansion of an east coast energy facility (private owner)
- After LNTP but before FNTP, project suspended to address Federal Government issues
- Informal restart from Suspension (No revised LNTP/funding) concluded by a 'surprise' FNTP
- No schedule submittal made between suspension and FNTP (contractor had expected a revised LNTP before resuming project controls)

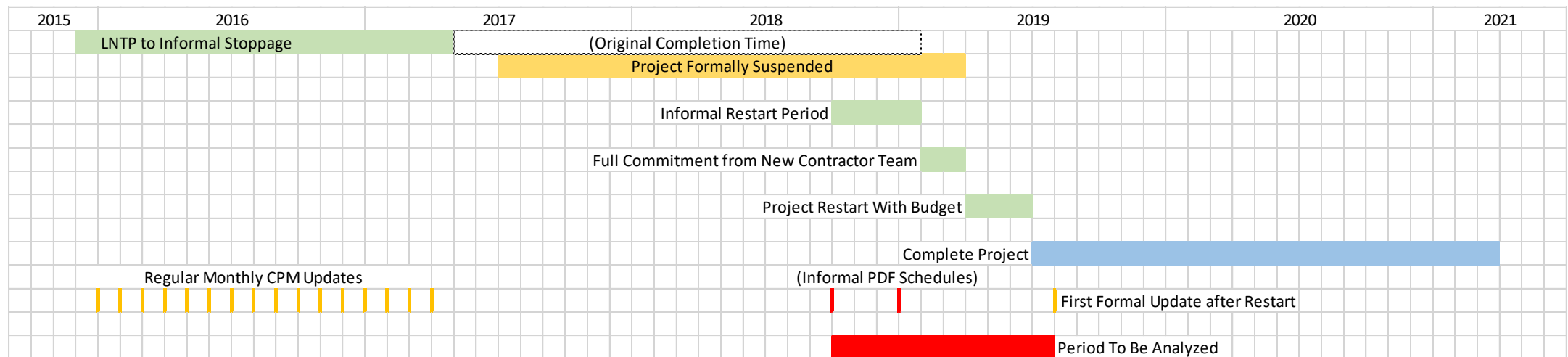
CAB Uses: Case Study Project

- Delays during 'informal restart' period
- Many pre-suspension engineering packages required redo
- First formal schedule submittal 3 months after FNTP, with a data date of FNTP + 90 days.
- Logic of activities actualized prior to data date was questionable, but actual dates could be tied to other project records and were reliable



Case Study Project: CAB Chosen

- First usable post-resumption schedule was dated June 8, 2019
- Prior update (April of 2017) could not be used
 - Engineering completions needed to be rolled back
 - Numerous vendors could no longer honor quotes; procurement process had to restart
 - Completely different Activity IDs and Names were used.
- Best course of action: copy June 8, 2019 schedule, collapse to Sep 2018



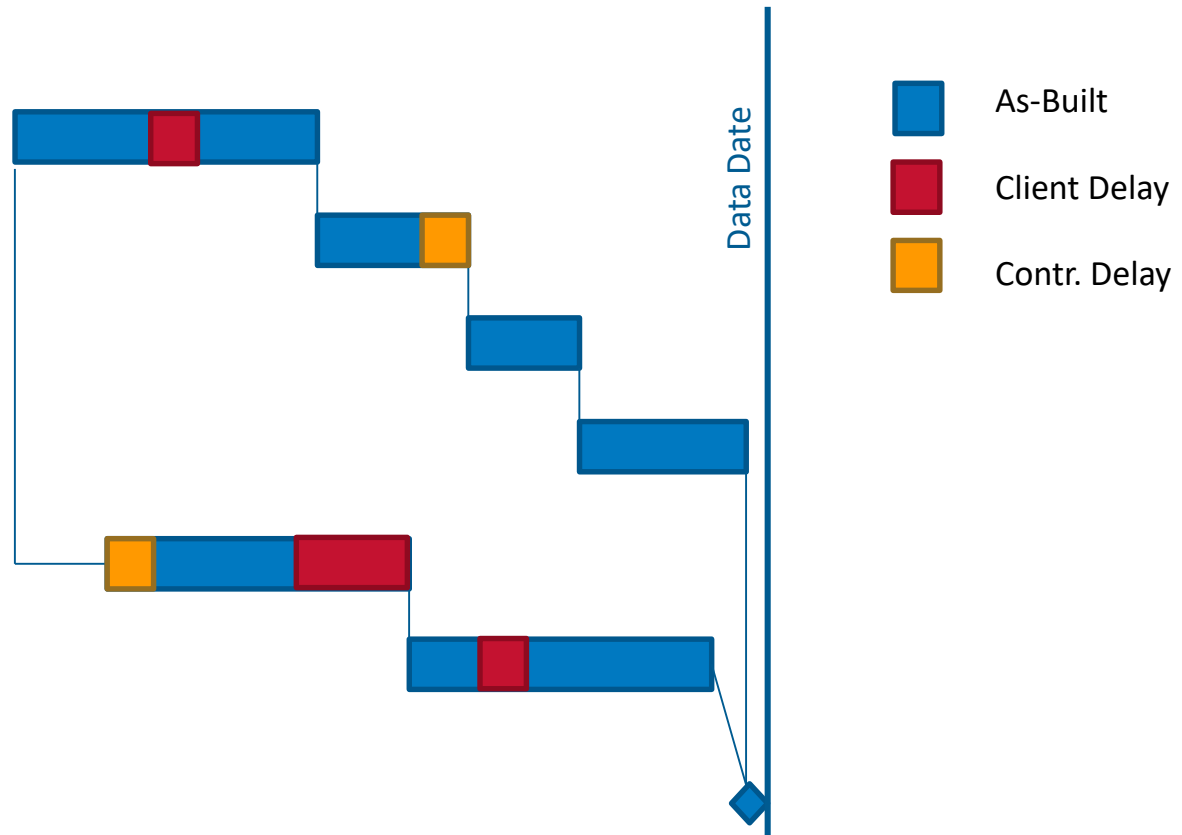


GENERAL CAB PROCESS

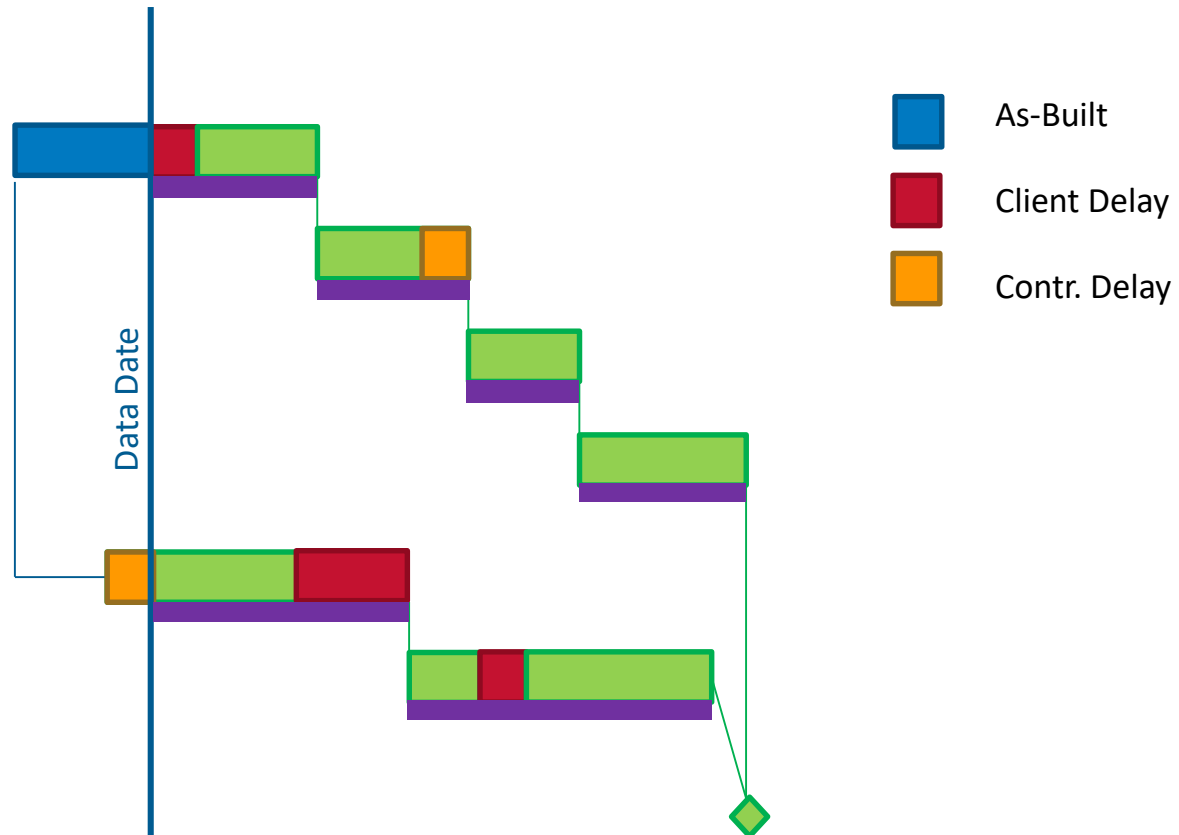
- # CAB PROCESS: AACE RP 29R03, MIP 3.8

Taxonomy	RETROSPECTIVE														
	OBSERVATIONAL								MODELED						
	Static Logic			Dynamic Logic				Additive				Subtractive			
	3.1 Gross	3.2 Periodic		Contemporaneous Updates (3.3 As-Is or 3.4 Spill)		3.5 Modified / Reconstructed Updates		3.6 Single Base ²		3.7 Multi Base ¹		3.8 Single Simulation		3.9 Multi Simulation	
		Fixed Periods	Variable Windows	All Periods	Grouped Periods	Fixed Periods	Variable Windows	Global Insertion	Staged Insertion	Fixed Periods	Variable Windows in Grouped	Online Extraction	Staged Extraction	Fixed Periods	Staged Extraction
Common Names	As- Planned vs. As-Built	Window Analysis		Contemporaneous Period Analysis, Time Impact Analysis, Window Analysis	Contemporaneous Period Analysis, Time Impact Analysis, Window Analysis	Contemporaneous Period Analysis, Time Impact Analysis	Window Analysis, Time Impact Analysis	Impacted As Planned, Wool-F	Time Impact Analysis, Impacted As- Planned	Time Impact Analysis	Window Analysis, Impacted As- Planned	Collapsed As Built	Time Impact Analysis, Collapsed As- Built	Time Impact Analysis, Collapsed As- Built	Time Impact Analysis, Window Analysis, Collapsed As-Built

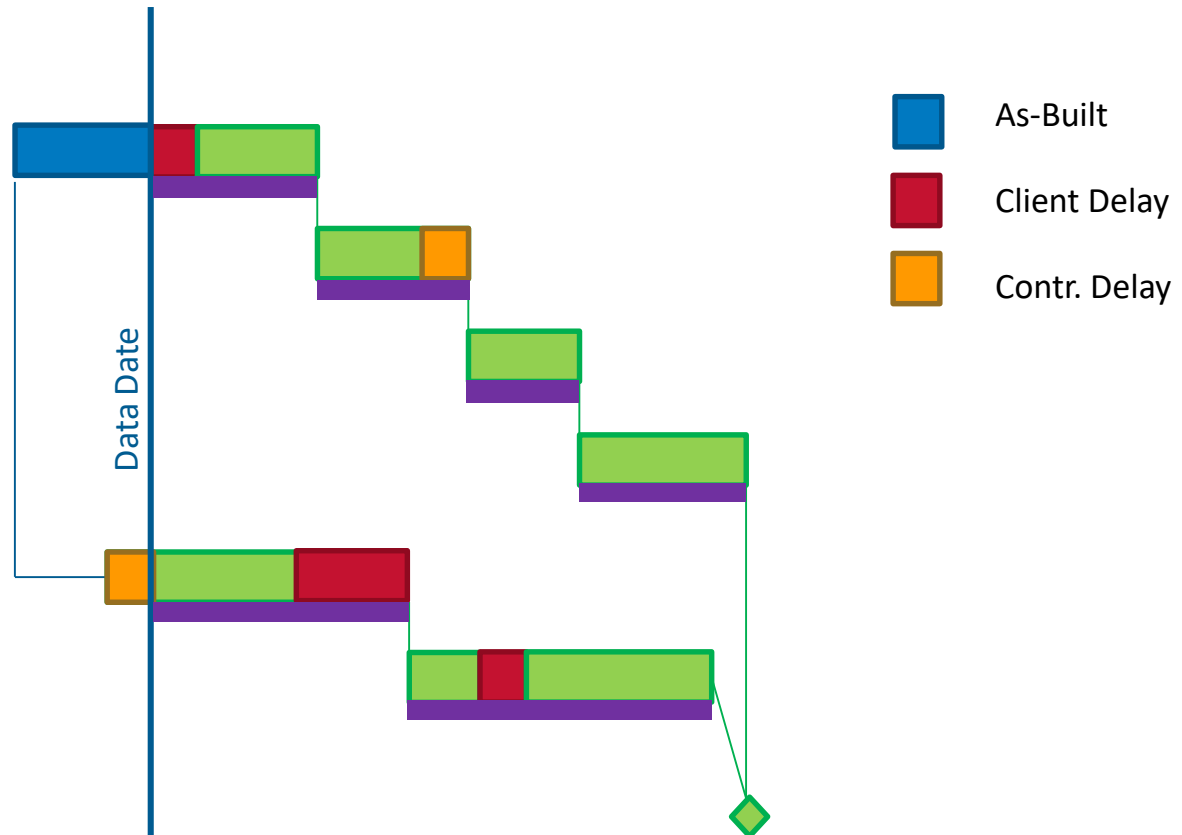
CAB Process – As Built



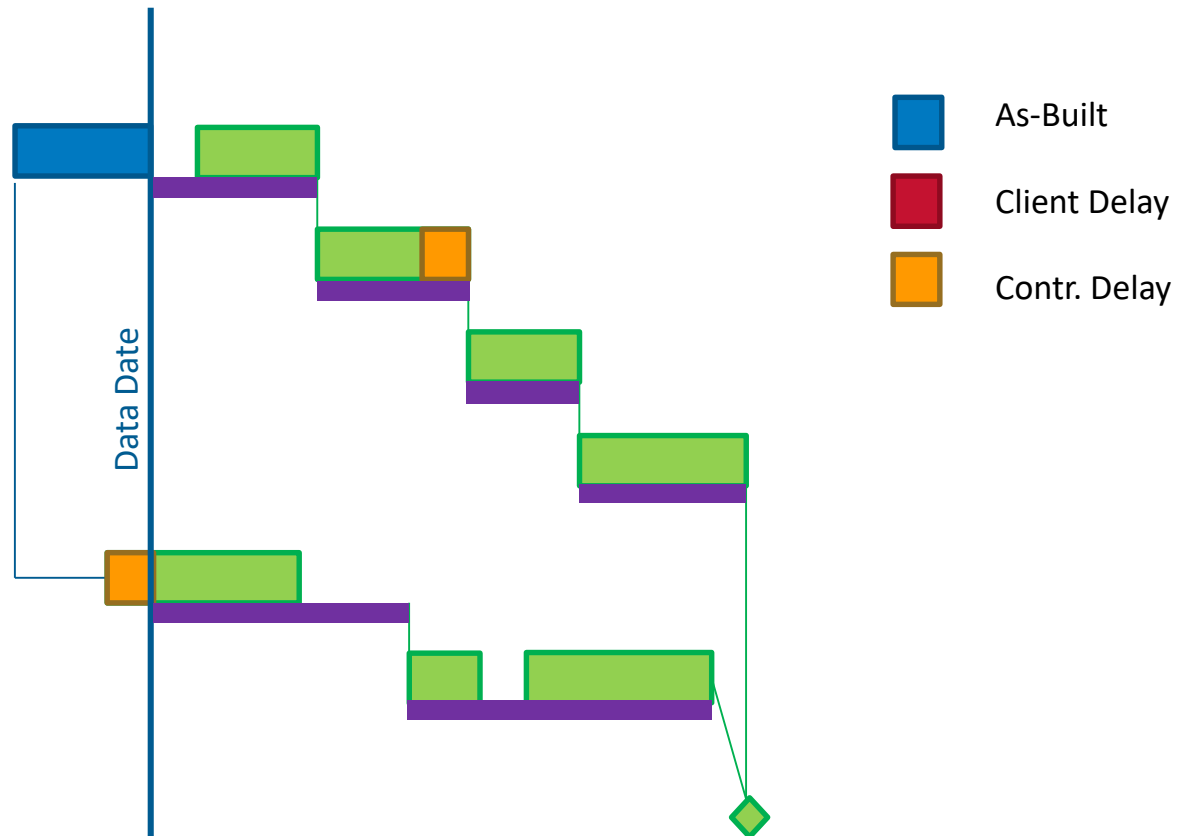
CAB Process – “Pre Collapse” Schedule



CAB Process – Collapse



CAB Process - Collapse





Creating the Pre-Collapse Schedule

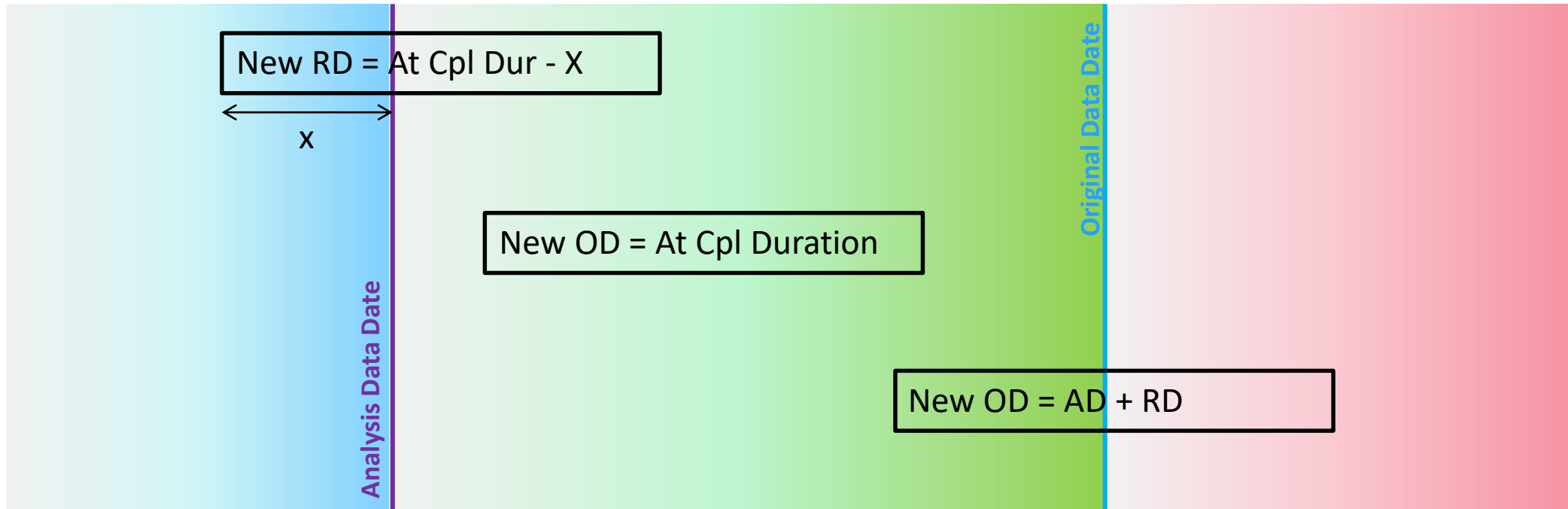
Creating the Pre-Collapse Schedule



Creating the Pre-Collapse Schedule



- Duration Adjustments



Creating the Pre-Collapse Schedule



Resource Assignments

- Actual Units must be zero to change an activity to 'Not Started'.

Creating the Pre-Collapse Schedule



Resource Assignments

- Actual Units must be zero to change an activity to 'Not Started'.
- If resource assignments remain, a 'before' vs 'after labor curve can be informative

Creating the Pre-Collapse Schedule



“Noise”

- Level of Effort Activities
- Activities with As Late As Possible constraints

Creating the Pre-Collapse Schedule



- Filter as needed
- Use the Activity Status column in the activity table
- Fill Down

Creating the Pre-Collapse Schedule



- (Self-Explanatory)

Creating the Pre-Collapse Schedule

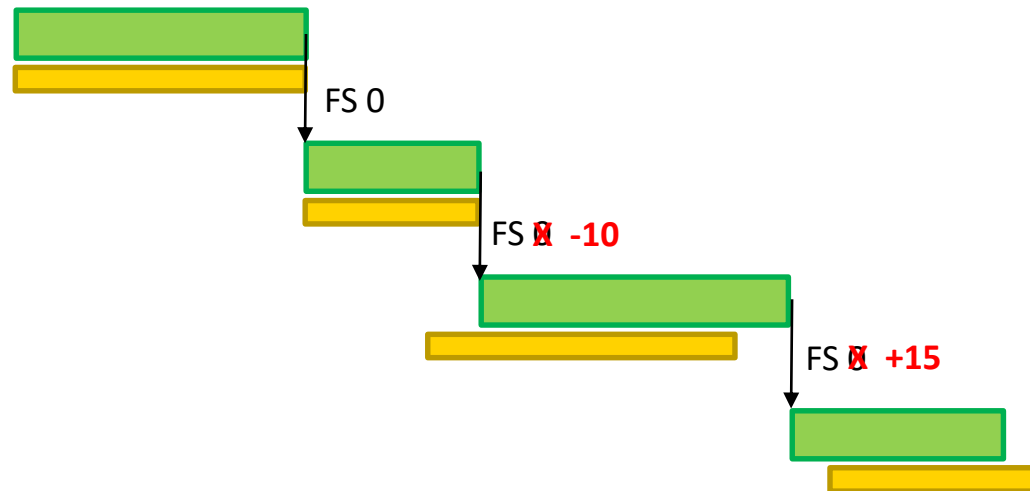


- Principle when making adjustments is to work early to late
- A change to a tie early in a logic path affects the entire path; a change to a tie late only affects downstream items.

Creating the Pre-Collapse Schedule



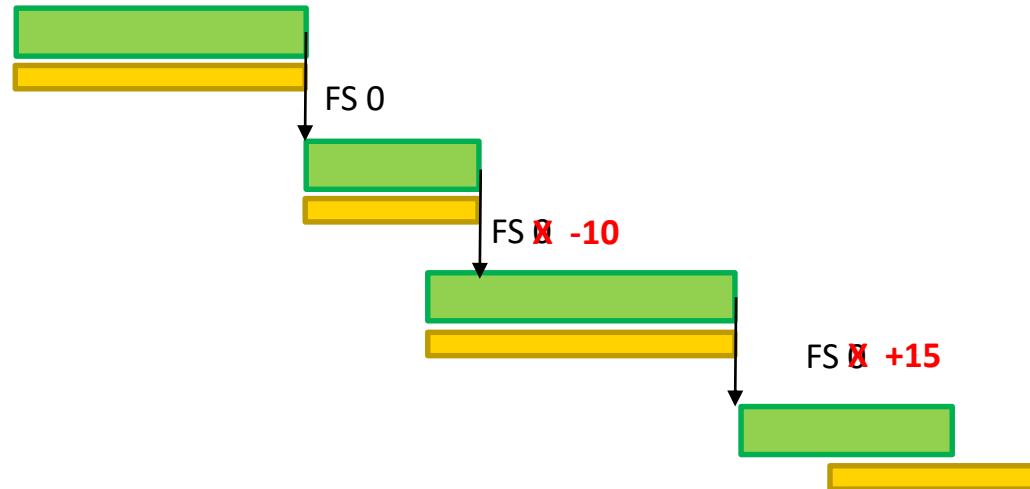
- Pass #1: “Field Surgery”



Creating the Pre-Collapse Schedule



- Pass #1: “Field Surgery”



100

Activity ID	* Notes	Activity Name	Remaining Duration
E000SOO.DGSRW.	Lag 35	Area 000-GENERAL MSE Retention Walls - (KIE) Drawings & Diagrams- IFC	33.00
E000SCA.DGSRW.	Lag 35	Area 000-GENERAL MSE Retention Walls - (KIE) Drawings & Diagrams- IFA	33.00

General | Status | Resources | Codes | Relationships | Notebook | Steps | Feedback | WPs & Docs | Expenses | Summary

Activity: E000SOO.DGSRW. | Area 000-GENERAL MSE Retention Walls - (KIE) Drawings & Diagrams- IFC

Predecessors

Activity ID	Activity Name	Reli	Lag	Critical	Driving	Ship Free Float	Start
E000SCA.DGSRW.	Area 000-GENERAL MSE Retention Walls - (KIE) Drawings & Diagrams - IFA	SS	35.00	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0.00	11-Dec-2017

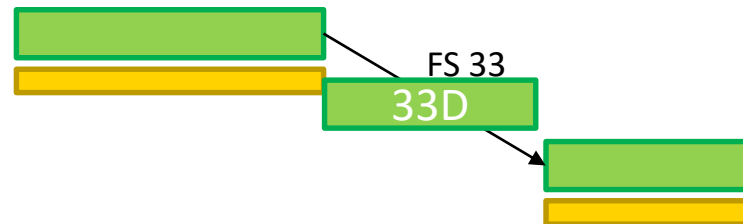
Activity ID	Area	Activity Name	* Notes	* Actions
PROC-5970	PDC	Power Distribution Center- Bids Rcv'd	Lag 14	Should change pred from SS to FS but must still explain the lag

Pre-Collapse Schedule



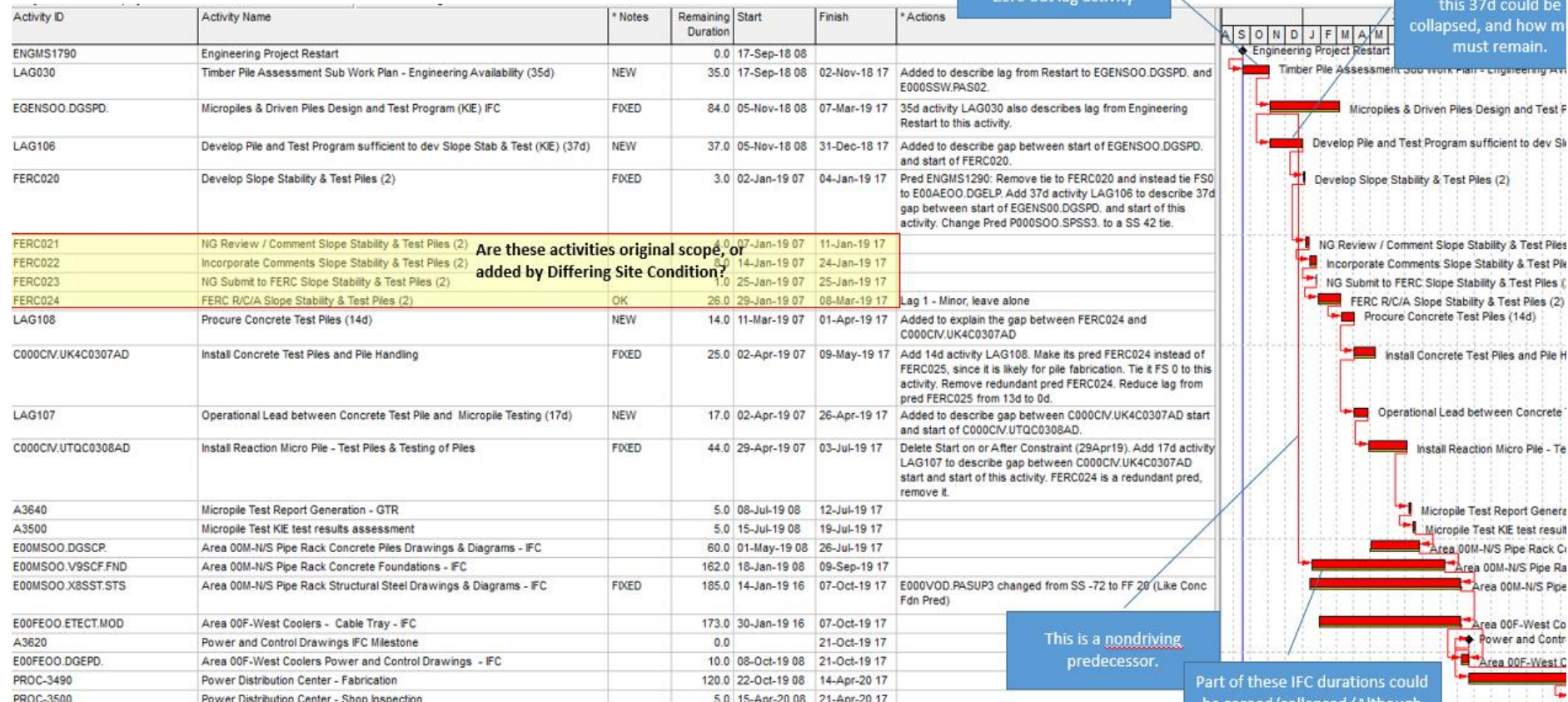
- Stage 2: Incorporate Job Team reasoning/recommendations

Activity ID	Area	Activity Name	* Notes	* Actions	Correction Recommended	Action By	Final Disposition
PROC-3280	Comp Bldg	Pre-Engineered Buildings - TBA	FIXED	Why the lag? Should it be a separate activity? Should this activity be 43d?	add vendor negotiations as a pred (found out vendor filed bankruptcy)	Nick/Cameron	Add 33d activity LAG027 to describe lag between Bids Rcv'd and TBA.
E00KML4.DSMVR	Vent Stack	Vent Stack Requisitions - IFR		Why the lag? Should this be a 39d activity instead?	engineer took time to do this	Evan	Add 34d activity LAG028 to describe lag between preds (Data sheets-SS34 & specsFS0) and this



Pre-Collapse Schedule

Early/Destatused portion of Longest Path #1 of June 14 Schedule (Current thru Aug 2, 2019)-DETAIL VIEW



Can a portion of this be collapsed because no LNTP/FNTP was granted until Mar 7, 2019?
To further analysis, cut FERC024 to 14d from 26d.

SC=24Jun21



GENERAL AND STAGED COLLAPSE

General and Staged Collapse

- General: All delay activities zeroed at once
- Staged: Delay activities are classified, then zeroed one group at a time

1-Cryogenic Manual Valves	Due to suspension, vendors were not able to provide valves in time for spool fabricator to install valves in shop.
2-Power Distribution Center Building Re-Bid	PDC Subcontractor cannot honor original quote, making a new tendering process necessary
3-Air Cooled Heat Exchanger Re-Bid	ACHE vendor cannot honor original quote, making a new tendering process necessary
4-Feed Gas Metering Skid Re-Bid	Feed Gas Metering Skid vendor cannot honor original quote, making a new tendering process necessary
5-Compressor Building Re-Bid	Subcontractor has filed bankruptcy, making it necessary to re-bid and re-award the work
6-Differing Site Condition	"1. Areas where original timber piles were not in good condition, as part our design, 30-40 additional piles were added. 2. 14"" piles did not rec'v PDA results expected. 14"" piles extended by 20LF 3. Resource overload/Dilution of manpower on design/engineering team. "
7-Timber Pile Assessment	Integrity of existing timber piles was questioned by FERC. Multiple test pits dug and piles examined.
8-Other Vendor Re-Engagement	Due to suspension, other vendors and subcontractors had to be contacted, and whether they could still honor their quote amount and terms had to be determined. In some cases alternative vendors and subcontractors had to be substituted.
9-Restart Funding and Timing	A revised LNTP with funding was never issued to Contractor prior to the FNTP, which itself was issued suddenly. Contractor's progress prior to FNTP was taken at its own risk and expense; therefore work was not pursued at the same intensity as it would have been with a proper LNTP.

Post-Collapse Modifications/Off-Script Step

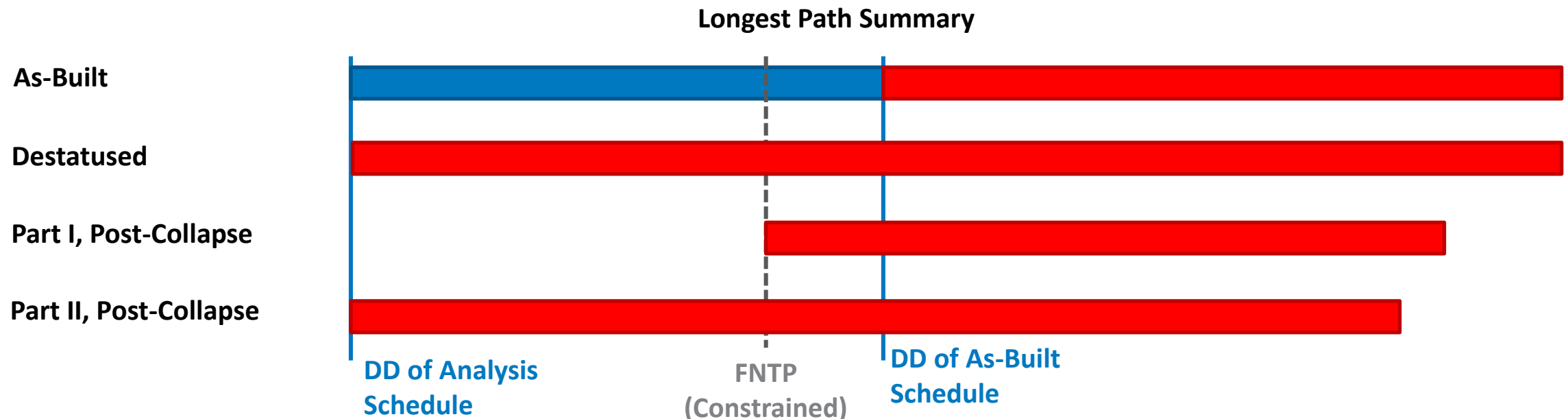
The 'piling timing' problem

- Contractor held that pile testing for engineering could be performed before FNTF
- Client would not give access to site for any operations prior to FNTF
- As-built logic included a relationship from FNTF to test piling.

Activity ID	Activity Name	Action	Reason
LAG107A	Install Sufficient Quantity to Begin Micropile Testing (9d)	Cut predecessor C000CIV.UK4C0337AD.X (a production piling activity) and replace it with new predecessor FERC025.	This will decouple micropile testing from obtaining production piles and FNTF. FERC025 is the Mobilization Lag specific to testing program.
C000CIV.UTQC0308AD	Install Reaction Micro Pile - Test Piles & Testing of Piles	Cut predecessor MS1100 (Mobilization)	MS1100 is post-FNTF full job mobilization. Existing predecessors are tied to FERC approval of testing program.
ENGMS1850 > MS1470	Gap filled by LAG117a and LAG117b	see original table, entry for MS1470	Collapsing LAG117a will show positive effect of test piling before FNTF.
GEN1060	Direct Craft Support	Collapse. Give Issue Category 10 (Overhead and nondriving activities)	This is in the schedule to account for indirect manhours, and is not intended to drive any dates.
OA1030	Owner Provision of Operating Personnel	Collapse. Give Issue Category 10 (Overhead and nondriving activities)	This is in the schedule to ensure certain startup activities have client personnel onsite. That is not relevant to this analysis.
E00DHOD.RPGE01.	Area 00D-E/W Pipe Rack - Pipe Stress Analysis	Because pred ENGMS1390 was split into 26d of productive and 43d non productive activity, change the SS 50 relationship to a FS 0 relationship.	Pipe Stress Analysis is an accounting activity and should not be driving completion.
E00MHOD.RPGE01.	Area 00M-N/S Pipe Rack - Pipe Stress Analysis	Because pred ENGMS1390 was split into 26d of productive and 43d non productive activity, change the SS 50 relationship to a FS 0 relationship.	Pipe Stress Analysis is an accounting activity and should not be driving completion.
E00LSOO.DGSCP.X	Area 00L-U/G Concrete Piles Drawings & Diagrams - IFC	Replace succ tie of EGENEOO.EDEDB.MOD from SS 17 to FF 5.	We have a critical tie coming into the finish of this activity, and a critical tie leaving the start of it. Thus as duration shortens, it continues to drag the start of the successor with it. The durations of both activities would need to be shortened.

Post-Collapse Modifications/Off-Script Step

- Perform a “Part I” analysis by the book
- Record “Part I” results
- Copy and modify collapsed schedule and make “Part II” logic modifications
- Record “Part II” results





COMPILING AND PRESENTING RESULTS

Results

- The “Punchline”: How many days?
- Labor curves before/after collapse (is the collapsed schedule possible?)

Report Structure

Executive Summary

Introduction

Selection of Analysis Method (Data inputs available, Why method was chosen)

Overview of Collapsed As-Built Methodology

Collapsed As-Built – Source Validation

Methodology of Preparing Collapsed As Built Schedule (First Steps, Destatusing, Alignment with As-Built, Call Out and Explain Deviations from Planned Logic, Identify and Isolate Delaying Events, Final Verification)

Collapsed As Built Actions Specific to Project (Delay categories, How Delay is Represented in the As-Built Schedule, Longest Path of As-Built Schedule)

Alignment of Destatused to As Built Schedules (Alignment Notes, Calendars, Results)

Identification and Collapse of Delays

Results of Collapsed As-Built Analysis

Conclusion

Appendices

- Full listing of changes with justification

Group 1: Activities Requiring Logic and/or Duration Adjustment			Variance from June 14 Schedule		Actions Taken (See User Defined Field *Actions)
Activity ID	Activity Name	* Notes	Start	Finish	* Actions
A1000	Earth Work Specifications - IFC	FIXED	31	0	Increase duration from 1 to 32 and set the lag from predecessor E000COO.DGCRG. to zero days. Allow the start variance so the finish variance and variance to successor logic path is zero.
A3000	Structural - Rebar Specifications - IFR	FIXED	0	0	Add 85d activity LAG022 to describe lag between ENGMS1790, Engineering Restart, and start of this activity.
A3080	Stress Analysis - Preliminary <u>loads</u> - Area D - F/W Pinerack	FIXED	0	0	Remove predecessor E000HPN.MMPMR. (out of Sequence)- Add 74d activity LAG080 to describe

Group 2: New Activities Added to Replace Lags with Described Events			Variance from June 14 Schedule		Actions Taken (See User Defined Field *Actions)
Activity ID	Activity Name	* Notes	Start	Finish	* Actions
C000CIV.UK4C0337AD.X	Concrete Pile Handling-Inactive/Not Supporting Operations (14d)	NEW	N/A	N/A	Add 10d activity LAG087 to describe gap between predecessor MS1100 and start of this activity. Pile handling is an accounting activity, not a driving operation.
E000POD.RPPRC.X	Process Calcs IFD - Inactive time from restart issues and awaiting vendor info (58d)	NEW	N/A	N/A	Split off from E000POD.RPPRC. to represent wait time due to restart issues and awaiting vendor info. It inherits only ES and EF successors from

Appendices

- Full listing of 'non-standard' CPM relationships not modified

Group 3: Activities Reviewed but Not Adjusted			Variance from June 14 Schedule		Actions Taken (See User Defined Field *Actions)
Activity ID	Activity Name	* Notes	Start	Finish	* Actions
A1010	Storm Water Specification - IFC	OK	0	0	No adjustment, actual lag of 33d is explainable
A3010	Structural - Rebar Specifications - Client Approval IFA	Lag 4	0	0	Lag not evaluated. Activity has a large float value once it is destatused.
A3020	Structural - Rebar Specifications - IFC	OK	0	0	Leave alone - Lag of 1d from predecessor is minor, and activity has significant float.
A3180	Engineered Pipe Supports - IFR	OK	0	0	Leave alone - Lag of 1d from predecessor is minor, and activity has significant float.

- Full listing of activities collapsed in the analysis

Activity ID	Activity Name	Remaining Duration	Justification
Issue Category 1: Cryogenic Manual Valves			
LAG110	Cryogenic Manual Valves - Receive New Quotes (32d)	32	Activity is only necessary because the vendor could not agree to original quote terms and price after the suspension.
PROC-5760	Cryogenic Manual Valves - Bids Rcv'd	8	Activity is only necessary because the vendor could not agree to original quote terms and price after the suspension.
PROC-5770	Cryogenic Manual Valves - TBA	3	Activity is only necessary because the vendor could not agree to original quote terms and price



CONCLUSIONS

Conclusions

When should/should you not perform a CAB Analysis?

- Less in depth than a windows analysis if one can be performed
- Good as a complementary/conformational analysis in addition to an additive or windows method
- Creating the pre-collapse schedule seems more 'true' than re-creating updates that were never developed contemporaneously

Conclusions

CAB Analysis Strengths

- Delays can be easily shown in pre-collapsed critical/near-critical paths
- Forces project team to address every logic deviation and duration variance
- Accounts for delay concurrency by only collapsing one party's issues

Conclusions

CAB Analysis Weaknesses

- Does not account for timing of mitigations/reactions
- Does not account for timing of delay discovery



THANK YOU!