J.S. Held Expert Report for:

Vogtle Nuclear Power Units 3 and 4 at

Plant Vogtle, Waynesboro, Georgia, United States

Prepared for:

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1 Introduction

1.1 Overview of J.S. Held

1. J.S. Held LLC (J.S. Held) was engaged by the Georgia Public Service Commission (Commission) with respect to matters concerning the construction and commissioning of the Alvin W. Vogtle Electric Generating Plant Units 3 and 4 (Project), in Waynesboro, Georgia.

2. J.S. Held is a worldwide consulting and advisory firm providing expert advice on the world's most complex construction and engineering matters. The J.S. Held team was led by Senior Managing Director Mr. Reza Nikain, Senior Managing Director Mr. Mark Cohen, and Managing Director Mr. Robert Strahle. Messrs. Nikain, Cohen and Strahle are recognized by clients and peers alike as some of the industry's top project management standard of care, construction, schedule delay, disruption, and cost experts. They collectively had the overall responsibility for the provision of services, resourcing, timely delivery, and technical quality. They were supported by other members of J.S. Held's Construction Advisory practice. Refer to **Attachment 1** for Curriculum Vitae.

3. J.S. Held's Construction Advisory practice consists of engineering and construction professionals with practical industry experience, who have advised on an extensive range of projects across multiple industry sectors, in both domestic and international contexts. Many of J.S. Held's professionals are either civil, mechanical, electrical, or chemical engineers, quantity surveyors, or architects by training and background, many of whom have supplemented their technical disciplines with further commercial qualifications, including construction and contracts management, business administration, international arbitration and dispute resolution, finance, and construction law.

4. The primary objective of this report is to present J.S. Held's analysis of the Project execution and whether management's actions or inactions were reasonable, prudent, and met the generally acceptable industry practices and the effect of various decisions on Project performance including quality, schedule, and completion cost.

1.2 Overview of Main Work Streams

5. The approach was to analyze the Project from three different work streams: Project Management / Performance Analysis, Delay and Disruption Analysis, and Damages / Cost Analysis. Each of which are discussed below.

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- **Project Management / Performance Analysis:** Reviewed the project management approach and subsequent management decisions as they related to internal policies and procedures, contract agreements and common industry practices promulgated by leading professional and industry organizations. This analysis emphasized on Risk Management, Quality Management, Time Management, and Cost Management.
- **Delay and Disruption Analysis:** Assessed the reasonableness of the Integrated Project Schedule (IPS) and performed forensic schedule analyses of delay and disruption. Root cause analyses were performed to determine underlying causes for delays and disruptions.
- **Damages / Cost Analysis:** Performed in conjunction with the Project Management / Performance Analysis and the Delay and Disruption Analysis, this work stream analyzed and quantified the cost overruns.

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2 Executive Summary

6. J.S. Held was engaged by the Commission with respect to matters concerning the construction and commissioning of Units 3 and 4 at the Alvin W. Vogtle Electric Generating Plant. J.S. Held reviewed the development and construction of the Project through commercial operation focusing on project management and the growth in schedule and cost primarily from the Westinghouse Electric Company LLC (WEC) bankruptcy through commercial operations. This Report represents J.S. Held's analysis of the Project execution over time and whether management's decisions were reasonable and prudent, met generally acceptable industry practices, and what were the effects of the management decisions on Project performance.

7. The analysis included a review of documents that were requested by J.S. Held and produced by the Commission and Georgia Power Company (Company). Additionally, throughout the analysis, additional documents were requested and produced by the Company on a periodic basis. Documents relied on include, but are not limited to, contracts and agreements, policies and procedures, Project reports, Vogtle Construction Monitoring (VCM) reports, monthly status reports, and other contemporaneous Project files, such as logs and schedules, including in native formats.

8. Following the WEC bankruptcy, the Company performed an assessment to determine whether the Project should continue. In coordination with the Boards of Directors of the Company, Oglethorpe Power Corporation (OPC), the Municipal Electric Authority of Georgia (MEAG), and Dalton Utilities (Dalton),[1] "*each determined that it is in the best interests of their customers to proceed with the Project*."[2] Within its Seventeenth Semi-Annual VCM Report, representing the period from January 1, 2017 to June 30, 2017, the Company made the following requests from the Commission.[3]

    - Approval of its $542 million in expenditures incurred during the VCM reporting period.

[1] Collectively known as the "Co-owner's".
[2] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A., page 6.
[3] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A.

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- Approval of the revised cost estimate and construction schedule developed by the Company as a component of the decision-making process undertaken to determine whether to proceed with the Project.
- Approval of the post WEC bankruptcy project management structure, in which "*Georgia Power, along with Southern Nuclear Operating Company ("SNC" or "Southern Nuclear") acting as the project manager, will manage the Project on behalf of the Owners.*"[4] Bechtel Corporation (Bechtel) was selected to serve as the prime construction contractor.

9. To assess its decision to continue with the Project, in addition to the SNC estimate to complete, the Company engaged several consultants and contractors to develop a revised cost estimate and construction schedule.

    - *Kenrich provided an analysis of the cost and schedule to complete Units 3 and 4.*
    - *Bechtel provided an independent assessment and estimate of the cost-to-complete and the schedule.*
    - *Pegasus-Global assisted in the development of the cancellation costs for two scenarios, the cancellation of Unit 4, and the cancellation of Units 3 and 4.*
    - *Black & Veatch provided estimates of the costs associated with demobilization of the Project and securing the site for the cancellation under either cancellation scenario.*
    - *PwC developed a quantitative risk analysis ("QRA") for the three options that were presented for consideration.*[5]

10. Within VCM 17, the Company restated its risk factors that were initially identified in 2009 and updated in 2016. Of the items included, those specific to construction, included the following:

    2. The risk that WEC will not meet its obligations under the new Services Agreement
    3. The risk that the labor force and craft will be unable to maintain their productivity improvements
    4. The risk that the Project will be unable to continue to meet FOAK challenges
    …

[4] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A., pages 6-7.
[5] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A., page 45.

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7. *Procurement Risk*
8. *Unidentified Scope Risk* [6]

11. The review identified broad actions taken by SNC as the project manager that drove the overall Project execution and impacted Project schedule and cost. The actions included the following:

- SNC's focus and emphases on schedule rather than cost and the resulting influence on forecasts.
- The transition from a focus on bulk piping and electrical installation to focusing on specific systems to achieve certain milestones and the related impacts to system turnover functions.

12. In addition, there were several conditions that drove the overall Project execution, most of which were known or anticipated by the Company and/or SNC within its risk process, but all of which contributed to Project delay, disruption, and increased costs. They included the following:

- The completeness of engineering and the effectiveness of engineering management after the onboarding of the replacement contractor, Bechtel.
- Procurement related material supply and management difficulties.
- Quality management issues including those affiliated with the prioritization of testing requirements, rework and corrective actions, and the cable separation matter.
- Management of labor resource performance and supply issues.

13. Lastly, the COVID-19 pandemic impacted the Project resulting in its own discrete delays and cost growth. The impact to construction caused by the pandemic could not have been anticipated by the Company or SNC and both the Company and SNC implemented efforts to comply with corporate and government health and safety requirements, as well as to mitigate the effects.

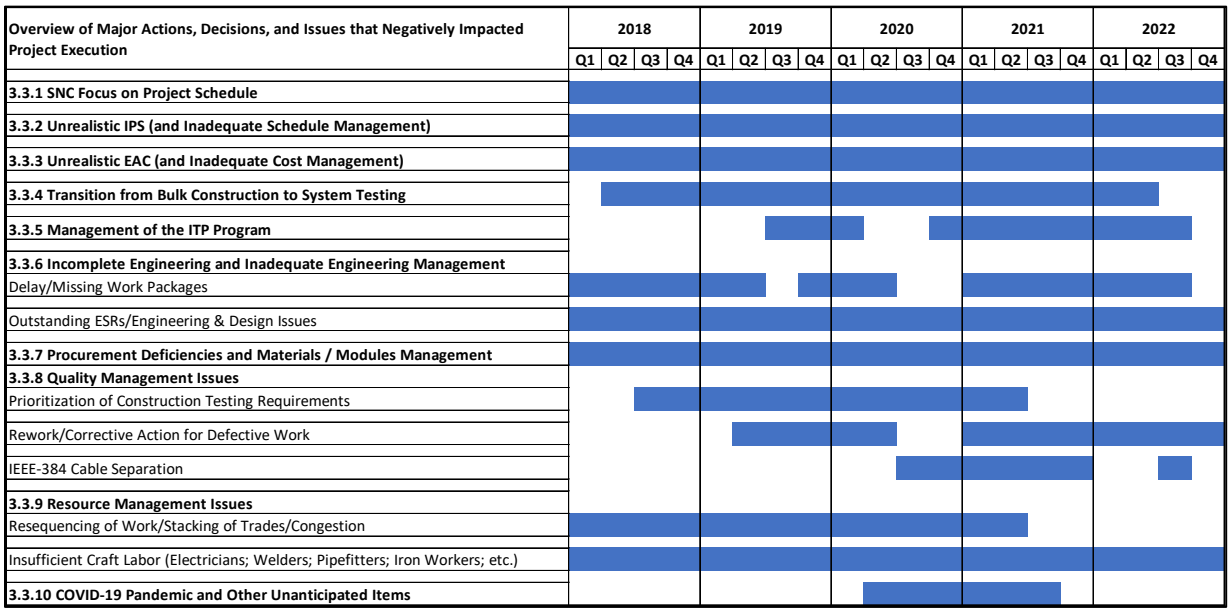
14. The construction specific risks identified by the Company in VCM 17 aligned to several of these items. Analysis indicated that only the COVID-19 pandemic could not have been reasonably anticipated. SNC did not effectively manage the known risks and the result was impacts and disruptions that ultimately led to significant delays and cost increases across all phases of the work. These conditions were pervasive throughout much of the Project from VCM 17 through completion of Unit 3 and the current completion schedule for Unit 4. To assess whether there were any correlations between the various events during the Project and the management of the work by SNC

[6] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A., pages 93, 94 & 96.

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and how it affected performance of the Project, each was reviewed independently. The time frames and extent of the impact were identified and reviewed based upon available information. The time periods in which the record indicated these events were occurring are shown in **Figure 1.2-1 Impact Timeline**.

Figure 1.2-1 Impact Timeline



15. SNC project management was governed by its own procedures and specifications as well as extensive regulatory requirements specific to the nuclear industry. In addition, SNC and its contractor Bechtel were expected to employ common industry practices that conformed with the expectations of experienced operators and constructors. Using these practices, promulgated by prominent professional organizations related to engineering and construction, as a yard stick by which to measure SNC's performance as the project manager, revealed shortcomings in the standard of care expected and the management of quality, time, risk, and cost.

16. The analysis determined that although project management controls and procedures were in place, they were not effectively employed. Although SNC developed and implemented quality management procedures and tools, the management of quality was ineffective. Shortcomings included failing to identify and mitigate the cable separation conditions necessitating the United States Nuclear Regulatory Commission (NRC) review, missing the condition during quality control inspections, and not elevating the issues to the Corrective Action Program (CAP) in a timely manner.

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17. SNC's management of the Project schedule was ineffective. For a major portion of the Project period, the schedule updates did not accurately depict the level of progress and productivity being experienced during construction execution, masking the actual progress delays to the Project. SNC's change to focus on testing resulted in inefficiency and additional costs and appeared to be implemented without a formal cost-benefit risk analysis of the schedule.

18. Although the underlying process supporting risk management was providing timely information relating to unfavorable trends in costs, it appeared that SNC did not implement effective mitigation measures. Instead, it proceeded in the same manner that had produced unfavorable trends. The Project consistently failed to meet planned Cost Performance Index (CPI) rates, but SNC repeatedly forecasted that performance would improve despite observed trends pointing to a sustained decline. The monthly Vogtle Project Management Board (VPMB) progress presentations indicated that production had not achieved expectations and CPI was worsening month-over-month. Nevertheless, SNC continued to forecast an improvement in CPI in each of the months to come. This approach to risk management conflicted with SNC's obligations and commitments, as well as common industry practices and deprived the Project of the benefits from risk management.

19. The analysis of the impacts and conditions that caused delay and disruption concluded SNC and the Company did not meet the standard of care expected of its management obligations. To assess the actual amount and causes of delay and the related disruption costs, J.S. Held performed a delay and disruption analysis and a quantification of the Project costs.

20. J.S. Held's schedule delay and disruption analysis assessed overall Project performance to quantify and apportion delays to completing construction and startup scope for achieving the Fuel Load milestone (and by extension, the Commercial Operation Date (COD) milestone). As summarized in Table 1.2-1 Fuel Load Delay Summary, the analysis determined the following:

    - The Project experienced significant delay, with a Unit 3 total delay of 1,386 days (3.8 years) and Unit 4 total delay of 1,325 days (3.6 years).[7]
    - During the post-VCM 17 period, since October 2017, the Project experienced delay of 734 days (24.1 months) to Unit 3 and 670 days (22.0 months) to Unit 4.[8]

[7] For the forensic schedule analysis, J.S. Held measured delay to the Fuel Load Start milestone.
[8] Fuel Load started for Units 3 and 4 started on October 13, 2022, and August 17, 2023, respectively.

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- Of the post-VCM 17 delays, COVID-19 caused 266 days (8.7 months) to Unit 3 and 211 days (6.9 months) to Unit 4.

21. SNC was responsible for the balance of Project delay experienced post-VCM 17 of 468 days (15.4 months) to Unit 3 and 459 days (15.1 months) to Unit 4. The balance of delay was primarily driven by the risk events known as of VCM 17 and SNC's unreasonable and imprudent management decisions further discussed below.

22. The realization of known risks events and issues that SNC accepted and identified in VCM 17 that would typically be covered by contingency, included:[9]

- That WEC will not meet its obligations (Engineering) under the new Services Agreement
- That the labor force and craft will be unable to maintain their productivity improvements
- That the Project will be unable to continue to meet First of a Kind (FOAK) challenges
- Procurement
- Unidentified scope risk
- Testing/Startup Risk

23. Issues that were the responsibility of SNC's actions, inactions, and management decisions after VCM 17 that created different circumstances or exacerbated risks, included:

- SNC's focus on schedule at the expense of quality and cost
- Managing the Project to an unrealistic IPS and Estimate at Completion (EAC)
- Lack of planning for and an early transition from bulk construction to system testing
- Ineffective management of the Partial Release for Test (PRT) and Initial Testing Program (ITP) programs
- Incomplete engineering and inadequate engineering management
- Deficient procurement and management of materials and modules
- Deficient quality management
- Deficient resource management

24. The table below summarizes the delays in Units 3 and 4 and the impact issues that contributed to

[9] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, pages 93-99.

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the delay and disruption across the six (6) windows in the forensic schedule delay analysis.

Table 1.2-1 Fuel Load Delay Summary

Window #	Window Start	Window Finish	Unit 3 Delay (days)	Unit 4 Delay (days)	Impact Issues
1	April 2008	October 2017	1927	1933	• Late Issue of Design Control Document / Combined Operating License • Rebar Non-Conformity • East Side of Unit 3 shield building • On-going / Late Design Changes • Late Delivery / Poor Quality Assurance of Modules and Sub-Modules
2	October 2017	October 2018	5	4	• Inadequate resource management and inability to source craft labor.
3	October 2018	March 2019	40	34	• Early transition from bulk installation to the ITP • Incomplete engineering and inadequate management of engineering documents • Procurement deficiencies and materials/module management • Ineffective resource management and inability to improve productivity
4	March 2019	March 2020	0	-61	• Incomplete engineering and inadequate management of engineering documents • Procurement deficiencies and materials/module management • Ineffective resource management and inability to improve productivity
5	March 2020	April 2021	266	211	• COVID-19 pandemic • Ongoing issues in prior windows
6	April 2021	Fuel Load Start (August 2023)	423	482	• Inadequate quality management and control, nonconformance and rework • Performance of deferred construction work from PRT process • Incomplete engineering and inadequate management of engineering documents • Procurement deficiencies and materials/module management • Ineffective resource management and inability to improve productivity • Diversion of craft labor from Unit 4 to Unit 3
		Total	**2661**	**2603**	

25. In addition to the delays, the impacts caused disruption to the labor resources. During the period

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from March 2020 through July 2021, the analysis determined there was a total of XXXXXXX inefficient direct labor hours for Unit 3 and Unit 4 caused by COVID-19. The observed indirect-to-direct labor hour ratio was applied to the total inefficient direct labor hours to calculate a total of XXXXXX inefficient indirect labor hours for COVID-19.

26. In summary, the analysis determined there were 211 days of schedule delay, and XXXXXXX inefficient direct labor hours and XXXXXX inefficient indirect labor hours resulting from COVID-19. The total COVID-19 impact cost was calculated as follows.

- To quantify the time related cost impacts, the average daily rate for indirect costs during the COVID-19 impacted period was applied to the total days of delay determined from the schedule analysis.
- To quantify the inefficiency during the COVID-19 impacted period, the hourly indirect and direct labor rates for that period were applied to the total inefficient direct and indirect labor hours to quantify efficiency impact costs.
- The total direct costs associated with COVID-19 were determined from the available Project documentation.

27. The Company's portion of the overall costs was 45.7 percent and resulted in XXXXXXXX in unforeseen total costs stemming from the COVID-19 pandemic. The summary is shown in **Table 1.2-2 COVID-19 Cost Impacts**.

Table 1.2-2 COVID-19 Cost Impacts

Category	Company Amount (45.7%)
Delay – Indirect Costs	XXXXXXXXXX
Inefficiency – Direct / Indirect Labor	XXXXXXXXXX
Direct Costs	XXXXXXXXXX
Total Costs	XXXXXXXXXX

28. As will be discussed throughout this Report and shown below in **Table 1.2-3 The Company's Total Costs**, the Company's total costs were $7.70 billion. The remaining $2.48 billion was due to SNC's unreasonable and imprudent management decisions and therefore should be disallowed.

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Table 1.2-3 The Company's Total Costs Company Portion of Total Construction and Capital Costs	
Category	**Amount**
Approved Total Construction & Capital Cost Forecast Net of Toshiba Parent Guarantee	**$7.30 Billion**
COVID-19 Cost Impacts	$404 Million
Total Costs	**$7.70 Billion**
Forecasted Total Construction & Capital Costs at Completion Net of Toshiba Parent Guarantee	$10.19 Billion
Total Company Portion	**($2.48 Billion)**

29. The Company, Public Interest Advocacy (PIA) Staff, the Georgia Association of Manufacturers, Georgia Interfaith Power & Light, Georgia Watch, and Partnership for Southern Equity (the Stipulating Parties) reached agreement on August 29, 2023, that stipulated $7.56 billion as the reasonable and prudent total construction and capital costs for Vogtle Unit 3 and Unit 4. This amount will be included in the base rate. J.S. Held finds this stipulation to be reasonable and prudent based upon its analysis of the Project.

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3 Background

3.1 Project Overview

30. The Plant Vogtle Units 3 and 4 Nuclear Project (Project) aimed to design, construct, test and operate two new WEC AP1000 Generation III+ nuclear powered electric generating plants located at the Alvin W. Vogtle Electric Generating Plant (Plant Vogtle) in Burke County, Georgia near Waynesboro, Georgia. The total projected generation capacity of the two new reactors is approximately 2,200 Megawatts (MW) with an annual generation of approximately 17.2 million Megawatt Hours (MWh).[10]

31. Vogtle Units 3 and 4 were the first U.S. deployment of the AP1000 Generation III+ reactor. The AP1000 was designed by WEC as the next-generation nuclear reactor that could provide a standardized design for the U.S. utilities market. The AP1000 was generally built with modules manufactured off-site and then assembled onsite. This method of prefabricated construction aimed to improve quality and ease onsite construction complexity and allowed shop fabrication to occur concurrent with site work. In addition, the AP1000 has a smaller footprint and simpler design, and used less piping, valves, and pumps than older designs.[11]

32. The Vogtle Units 3 and 4 Project is currently the only new nuclear plant project being constructed in the United States. It is also the first plant to be completed in the U.S. having obtained a Nuclear Regulatory Commission combined license (COL) to build and operate a plant as well the first to complete construction of a nuclear plant in the U.S. in approximately 35 years.

3.1.1 Overview of Constituents / Roles and Responsibilities

33. On April 21, 2006, the Company, Oglethorpe Power Corporation (OPCPEP), Municipal Electric Authority of Georgia (MEAG), and City of Dalton (Dalton) entered the Plant Alvin W. Vogtle Additional Units Ownership Participation Agreement. Through this agreement and subsequent amendments, the Company secured a 45.7 percent ownership stake in the development of Units 3 and 4, with the remaining partners owning the remaining part and with the understanding that the Company would act as Agent on behalf of the rest of the Co-ownership group.

[10] Source: https://www.energy.gov/lpo/vogtle
[11] Source: https://www.energy.gov/lpo/vogtle

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34. Of the four Co-owners in the consortium, the Company is the only for-profit company. As such, the rates that the Company charges for the electricity it provides to its customers are regulated through the Commission. The Commission has continuously monitored the Project since 2009 with bi-annual monitoring reviews occurring in the form of the VCM reports and hearings. Each VCM hearing provides an opportunity for the Company to report the Project status, current cost and schedule forecasts of the Project, and for Commission Staff (Staff), which includes all engaged consultants, and public interest advocacy groups, to voice their opinions and gain insight into the status of the Project.

35. On April 8, 2008, WEC and Stone & Webster, Inc. (Stone & Webster) signed an Engineering, Procurement and Construction Agreement (EPC Agreement) with the Company, acting for itself and as an agent for the other Co-owners, to develop, license, procure, and construct Units 3 and 4. In February 2013, Chicago Bridge & Iron (CB&I) acquired The Shaw Group, parent company of Stone & Webster, and assumed the role of the lead construction contractor. WEC served as the EPC contractor in conjunction with CB&I until 2015 when WEC acquired the contractor, then known as CB&I Stone & Webster Inc. The newly acquired organization resided within the WEC subsidiary, WECTEC. Following the purchase of CB&I Stone & Webster Inc. and creation of WECTEC, WEC contracted with Fluor Corporation (Fluor) to take over management of the construction-phase of the Project as the construction contractor. WEC worked in this capacity for the Project until it filed for bankruptcy on March 29, 2017.[12]

36. Following the bankruptcy filing, the Co-owners continued construction under an interim assessment agreement. On June 9, 2017, the Co-owners affirmed the value of Toshiba Corporation's (Toshiba, WEC's parent company) Guarantee (TPG) at $3.68 billion and finalized a new services agreement with WEC. The new services agreement, approved on July 27, 2017, stated that WEC will continue its ongoing design, engineering and procurement services while transitioning construction management responsibilities to SNC. SNC relieved Fluor of its duties as construction contractor for the Project and entered into a Construction Completion Agreement with Bechtel on October 23, 2017, to serve as the prime construction contractor.[13]

[12] April 2018, SNC Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 4.
[13] October 23, 2017, Construction Completion Agreement Between Georgia Power Company, for Itself and as Agent for Oglethorpe Power Corporation (An Electric Membership Corporation), Municipal Electric Authority of Georgia, Meag Power Spvj, Llc, Meag Power Spvm, Llc, Meag Power Spvp, Llc, and the City of Dalton, Georgia, Acting by and through its Board of Water, Light and Sinking Fund Commissioners, as Owners and Bechtel Power Corporation.

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37. SNC's new role on the Project afforded it "*responsible for all aspects of the Project with Westinghouse providing engineering services and Bechtel Construction Company operating as the lead construction contractor on site.*"[14] Under the new configuration of constituent parties SNC owned the ultimate responsibility for successful completion of Units 3 and 4 and would accomplish this through the overall management of execution of the Project and direction of day-to-day Project activities.[15]

38. The transition of Project execution management to SNC also included the continued operation and establishment of various additional governance and oversight committees, including the Vogtle Executive Oversight Committee (VEOC), the Vogtle Project Management Board (VPMB), and Vogtle Construction Review Board (VCRB). Additionally, a Monthly Project Review (MPR) report was issued by SNC to the Co-owners which focused on site activities. The VEOC included Officers from the Company, SNC, and others, and is charged with oversight of the Company's activities and obligation in connection with the Project. The VPMB is comprised of senior executive representatives from the Company as well as representatives from each of the Co-owners. The VPMB meets on a monthly basis and reviews major Project decisions and discusses the "*development, scheduling, planning, construction, completion, startup, and commissioning of Vogtle 3&4.*"[16] The VCRB advises the Chairman, President, and CEO of SNC on "*execution and parameters from procurement, engineering, WEC Services Agreement, prime contract management, subcontract management, scheduling, risk management, and controls put in place for the success of the Project*."[17]

39. Additionally, due to the Loan Guarantee Agreement from the United States Department of Energy (DOE) made on February 20, 2014, the Company was required to submit regular reports and make notifications to the DOE after certain reportable events occur to ensure compliance with the terms of the agreement.[18] Further governmental organizations involved in the oversight of the development of Units 3 and 4 included the NRC and various consultants retained on behalf of these organizations.

40. J.S. Held was contracted by the Commission to complete independent analysis of the project

[14] April 2018, SNC Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 4.
[15] April 2018, SNC Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 12.
[16] April 2018, SNC Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 7.
[17] April 2018, SNC Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 8.
[18] April 2018, SNC Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 13.

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management, scheduling, and cost management performance by the Company and SNC with the primary focus on the period post-bankruptcy.

3.1.2 Overview of Increased Costs, Increased Manhours and Schedule Delay

41. On March 30, 2009, the Commission provided the Company approval for the Project to proceed by issuance of an Amended Certification Order with an anticipated Commercial Operation Date (COD) of April 2016 and April 2017, for Units 3 and 4 respectively. This Certification Order included an approved total construction and capital cost forecast and financing costs of $6.45 billion. As part of the first VCM filing in August 2009, the Commission adopted a stipulation which revised the Certified Project Cost to $6.11 billion resulting from a change in Georgia Law which allowed the Company to collect financing costs as incurred from its own customers. Of the $6.11 billion certified amount, approximately $4.42 billion was forecasted for Capital and Construction Costs.[19]

42. From the onset, the Project was beleaguered by delays, increases in labor hours and cost overruns. On December 20, 2016, the Commission approved a new stipulation which revised the Capital Cost Forecast to $5.68 billion, all of which was presumed reasonable and prudent, with a significant amount of work remaining to complete the Project. Only a few months later, when WEC declared bankruptcy, the Project was at risk of being abandoned. During this period, SNC reevaluated the status of the Project and generated a new Estimate of Completion (ETC) and projected schedule. The Company presented this new forecasted ETC value of $8.77 billion to the Commission in VCM 17. During a Special Administrative Session on December 21, 2017, the Commission issued an order that the Company should move forward to complete construction of Vogtle Units 3 and 4.[20]

43. Additional orders resulting from this Special Administrative Session included approval of the revised Project schedule, the new Project structure, and the revised capital cost forecast of $7.30 billion. The $7.30 billion capital cost forecast accounts for $8.77 billion in ETC costs net of the TPG. The TPG totaled $3.68 billion with the Company's proportionate share of this guarantee equaling approximately $1.68 billion. A separate order approved by the Commission stipulated that of the Company's $1.68 billion portion of the parent guarantee, approximately $188 million would be

[19] September 21, 2021, Verification of Expenditures Pursuant to Georgia Power Company's Certificate of Public Convenience and Necessity for Plant Vogtle Units 3 and 4, Twenty-Fifth Semi-annual Construction Monitoring Report, page 2.
[20] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, page 47.

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refunded to the Company's customers. Thus, the $8.77 billion net of the TPG and the resulting customer refunds, the Commission arrived at the value of $7.30 billion, which was deemed reasonable in VCM 17. The Commission ordered that all costs verified and approved during the VCM filing process through VCM 14, $5.68 billion, carried the presumption of prudence. However, the Company still retained the burden of proof on prudency on all capital costs above $5.68 billion.[21] As per VCM 17, costs above the $7.30 billion have not been found to be reasonable with the burden to show reasonableness resting on the Company.

44. This decision to move forward with the Project did not spell the end of the delays and overruns. Ultimately, since issuance of the March 2009 Certification Order the Vogtle 3 and 4 Project capital cost estimate has nearly tripled, and the CODs had slipped by over 7 years. The delays and overruns experienced on this Project will be described in more detail in this Report.

3.1.3 Summary Timeline (Major Milestones, Issues, Conditions, etc.)

45. The Company began developing the Project as early as 2006 and by 2008 had agreed to an EPC Contract with WEC and Stone & Webster. With the issuance of the Certification Order in 2009, SNC began construction on the Project.

46. Over the next 8 years, WEC, Stone & Webster, and SNC made significant progress on the Project, but not without encountering a vast array of issues and delays. By December 2012, SNC was nearly a year behind schedule and WEC and its subcontractors had filed a nearly $900 million lawsuit against the Company and the Co-owners for design changes. The lawsuit was later settled, however, the efficiency of the work completed on the Project would see little improvement over that time span.

47. On March 29, 2017, WEC filed for bankruptcy, impacting the existing EPC Contract that was in place with the Company and associated Co-owners. An agreement was entered with WEC on March 29, 2017, to assess the Project with full access to all cost and scheduled information necessary for SNC to complete a review. After the Go / No-go decision was officially reached there was renewed expectation for improvements in schedule and cost efficiency. A switch in Project execution strategy transitioning bulk installation to a system turnover testing program earlier than originally

[21] September 21, 2021, Verification of Expenditures Pursuant to Georgia Power Company's Certificate of Public Convenience and Necessity for Plant Vogtle Units 3 and 4, Twenty-Fifth Semi-annual Construction Monitoring Report, page 2.

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anticipated was implemented by SNC to minimize schedule delay. This decision had the opposite impact and labor productivity significantly deteriorated and schedule delays increased.

48. In 2020, the COVID-19 pandemic arrived at Plant Vogtle and brought with it significant impacts to the work on Units 3 and 4, creating disruptions in both the supply of manpower and materials, impacting productivity, and increasing execution time durations. Due to COVID-19, the Project experienced further delays and cost overruns, however progress continued.

49. Finally, after years of delay, in August 2022, the NRC approved SNC to begin fuel loading on Unit 3. In March 2023, Unit 3 first reached criticality, followed by the first successfully generated electricity a month later. Approximately 3 months later in July 2023, SNC began commercial operation of Unit 3. Unit 4 is projected to reach commercial operation in the coming months and has seen significant progress. For example, in December 2022, SNC completed Cold Hydro Testing (CHT) of Unit 4, and more recently, in March 2023, SNC began Hot Functional Testing (HFT) on the Unit.

3.2 J.S. Held General Methodology for Work Streams

50. J.S. Held enacted a phased approach to provide an efficient and value-driven framework that allowed for a methodical analysis and review of the Project. The analysis began by establishing a preliminary understanding of the issues encountered on the Project in Phase I. The results of Phase I facilitated the development of the detailed work plan for Phase II to evaluate and quantify the major issues which formed the basis for the findings in this Report.

51. The objective of this engagement was to determine whether the Project incurred unreasonable, excessive, or inappropriate charges, stemming from management decisions. As such, and as further described below, J.S Held's evaluation was conducted within the framework of management processes, responsibilities, and SNC decisions that potentially affected the Project objectives.

52. J.S Held's work plan for Phase I intended to provide a preliminary understanding of the construction program/Project, the issues, the structure of the management organization, including key personnel, and an understanding of the available relevant files relating to the Project.

53. Phase I entailed the review of select relevant documentation such as: construction agreements, large change orders, and claims, increases to the control budgets, extensions of time/delays, and other issues or events (such as quality issues) that may have impacted the cost and schedule.

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54. Additionally, J.S. Held coordinated with the Commission and the Company to create a repository of available documents, including the organization and coding of the files.

55. Phase II entailed completion of detailed analyses based on the Phase I findings. The detailed analyses were broken into three separate topics listed below.

- Project Management / Performance Analysis
- Delay and Disruption Analysis
- Damages / Cost Analysis

3.2.1 Project Management / Performance Analysis

56. The Project Management responsibilities and practices are generally defined by:

- The Company's internal policies and procedures, including regulatory requirements
- SNC and Bechtel's Contracts/Agreements, Specifications, and execution plans
- Common industry practices and standards

57. To assess the reasonableness and prudency of the Company's decisions, J.S. Held considered the approach that the Company's management took in relation to the crucial management decisions such as, the decision to switch the Project execution strategy and other decisions relating to subsequent delays and cost growths.

58. Management requirements that defined the appropriate Standard of Performance for a project such as this Project are discussed in various publications from professional industries such as the Project Management Institute (PMI), Association for the Advancement of Cost Engineering International (AACE), Construction Management Association of America (CMAA), which collectively represented "*industry standards/common practice*" that are generally regarded within the industry as fundamental to a sound project management. It is well recognized that the use of judgment in executing those processes must be exercised within express guidelines (Consistency), provide an accessible and well understood record of decisions that were made (Transparency), and the decisions should be made by the same or similarly competent staff each time (Accountability).

59. J.S. Held's analysis included the following Project Management processes:

- Project Quality Management
- Project Risk Management

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- Project Schedule (Time) Management, including coordination of construction phases with testing/commissioning phase.
- Project Cost Management, including Project Scope Management and Change Management.

60. The following types of documents formed the starting basis of the analyses:

- Documentation supporting the basis for the Company's move forward decision during the 17th VCM hearing (The Go / No-go decision post-WEC bankruptcy).
- Internal policies and procedures relating to configuration management, risk management, time (schedule) management, budget control and change management, including processing of change orders, and claims, reporting, and invoicing/payments.
- Applicable regulatory requirements
- Construction Contracts/Agreements
- Project Execution/Management Plan
- Procedures/tools for time management, change management; Quality Assurance/ Quality Control (QA/QC); reporting; materials handling and control; and contract administration.
- Change order logs; trend reports and total cost EAC; and risk registers.
- Complete monthly reports and monthly schedule updates.
- Complete files supporting significant change orders, claims, reforecasting of control budgets, material changes to contractual requirements/specifications/scope/completion milestones, including correspondence relevant to the specific issues.

61. The investigation began by reviewing the supporting documentation and analyses relied upon by the Company as the basis of its decision (the due diligence) to continue with construction after WEC declared bankruptcy. Support for this review focused on the various risks such as, schedule delays from re-procurement of services and demobilization/mobilization, status of design and quality of existing Issued-For-Construction (IFC) drawings, risks with WEC installations, and planned levels of productivity and indirect / direct labor ratios.

Cost Control/Change Management

62. Common industry practices emphasize the importance of providing robust systems for monitoring, controlling, and reporting of costs. This typically involves the deployment of integrated systems that provide an accurate assessment of incurred costs against an established baseline, and budget adjustments and forecasts, all regularly monitored by the Company. This includes monitoring and

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reporting of Original Budget, Approved Changes, Current Budget, Check Estimates, Committed and Actual Costs, and Forecasted Costs. These processes must be accurate, relevant, and timely.

63. In addition, J.S. Held investigated whether the cost management system included the proper level of reports relating to variance and trend analyses, forecasts of EAC, identification of change requests and applicable updates to the project management plan, including changes to the Cost Baseline and/or cost management plan. J.S. Held also assessed if SNC conducted the proper and timely review of reports and if SNC took appropriate and effective mitigative steps relating to unfavorable trends and forecasted increases.

64. Further, the analysis verified if the forecasting was performed in a proactive, systematic approach based on an established update frequency, rather than being performed in reaction to performance problems.

Investigate Time/Schedule Management

65. The following assessments were completed to investigate the Company's time/schedule management:

- Verify that time management conformed to contractual requirements and common industry practices.
- Assess the reasonableness of the IPS schedules.

66. J.S. Held evaluated the Company's contractual requirements relating to time management to determine if they are comprehensive and robust, and designed to provide meaningful processes and tools for planning, monitoring, and controlling the execution of the scope.

67. In coordination with and based on the findings of the forensic schedule analysis, J.S. Held determined the reasonableness and viability of the IPS schedules. J.S. Held's evaluations were made within the context of contractual requirements, contemporaneous Project circumstances and common industry practices.

Investigate Quality Management

68. The following assessments were completed to investigate quality management:

- Assess Quality Management Processes and Procedures
- Investigate Quality Assurance and Quality Control (QA/QC)

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69. A critical objective for successful completion of a project is to complete the work scope in conformance with the contractual (and regulatory) quality requirements. Given the risks to public safety health, and the environment, and the associated regulatory requirements, quality management on nuclear projects is set apart from most other construction projects. Project quality management determines the quality policies, objectives, and responsibility to assure the project needs will be met across all phases – including, the quality of engineering, and the conformance to contractual requirements of the procured materials/equipment and the installation/construction.

70. J.S. Held investigated if there were quality failures and their impact on the Project with respect to cost and schedule. The implications of failures were also reviewed, including corrective actions, re-testing and/or re-work, and the Company's resolution of such impacts were likewise evaluated.

Review of Risk Management

71. J.S. Held evaluated the management of risks on the Project. Broadly, the objective of risk management is to employ foresight for the early identification of risks to allow them to be tracked and managed (including mitigation of risks that cannot be eliminated) throughout the Project execution.

72. J.S. Held conducted a review of the risk registers, including verifying if known initial risks as well as emergent risks were properly identified and managed across various construction phases, contractors, and disciplines. As needed, the analysis assessed the Company's risk management strategies for certain risks to verify conformance with policy and contractual requirements, alignment with common practices and prudency with respect to cost, schedule and quality implications. By way of example, J.S. Held investigated the Company's level of risk management relating to the prioritization of completion of Project Milestones and the apparent extensive use of the PRT procedures.

3.2.2 Delay and Disruption Analysis

73. The following assessments were completed to investigate quality of Project schedules, and delays and disruptions to the Project:[22]

[22] Delay is defined by AACE International Recommended Practice, 10S-90, Cost Engineering Terminology, Rev. May 15, 2023, as "*To cause the work or some portion of the work to start or be completed later than planned or later than scheduled." Disruption is defined as "An interference (action or event) with the orderly progress of a project or*

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- Assessment of the reasonableness of the Baseline and Re-Baseline schedules.
- Performance of forensic schedule and productivity analysis, including root cause analysis.

74. J.S. Held evaluated the reasonableness and viability of the IPS schedule. The evaluation started with a review of the "mechanical" aspects of the schedule. In addition, J.S. Held reviewed the reasonableness of the estimated production rates and identified if these were optimistic and/or overly aggressive when compared to actual performance. The evaluation confirmed if the Company undertook similar schedule evaluations, the Company's comments/findings, and the Company's response to deficiencies or gaps in the schedules.

75. J.S. Held evaluated the re-baseline schedules and/or mitigation measures.

76. J.S. Held conducted a forensic analysis of the IPS schedules. Broadly, this analysis entailed the identification of the critical paths during the Project execution. J.S. Held employed window methodology which breaks down the Project execution into periods (windows) of time to complete the schedule analysis. The critical path was identified for each window, followed by identification and quantification of delays for each window.

77. This task also included a disruption/productivity analysis. Based on the Project details and guidance from Staff, J.S. Held conducted productivity analyses.

78. Further, J.S. Held assessed the impacts from the early switch from bulk installation phase to system testing, and the prioritization of completion of Project milestones.

79. Based on the results of the schedule analysis, J.S. Held conducted a root cause analysis to determine the underlying causes for the delays and disruptions. This analysis encompassed a review of periodic Project reports, meeting minutes, correspondence, claims, and other documentation identified as relevant during the review and assessment of the available documentation.

3.2.3 Damages / Cost Analysis

80. The cost analysis was coordinated with the findings of the Project Management / Performance Analysis, and the Delay and Disruption Analysis.

activity(ies). Disruption has been described as the effect of change on unchanged work and manifests itself primarily as adverse labor productivity impacts."

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81. Contractor, subcontractor, and vendor delay driven costs such as indirect or general conditions were quantified for delays attributable to the imprudent Company decisions and other unanticipated impacts such as the COVID-19 pandemic. The quantification was calculated based on a daily rate derived from cost reports, manpower reports, or other supporting documents such as change orders or claims.

82. Additional direct costs related to unanticipated impacts, such as the COVID-19 pandemic, were quantified using available cost information such as cost reports, labor reports, change order and claims.

83. J.S. Held quantified additional (inefficiency) construction costs resulting from management decisions and other unanticipated impacts such as the COVID-19 pandemic. These costs rely on the schedule disruption and inefficiency findings in terms of identified direct and indirect manhours and using applicable labor rates. The labor rates were based on available cost information such as cost reports, labor reports, change orders, and claims.

3.3 Actions, Decisions, and Issues that Impacted Project Execution

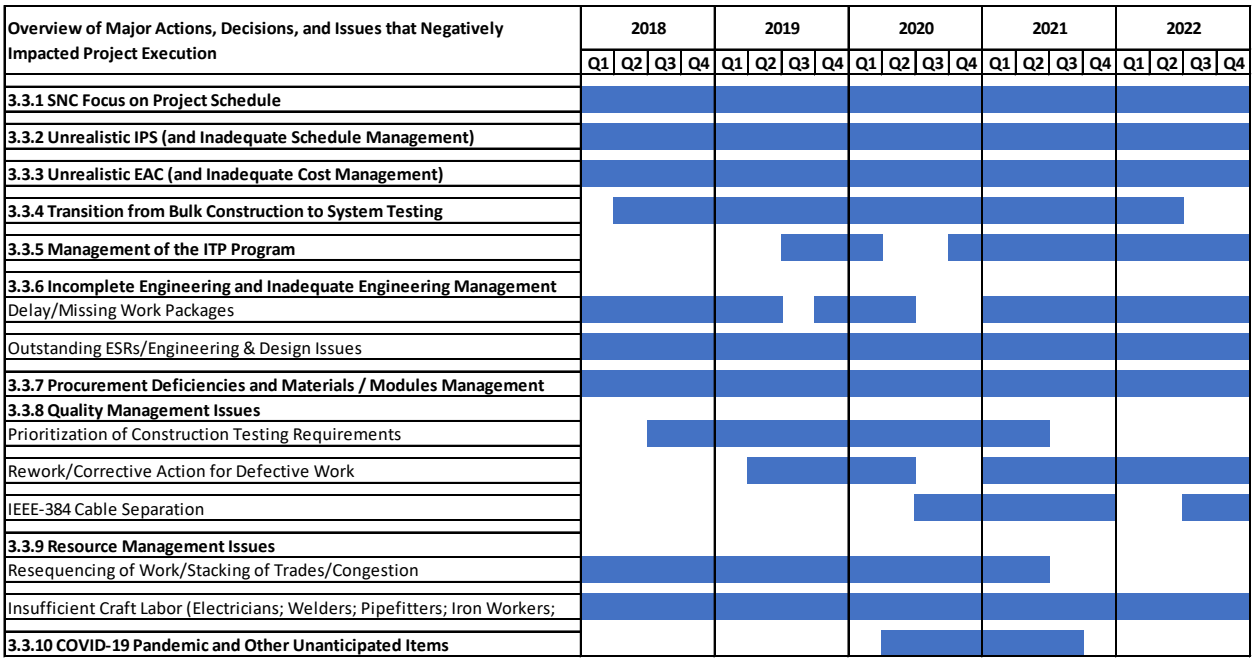
84. Specific actions, conditions, and circumstances that impacted the Project from a project management, schedule and cost standpoint are discussed within Section 3.3. Most of these items were rooted in decisions and actions determined by project management within SNC. Others, notably the COVID-19 pandemic, could not be planned for or anticipated. The conditions and impacts analyzed included the following:

- The SNC focus on schedule over cost and the related cost schedule and cost forecasts.
- The transition from a focus on bulk electrical and piping installation to focusing on specific systems to achieve certain milestones and the related impacts to system turnover functions.
- The completeness of engineering and the effectiveness of engineering management after the onboarding of the replacement contractor, Bechtel.
- Procurement related material supply and management difficulties.
- Quality management issues including those affiliated with the prioritization of testing requirements, rework and corrective actions, and the cable separation matter.
- Labor resource management performance and supply issues.
- The COVID-19 pandemic issues.

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85. These conditions were pervasive throughout the entire work period from 2018 through 2022. **Figure 3.3-1 Impact Timeline** details the periods in which there are documented occurrences and events related to or caused by these conditions, which ultimately are the source of both schedule and cost growth during the construction of Vogtle Unit 3 and Unit 4.

Figure 3.3-1 Impact Timeline



3.3.1 SNC Focus on Project Being Schedule Driven and Not Cost / Quality Driven

3.3.1.1 Overview

86. Three primary objectives of a successful construction project are time (schedule), costs, and quality. Each of these objectives is crucial for ensuring that a project is successful, meets its objectives, and satisfies the stakeholders. The role and interface of each function typically varies over the course of a project and to be successful must be properly coordinated and integrated. In addition, these objectives are intertwined, thus the efforts to focus on one objective will typically influence the others. As of VCM 17, SNC assumed the role of overall project management for the Project and was responsible for meeting each of these Project objectives.

87. SNC placed more emphasis on achieving the schedule to the detriment of cost and quality. SNC inaccurately portrayed progress and was willing to advance the schedule at all costs, which led to mis-informed management decisions that exacerbated ongoing problems and contributed to

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avoidable cost growth and the need to mitigate significant quality deficiencies.

3.3.1.2 Objectives of a Successful Project

Time/Schedule

88. The schedule refers to the timeline or timetable that outlines the planned sequence of activities and their durations from project initiation to completion. The schedule is a part of the time management system against which the execution of the work is planned, monitored, and controlled. Adhering to schedule management practices ensures that the project work is executed in an efficient, logical, and coordinated manner that conforms to contractual requirements and deadlines, which is vital for meeting client expectations. Factors influencing the schedule include properly allocating resources, like labor, materials, and equipment; effective planning and sequencing of tasks to minimize delays and optimize the construction process; and contingency planning to anticipate potential setbacks and having mitigation plans in place to minimize disruptions. The schedule also provides a structured approach to measuring progress, thereby allowing for early warnings of delays, and allowing the project team to formulate a structured and measurable approach to mitigating delays and excess costs.

89. As described in Sections 3.3.2 and 4 of this Report, SNC's time management and schedule reporting practices inaccurately portrayed progress, which led to mis-informed management decisions exacerbating problems that contributed to avoidable cost growth and quality deficiencies.

Cost

90. Cost encompasses the financial resources required to complete the construction project, including expenses for labor, materials, equipment, permits, and any other related expenditures. Managing costs is crucial for staying within the budget and ensuring that the project remains financially viable for both the contractor and the client. Accurate initial budgeting and cost estimation are essential for avoiding cost overruns, as well as effective procurement practices and contract management to control costs with materials, subcontractors, and other service providers. Key to cost management is proper management of changes in scope or requirements to minimize unexpected costs.

91. As described in Section 6 of this Report, the Project experienced significant cost growth associated with delay, disruption, lost productivity, and other escalation factors.

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Quality

92. Quality refers to the degree of excellence in the workmanship, materials, and outcome of the construction project. Quality objectives span across all phases and functions of the project – including, the quality of engineering, procurement of materials/equipment, module fabrication, installation/ construction, and testing and start up. It ensures that the completed project meets or exceeds the specified standards and requirements. Maintaining high quality is essential for delivering a safe, durable, and reliable facility that meets the client's expectations and complies with industry standards and regulations. Implementing rigorous quality control measures and adhering to quality assurance protocols are crucial for monitoring and maintaining the desired level of quality and ensuring that construction adheres to building codes and industry standards. A skilled and well-trained workforce is fundamental for achieving quality workmanship.

93. Since the Project involved construction of a nuclear facility, it required rigorous and special attention to quality that was also monitored by the NRC. Deviations or flaws in quality identified by the NRC would likely result in further investigations, increased inspections, and corrective actions required by the NRC.

94. As described in Sections 3.3.8 and 4 of this Report, the Project experienced numerous shortcomings and deficiencies with respect to quality, which resulted in delays, disruption, lost productivity, and avoidable cost growth.

3.3.1.3 SNC's Emphasis on the Schedule at the Expense of other Objectives

95. Balancing these three objectives is an important management responsibility, as changes or challenges in one area can impact the others and cause new or exacerbate ongoing problems. Successful project management involves continuous monitoring, adaptation, and effective communication to ensure that the project progresses smoothly while adhering to the schedule, budget, and quality standards.

96. SNC failed to balance the objectives and emphasized adherence to the schedule milestones to the detriment of the cost and quality of the Project.

97. SNC continually reported that the Project was maintaining adherence to key Project milestones and was not showing delay, while at the same time, production and Earned Value data was showing steady delay and failure to achieve planned levels of progress.

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98. SNC implemented non-progress changes to the IPS to mask the delays to progress. One significant practice SNC implemented was to change numerous constraints, on which progress and payment would be credited, from finish to start. Instead of crediting progress when an activity finished (which is typical in the construction industry), SNC credited progress when an activity started and thereby over-reported progress in the schedule and mis-represented actual progress achieved.

99. SNC also compressed activities and shortened durations, despite the loss of productivity experienced and the demonstrated delay depicted in the contemporaneous progress data.

100. SNC prematurely transitioned the Project from the bulk installation of construction commodities to an approach that focused on system testing. This approach deferred incomplete bulk construction work to be performed later in the Project and during the system testing period, which was inherently less efficient. This SNC decision resulted in the loss of productivity, decreased progress, and increased schedule delay.

101. SNC's focus on reporting adherence to the IPS schedule ultimately led to mis-informed management decisions that caused new and exacerbated ongoing performance shortcomings, deficiencies with respect to quality, delays, disruption, lost productivity, and avoidable cost growth.

3.3.2 Unrealistic IPS (and Inadequate Schedule Management)

3.3.2.1 Overview

102. The magnitude of deficiencies in the Project's IPS was a consistent concern as SNC failed to adequately manage the IPS schedule and fulfill the industry standard practices that "*Schedules are Realistic and Understood*."[23] As a result, SNC inaccurately portrayed actual progress and forecasted progress, which resulted in mis-informed management decisions and exacerbated problems that contributed to avoidable cost growth and quality deficiencies.

103. As of VCM 17, SNC assumed the role for overall management of the Project, with responsibility to manage the IPS, while Bechtel was responsible for most of the construction related scope.

[23] May 30, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 6, page 11.; May 2013, Plant Vogtle Units 3 & 4 Project Execution Plan (VPEP) v.4.0, Institute of Nuclear Power Operations (INPO) Principles for Excellence in Nuclear Project Construction, page 10.

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3.3.2.2 History of Unrealistic IPS

104. Prior to VCM 17, the IPS exhibited three (3) fundamental areas of concern with respect to the industry practice of being "*realistic and understood*":

- Completeness of the IPS; the IPS was identified as being incomplete for several reasons including missing critical activities, missing activities after a certain date, and missing critical logical relationships. These deficiencies were repeatedly identified and discussed during the Project at an executive level between SNC and the contractor (WEC) including, but not limited to April 2011, April 2012, March 2013, and March 2014.[24] Without resolving these deficiencies, the IPS did not represent a complete and accurate model of the work necessary to achieve the Project milestones and thus was unable to function effectively as a Project management tool.[25]
- Incorporation of unevaluated compression / mitigation; beginning with the Project baseline, compression techniques were being applied to the IPS, starting with a standard application of a fifty (50) hour / week schedule. Additional compression techniques were applied to the IPS to mitigate delays and represent adherence to Project milestones. The achievability and economics of these proposed compression and mitigation techniques were questioned based on the contractor and SNC's inability to develop and successfully implement past compression efforts on the Project. For example, the contractor indicated that double shifting would be required to maintain the schedule from foundation placement to system turnover and would add approximately 1.4 million labor hours to the Project.[26] The contractor and SNC failed to provide an evaluation of whether the proposed effort could be achieved and the full cost of

[24] April 13, 2011, Report of the Georgia Public Service Commission Plant Vogtle 3 and 4 Construction Monitor EPC Meeting page 6; April 19, 2012, Report of the Georgia Public Service Commission Plant Vogtle 3 and 4 Construction Monitor EPC Meeting, page 5; March 19, 2013, Report of the Georgia Public Service Commission Plant Vogtle 3 and 4 Construction Monitor Project Executive Report Out (PERO) Meeting, page. 6; March 19, 2014, Report of the Georgia Public Service Commission Plant Vogtle 3 and 4 Construction Monitor Monthly Project Review Meeting, page 3.

[25] June 9, 2011, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 4, page 8.; May 30, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 6, page 10.; December 7, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 7, page 7.; August 8, 2013, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 8, page 12.; June 20, 2014, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 9/10, pages 7-8.; November 21, 2014, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 11, pages 7-8, 20-25.

[26] April 13, 2011, Report of the Georgia Public Service Commission Plant Vogtle 3 and 4 Construction Monitor EPC Meeting, pg. 5.

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implementing such measures. As such, the effectiveness of the IPS as a project management tool was compromised.[27]

- Loss of fidelity as an accurate forecasting tool; as the Project progressed and related to the areas of concern regarding completeness and compression of the IPS, the loss of fidelity in the IPS schedule emerged with respect to the ability of the IPS to accurately forecast the completion dates for Project milestones and its value as a management tool.[28] A year after the identification of the lack of fidelity, it was identified that SNC and the contractor were not in alignment on the projected CODs for the Project.[29] The loss of fidelity emerged as a function of "pinned" (via constraints) activities which masked delays and lack of progress and thus the IPS did not reflect schedule gains / losses due to early / late progression of predecessor activities. As a result, the forecast associated with downstream activities, including key project milestones, became unreliable and the IPS lost its value as a project management tool.[30]

105. Starting in March 2017, and as of VCM 17, SNC increased its responsibility for the overall management of the Project including the IPS. These responsibilities included the duty to perform the following tasks:[31]

- Oversee reporting related to Project cost and Project schedule
- Develop, manage, and maintain the Level 1[32] and Level 2[33] Project schedules

[27] June 9, 2011, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 4, page 10.; May 30, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 6, pages 10, 12-13.; December 2, 2011, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 5, pages 7-10.; June 20, 2014, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 9/10, pages 17-18.; Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 11, pages 32-33.; June 17, 2016, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 14, page 19.

[28] January 19, 2012, Report of the Georgia Public Service Commission Plant Vogtle 3 and 4 Construction Monitor EPC Meeting, page 2.

[29] February 20 ,2013, Report of the Georgia Public Service Commission Plant Vogtle 3 and 4 Construction Monitor Project Executive Report Out (PERO) Meeting, page 4.

[30] November 20, 2015, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 13, page 9 & 30; November 17, 2016, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 15, pages 18-19.

[31] October 23, 2017, Construction Completion Agreement – Exhibit A – Scope of Work / Division of Responsibilities, page 19.

[32] A Level 1 Schedule is defined by AACE International Recommended Practice, 91R-16, Schedule Development, Rev. August 13, 2020, as "*...a high-level schedule that reflects key milestones and summary activities by major phase, stage or project being executed." "Typically represented in Gantt format and depending upon when and how developed, a Level 1 schedule may or may not be the summary roll-up of a more detailed CPM schedule.*"

[33] A Level 2 Schedule is defined by AACE International Recommended Practice, 91R-16, Schedule Development, Rev. August 13, 2020, as being "*...prepared to communicate the integration of work throughout the life cycle of a project." "Typically presented in Gantt (bar chart) format and rarely in CPM network format Level 2 schedules provide high-level information that assist in the project decision-making process (re-prioritization and criticality of project deliverables).*"

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- Develop, manage, and maintain the non-construction Level 3[34] Project schedules (i.e., Engineering, Licensing, ITAAC, Startup, etc.)
- Integrate the Level 1, Level 2, and Level 3 Project schedules
- Analyze impacts to the Project schedules resulting from the Level 3 construction schedules.

106. Despite this change in ownership of the IPS, the schedule continued to exhibit deficiencies as a project management tool and remained unrealistic and overly aggressive, with unachievable unit production rates, inadequate resource loading, missing logic, incorrect logic, inappropriate use of milestones and hard constraints, and the inappropriate use of start as opposed to finish milestones to report and credit Project progress.[35]

3.3.2.3 Assessment of IPS

107. SNC was managing the Project to an unrealistic IPS as demonstrated by SNC using unachievable unit production rates, mis-representing progress, inadequate resource loading, missing logic, incorrect logic, inappropriate use of milestones and hard constraints, and the inappropriate use of start as opposed to finish milestones to report and credit progress. J.S. Held's review of these issues follows.

Use of Unachievable Unit Production Rates

108. SNC used unachievable unit production rates as detailed below and did not incorporate the known and persistent deficient performance when issuing progress updates or re-baselines to the IPS.

109. The productivity factors (PF) were notably not achieving the targeted range of 0.95 – 1.05 for both Unit 3 and Unit 4 and generally trended upward (got worse) over time.[36] **Attachment 2** contains the compiled labor productivity curves for the major areas of work and for major trade disciplines and

[34] A Level 3 Schedule is defined by AACE International Recommended Practice, 91R-16, Schedule Development, Rev. August 13, 2020, as being "*...prepared to communicate the execution of the deliverables for each of the contracting parties." "Typically presented in Gantt or CPM network format and is generally the output of CPM scheduling software. Level 3 schedules provide enough detail to identify critical activities.*"

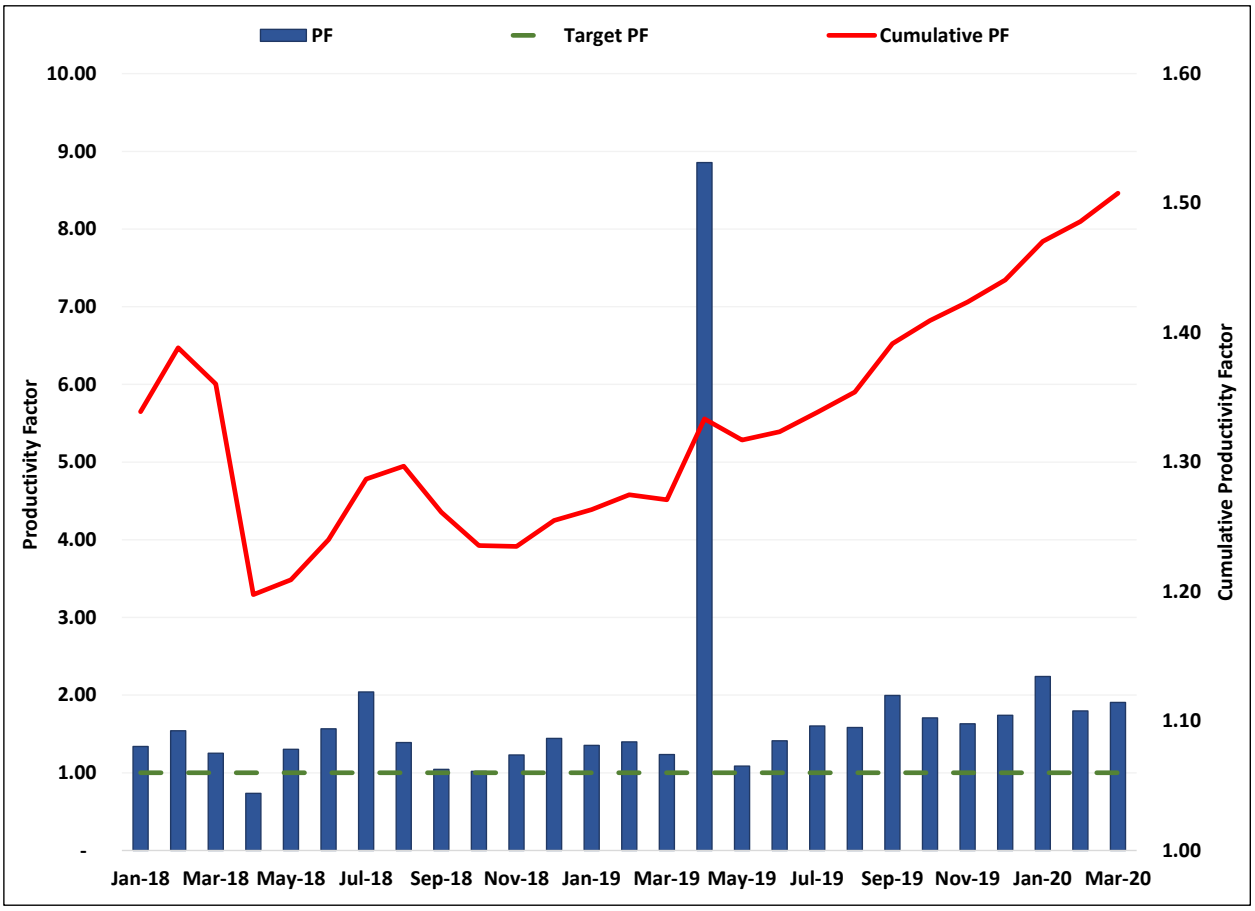
[35] June 6, 2018, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 18, page 21.; November 30, 2018, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 19, page 12.; November 22, 2019, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 20/21, pages 10, 14, 16 & 28-29.; June 5, 2020, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 22, pages 10, 22 & 26.; November 24, 2020, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 23, pages 8-10 & 15-16.; June 7, 2021, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 24, pages 68-69.; December 1, 2021, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 25, pages 17-18.

[36] Separate from the issue of GPC/SNC/Bechtel incorrectly CPI as PF, the use of the terms "Performance Factor" and "Productivity Factor" were used interchangeably during the project, and for consistency, the term "Productivity Factor" is used in this Report to mean actual hours incurred divided by earned hours.

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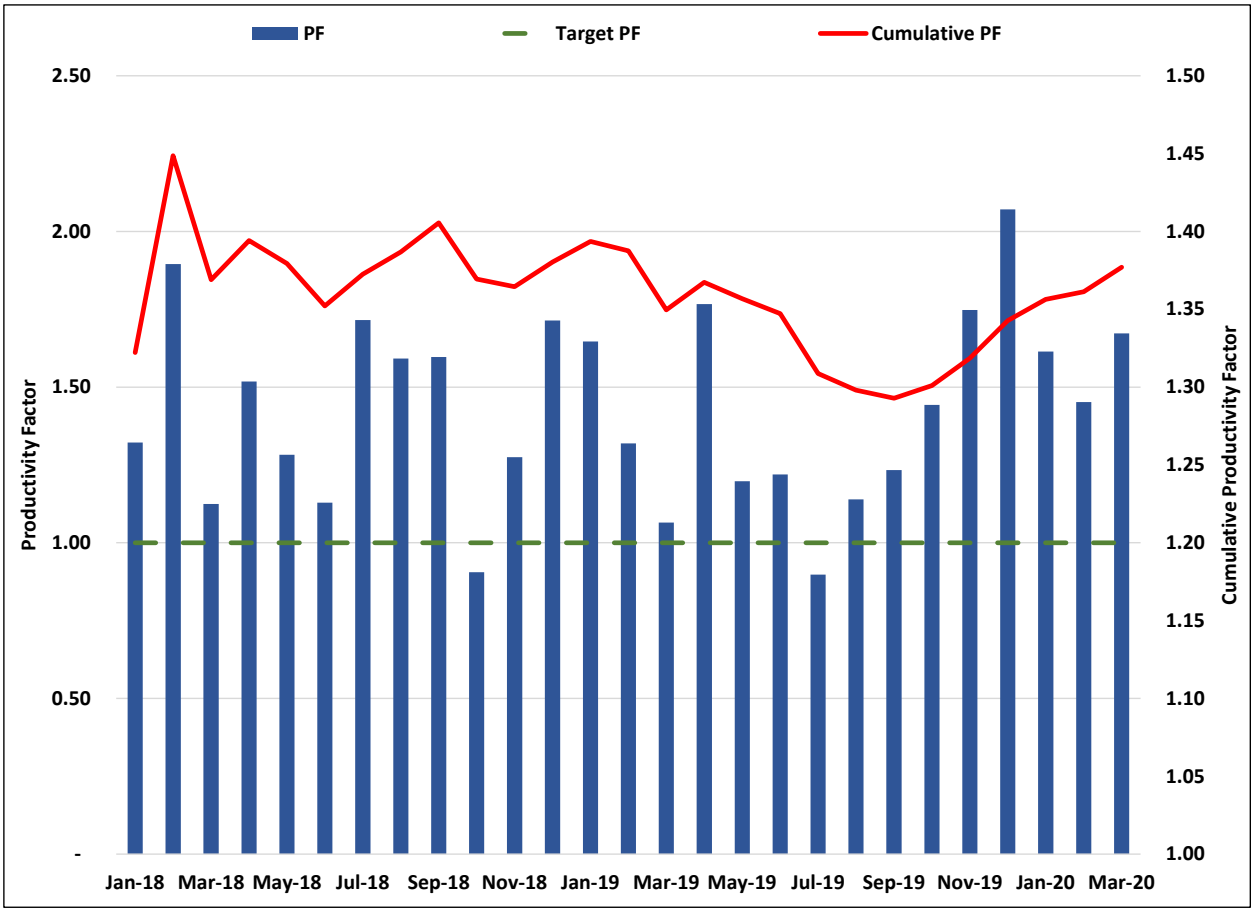
commodities on the Project as reported in Bechtel's scorecards. The following figures from **Attachment 2** show the periodic and cumulative PF in the containment building and the turbine building for Unit 3 and Unit 4 and how the cumulative target PF was never achieved.

Figure 3.3-2 Unit 3 Containment Building PF



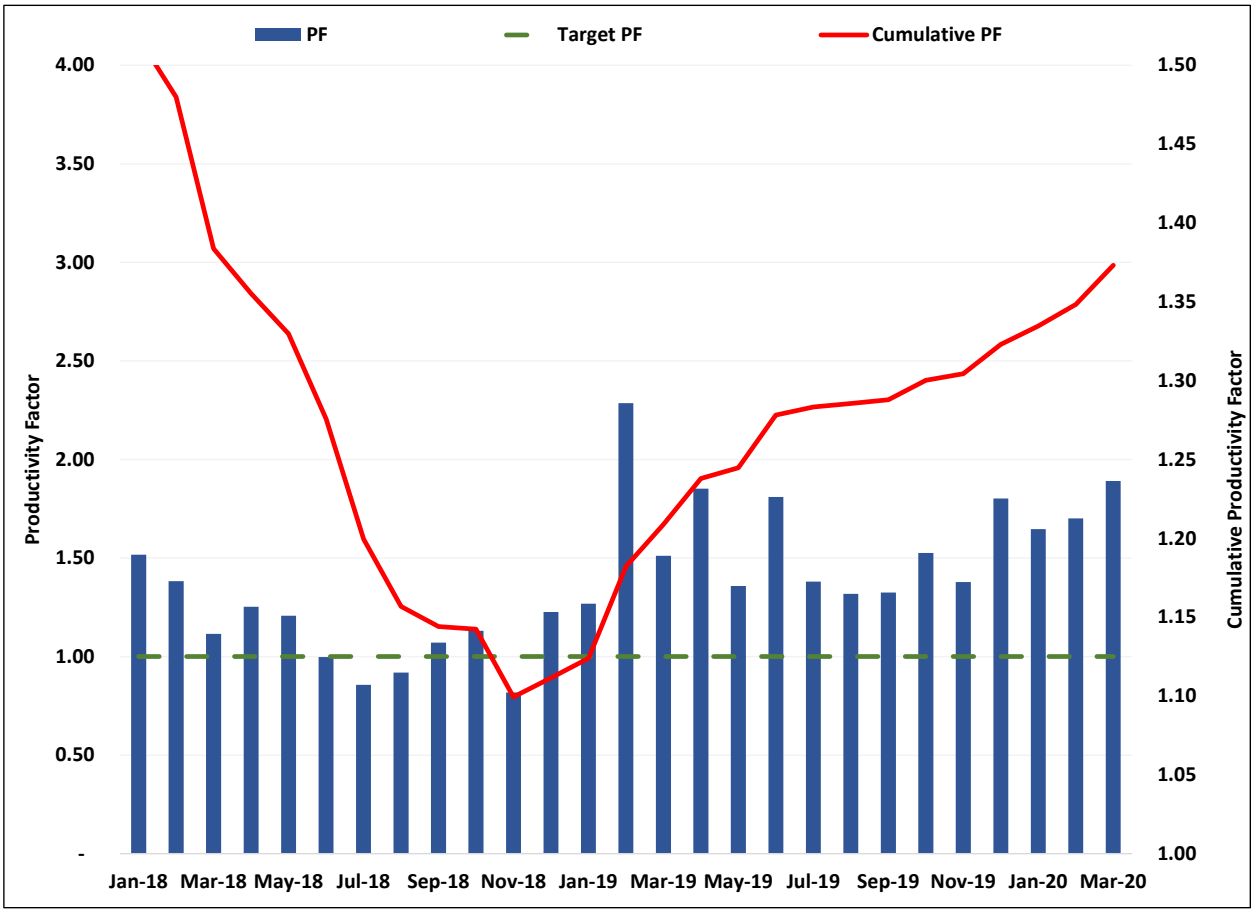
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Figure 3.3-3 Unit 4 Containment Building PF



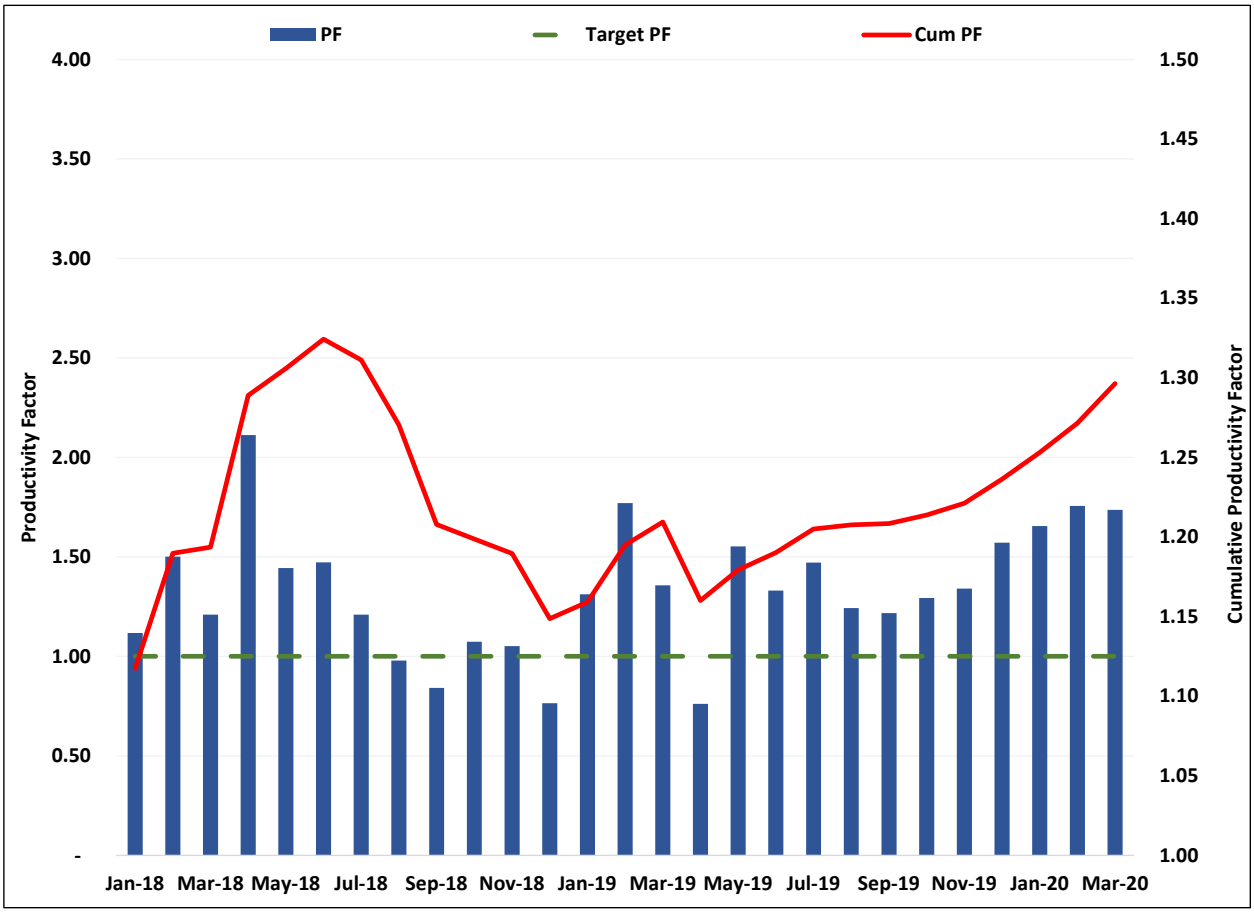
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Figure 3.3-4 Unit 3 Turbine Building PF



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Figure 3.3-5 Unit 4 Turbine Building PF



110. Despite the continual failure to achieve productivity, SNC failed to adjust the production planned in the IPS to accurately reflect actual performance and thereby reported inaccurate planned durations in the IPS forecasts rendering them unrealistic.

Mis-represented Actual Progress

111. In addition, SNC failed to report that actual monthly progress rarely met the IPS plan. This phenomenon is demonstrated by the earned value plan versus actual progress curves from **Attachment 2** for the Unit 3 containment building and critical commodities. The following figures show the actual cumulative earned progress on the Project lagged the plan, even after SNC re-baselined the Project IPS.

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Figure 3.3-6 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



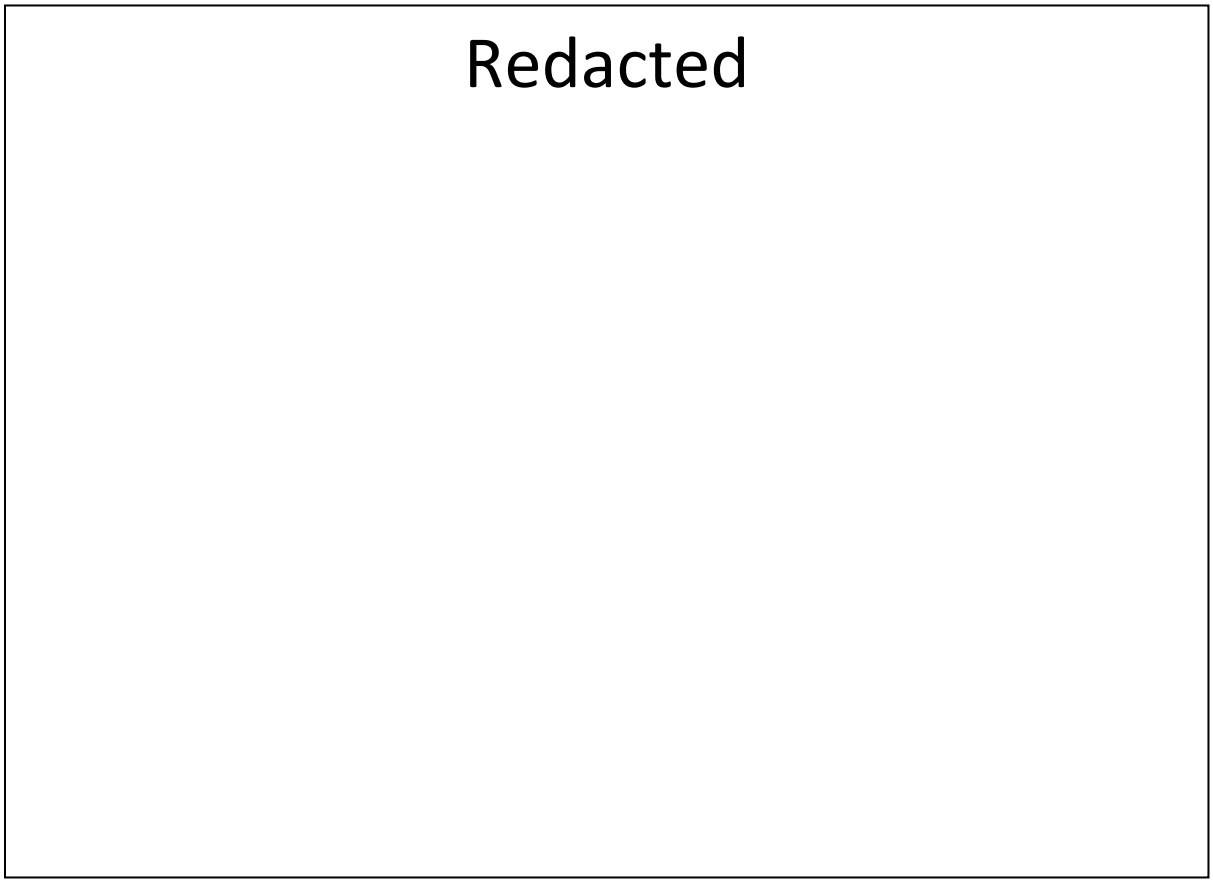
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Figure 3.3-7 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



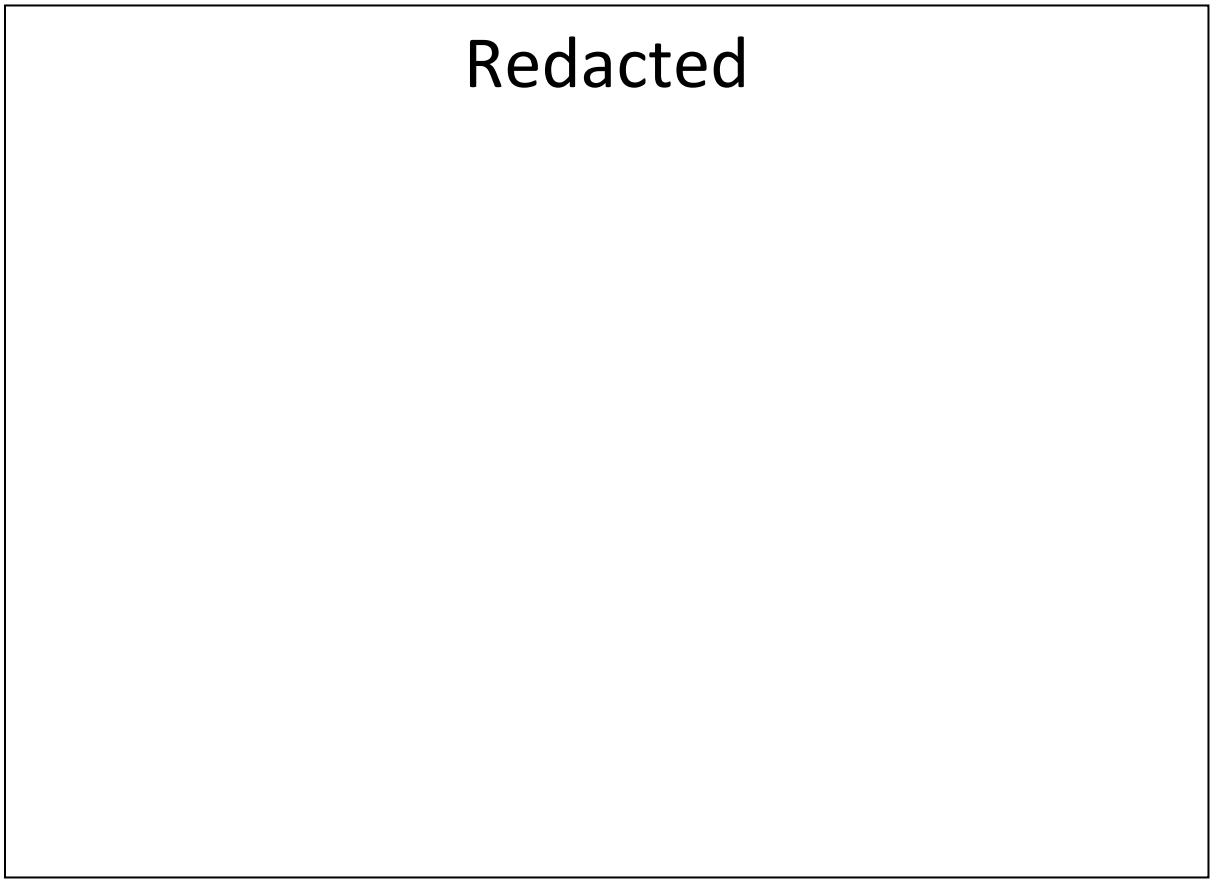
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Figure 3.3-8 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



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Figure 3.3-9 XXXXXXXXXXXXXXXXXXXXXXXXX



112. Bechtel continually indicated that construction progress and productivity were detrimentally impacted by turnover of systems, prioritization of construction testing, resequencing of work and stacking of trades.[37]

113. SNC's independent consultant, Vitale, conducted a series of motion studies spanning 2016 through 2019. This study determined that direct craft field labor was working productively for only 21.1% of a workday and identified that active supervision of direct labor was deficient.[38]

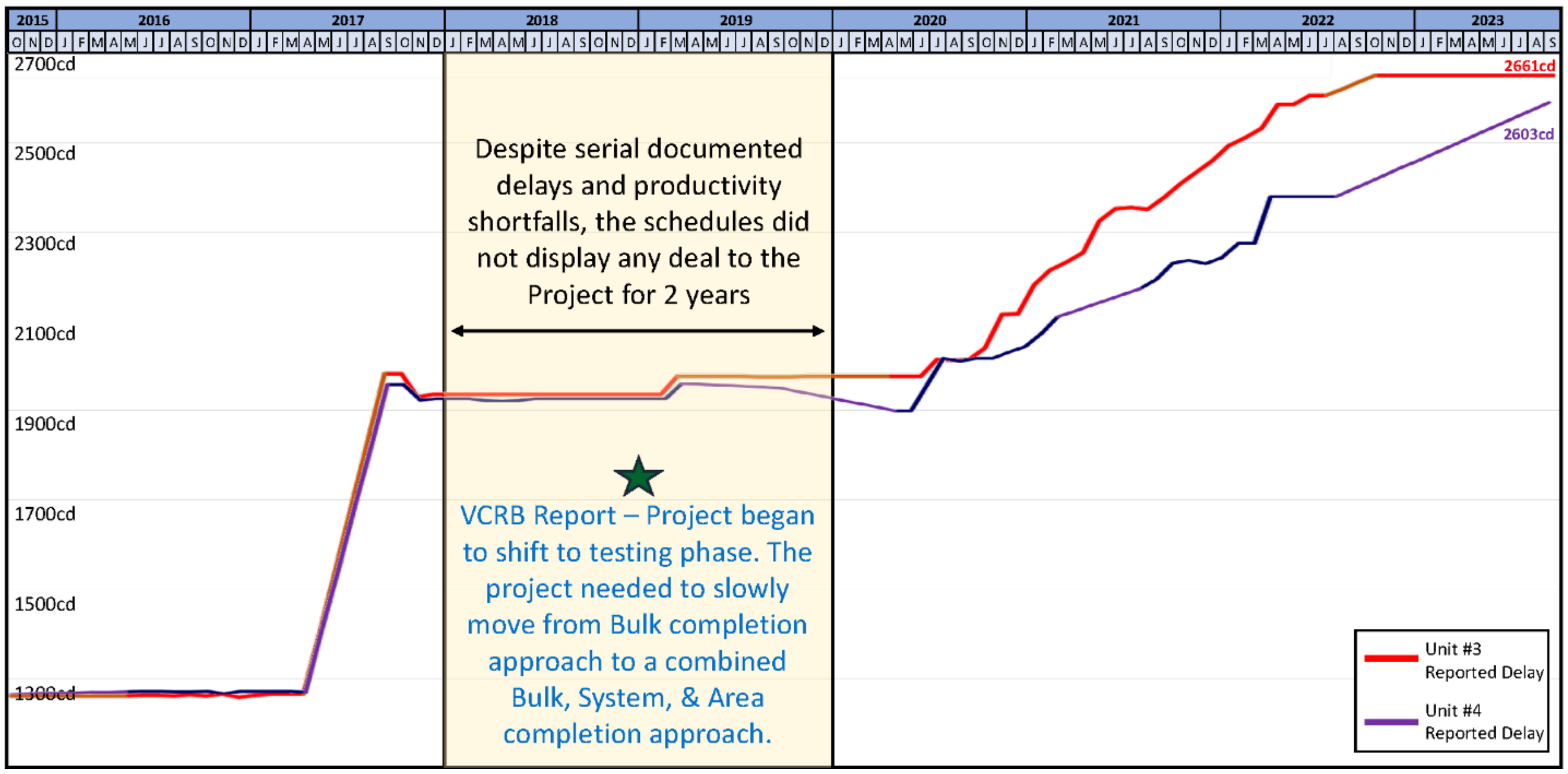
114. Contrary to the continual failure to achieve productivity, and earned hours, SNC failed to accurately report progress achieved each month in the IPS and thereby reported inaccurate progress status in the IPS forecasts rendering them unrealistic.

[37] February 3, 2022, letter from Bechtel to SNC, Subject: Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope from April 20, 2019, through May 2, 2021.
[38] August 2018, Vogtle No. 3 & 4 Units, RCC, Vitale & Associates, Productivity Analysis, June 27 – August 10, 2018.

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115. The figure below shows that, from 2018 to 2020, SNC reported in the IPS that the Project (Fuel Load milestone) in both Units 3 and 4 did not experience any delay. The IPS did not show delays despite the ongoing documented delays and productivity shortfalls, and despite contemporaneous reports that progress was not achieved in critical areas and trades.

Figure 3.3-10 Unit 3 and Unit 4 IPS Reported Fuel Load Forecast Completion



116. As shown above, for a prolonged period prior to VCM 17, the IPS generally trended sideways and reflected no delay. In contrast, the IPS re-baseline showed the accumulation of a two (2) year delay to Project completion that had not been reported in the IPS until VCM 17.

117. After VCM 17, for a period of two (2) years from 2018 to 2020, the Project completion again trended sideways and reflected no delay, despite identified and known performance difficulties and delay. Starting in 2020, and coinciding with the impacts of COVID-19, the IPS displayed a day-for-day delay for a period of 23 months from September 2020 to July 2022. This reflected the accumulation of delays that were not reported in the first two years following VCM 17.

118. In February 2019, KPMG prepared an audit that revealed that, while the Project had a schedule change management process, it did *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX* In addition, the existing schedule impact

assessment process *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[39] Thus, detailed changes to the schedule which masked delay, were potentially not approved, or known to SNC and SNC thus mis-represented and mis-reported progress.

119. The inaccurate progress reporting and forecast in the monthly updates to the IPS rendered them unrealistic and unreliable.

Inadequate Resource Loading

120. Inadequate resource loading in the IPS rendered the IPS unrealistic.

121. The following tables show the number of task dependent activities which were not resource loaded as reported in the October 2018 Construction Schedules for Unit 3 and Unit 4.

Figure 3.3-11 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
XXXXXXXXX	**XXXX XXXXXXXXX XXXXXXXXX**	**XXXX XXXXXXXXX XXXXXXX XXXXXX XXXXXXX**	**X XX XXXX XXXXXXXX XXXXXXXXX XXXXXXX XXXXXXX XXXXXXX**
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Figure 3.3-12 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
XXXXXXXXX	**XXXX XXXXXXXXX XXXXXXXXX**	**XXXX XXXXXXXXX XXXXXXX XXXXXX XXXXXXX**	**X XX XXXX XXXXXXXX XXXXXXXXX XXXXXXX XXXXXXX XXXXXXX**
XXX	XXXX	XXXX	XXX
XXXXXXXXXXXXXXXX	XXXX	XXXX	XXX

[39] February 8, 2019, Vogtle Project Controls Maturity Assessment, KPMG, Schedule Reporting, page 40.

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Figure 3.3-12 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
XXXXXXXXX	**XXXX XXXXXXXXX XXXXXXXXX**	**XXXX XXXXXXXXX XXXXXXX XXXXXX XXXXXXX**	**X XX XXXX XXXXXXXX XXXXXXXXX XXXXXXX XXXXXXXX XXXXXXX**
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XXXXXXXXXXXXXXXXXXXXX	XXXX	XXXX	XXX
XXXXX	XXXX	XXXX	XXX

122. Most task-dependent activities were not resource loaded in the Project schedules. Additionally, some of the Project scopes were loaded using "level of effort" instead of discrete (task-dependent) activities. The level of resource loading present in the IPS proved to be insufficient and did not provide enough granularity for accurate monitoring of construction work.

123. The following are additional examples of SNC's inadequate resource loading in the IPS.

- An internal audit from November 2018 identified the need to resource load the activities of the Level 3 IPS to accurately monitor activities. The audit observed that there was a contractual obligation to, *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[40]
- An independent audit prepared by KPMG in February 2019 identified a deficiency in resource loading due to *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[41]

<u>Missing and/or Incorrect Logic</u>

124. Missing and/or incorrect logic in the IPS rendered the IPS unrealistic. The IPS suffered from missing activities and incorrect logic even before VCM 17 and as early as 2012.[42] This deficiency in the IPS continued after VCM 17 and a complete IPS was to be developed as part of the transition to SNC

[40] November 29, 2018, Vogtle 3&4 Schedule Assessment - Report No. GPC2018-08, page 12.
[41] February 8, 2019, Vogtle Project Controls Maturity Assessment, KPMG, Schedule Reporting, page 42.
[42] December 7, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 7, page 21.

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management of the Project and IPS.[43] The absence of activities and logic, especially for critical path work, led to an unreliable forecast of milestones and Project completion.

125. The following examples illustrate the known missing and incorrect logic in the IPS that preceded VCM 17 and continued after VCM 17.

- A Defense Contract Management Agency (DCMA) 14-Point Assessment[44] was performed on the February 2016 and September 2016 IPS progress updates (among other progress updates) and identified that the schedule health was suspect. In these assessments, out of a maximum possible score of 100, a good score is considered higher than 75, an average score is between 50 and 75, and a poor score is below 50. The February 2016 progress update scored a value of 44, while the September 2016 progress update scored a value of 51.[45] SNC was contemporaneously informed that these scores indicated that the schedule health was suspect and that the forecasts of schedule milestones was questionable. [46]
- In March 2018, while preparing for the Project Management Board meeting it was noted *XXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[47]
- The November 2018 Schedule Management Assessment noted several concerns relating to missing schedule logic, stating that *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[48] In addition, approximately 1% of Bechtel activities were shown to be missing a logical predecessor or successor.[49]
- In addition, the DCMA 14-Point Assessment of the November 2018 progress update received "poor" scores of 33 for the Unit 3 construction schedule and 28 for the Unit 4 construction schedule.[50]

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[43] June 6, 2018, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 18, page 20.
[44] DCMA 14-Point Assessment is a rigorous set of schedule quality guideline developed by the US Defense Contract Management Agency to evaluate the construct of a schedule and if it adheres to best practices that are considered to the successful management of a project.
[45] SNC performed the DCMA 14-Point Assessment reports as requested in STF-101-1.
[46] November 17, 2016, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 15, page 20.
[47] March 1, 2018, PMB Meeting, Notes, page 3.
[48] November 29, 2018, Vogtle 3&4 Schedules Assessment – Internal Audit Report No. GPC2018-08, page 5.
[49] November 29, 2018, Vogtle 3&4 Schedules Assessment – Internal Audit Report No. GPC2018-08, page 7.
[50] December 7, 2018, Deltek Acumen Fuse Ribbon View Report, November 2018 Update to TS Attachment STF-9001.

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- The schedule continued to receive mostly "poor" scores in June 2019, with scores of 44 for the Unit 3 construction schedule and 31 for the Unit 4 construction schedule.[51]
- An SNC internal audit, issued in November of 2021, identified the continued failure to meet acceptable thresholds for missing logic, as well as other schedule health criteria, as defined by the DCMA 14-Point Assessment.[52]

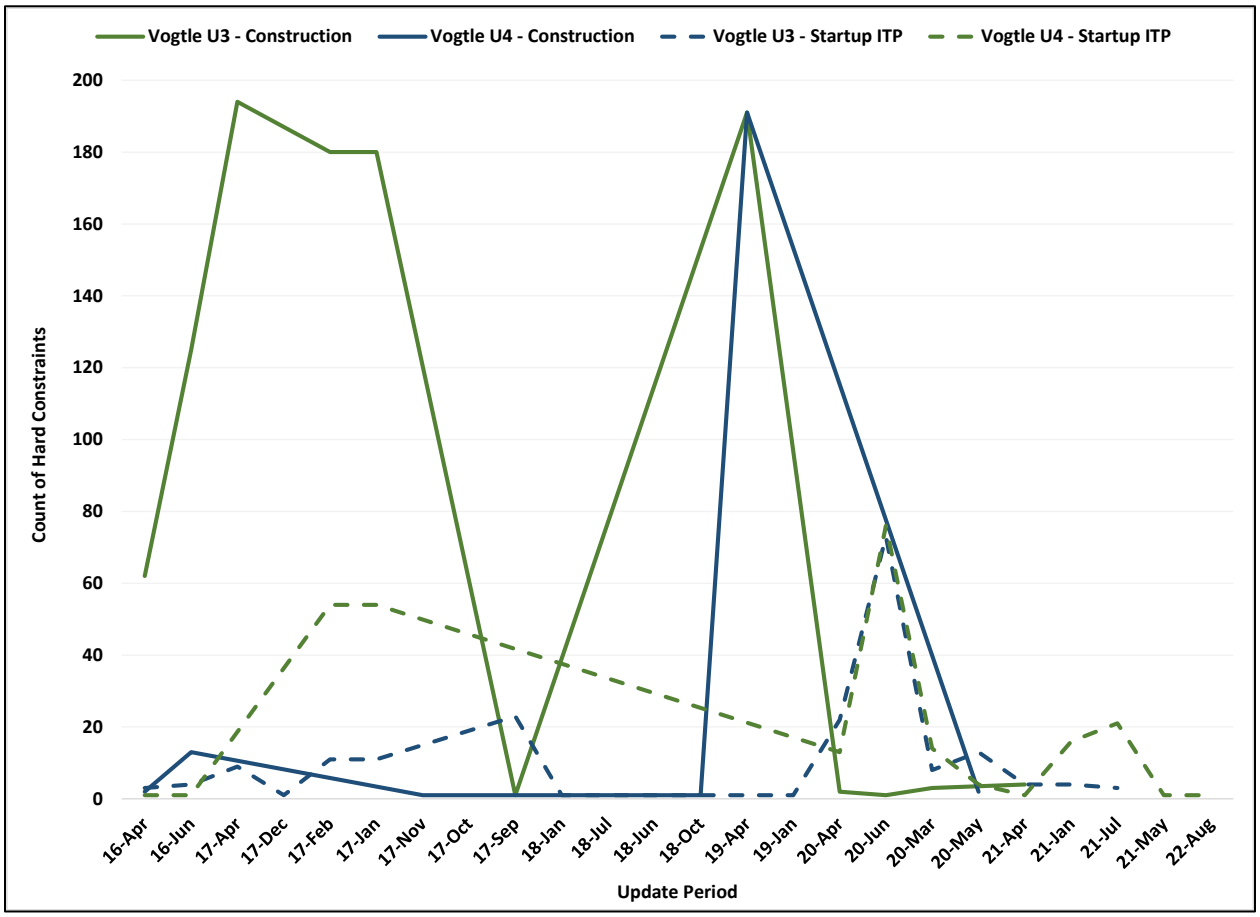
Inappropriate Use of Constraints and Milestones

126. SNC inappropriately used milestones and constraints in the IPS that masked the lack of progress and resultant delays. The IPS exhibited the inappropriate use of constraints before VCM 17 as various activities were identified as being "pinned" by constraints. As a result of applying constraints to an activity, the start date forecasted for the activity will not deviate in an update, while the predecessor activities were delayed by more than 100 days.[53] Despite this known deficiency, hard constraints were used to mask delay in IPS progress updates and this issue was again identified in February 2020 as an impediment to accurate forecasting of Project completion.[54] The following illustrates the number of constraints, by type of constraint, over time in the construction and ITP schedules for Units 3 and 4.[55]

[51] June 6, 2019, Fuse Analyst Report, DCMA 14 Point, TS Attachment STF-86 20190525.
[52] November 17, 2021, Vogtle 3&4 Schedule Management Audit – Internal Audit Report No. GPC2021-17, page 13.
[53] June 17, 2016, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 14, page 18.
[54] June 5, 2020, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 22, page 27.
[55] Vogtle Monthly Progress P6 Schedule Data - 16-Apr, 16-Jun, 17-Jan, 17-Feb, 17-Apr, 17-Sep, 17-Oct, 17-Nov, 17-Dec, 18-Jan, 18-Jun, 18-Jul, 18-Oct, 19-Jan, 19-Apr, 19-Jul, 20-Mar, 20-Apr, 20-May, 20-Jun, 21-Jan, 21-Apr, 21-May, 21-Jul, 22-Jan, 22-Aug.

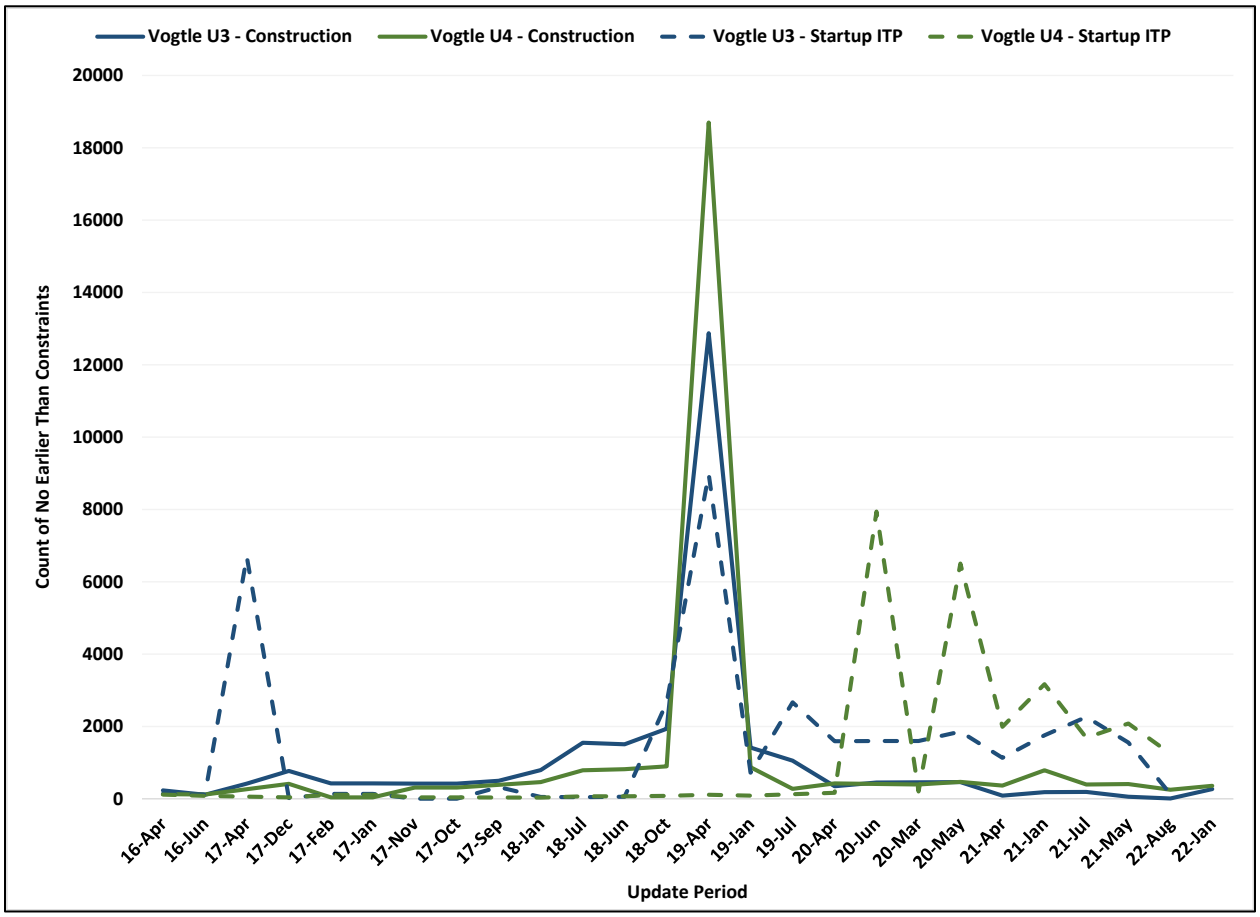
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Figure 3.3-13 Count of Hard Constraints Over Time – Unit 3 and Unit 4, Construction and Start / ITP Schedules



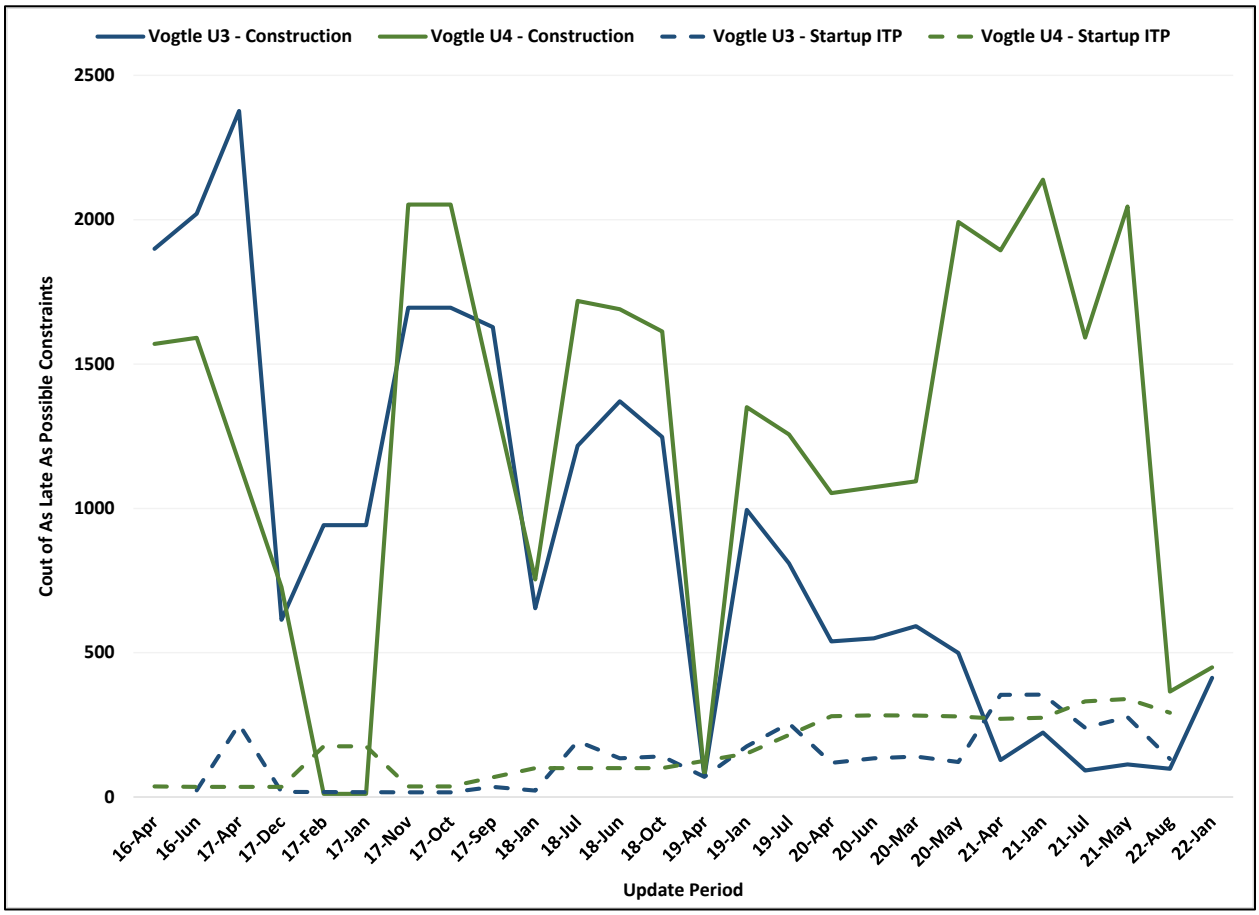
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**Figure 3.3-14 Count of No Earlier Than Constraints Over Time –
Unit 3 and Unit 4, Construction and Start / ITP Schedules**



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**Figure 3.3-15 Count of as Late as Possible Constraints Over Time –
Unit 3 and Unit 4, Construction and Start / ITP Schedules**

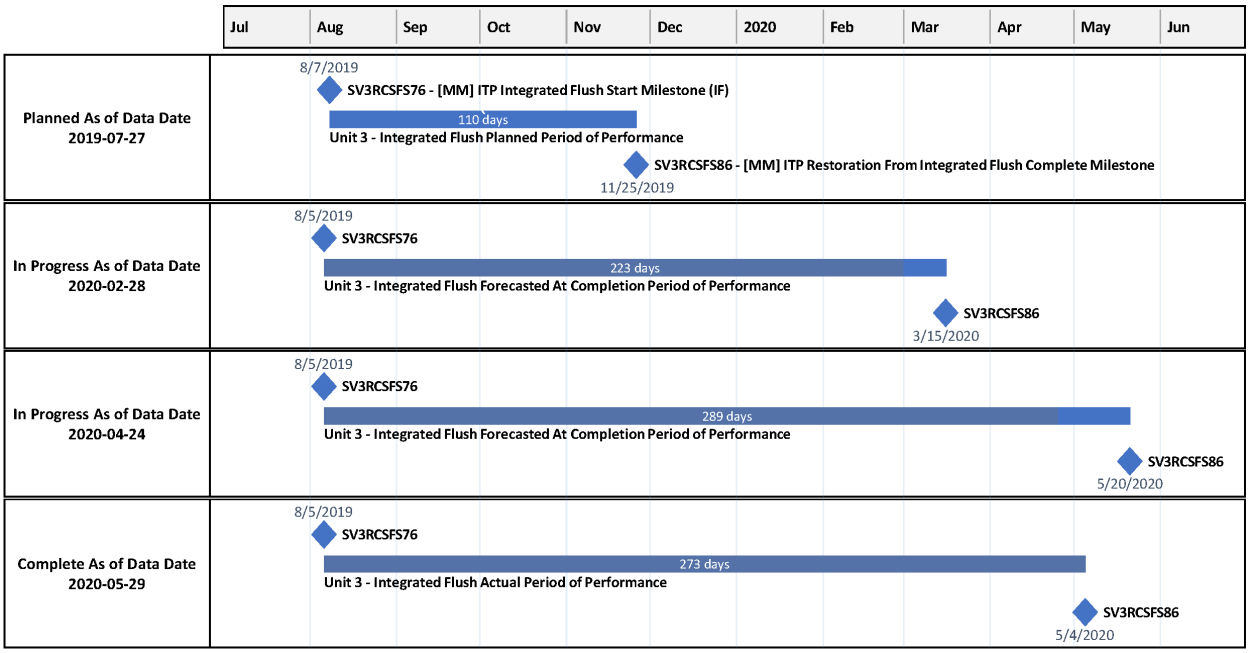


127. Additionally, SNC reported progress based on the achievement of start milestones as opposed to finish milestones. This selective reporting provided a false sense of progress on the Project. For example, the start of Unit 3 integrated flush was targeted for and was achieved in early August 2019 and was to be completed in approximately four months. However, the actual performance of the integrated flush remained incomplete six months later. The below figure shows the as-planned and as-built data from the Project schedules for the integrated flush activities in Unit 3. This created a misleading impression that progress was achieved by completion of the start milestone.[56]

[56] June 5, 2020, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 22, page 10.

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Figure 3.3-16 Unit 3 Integrated Flush Start and Finish Milestones



128. This reporting methodology was discussed during the testimony associated with VCM 20/21 which highlighted the variance between achievement of start milestones and the deficit of expected hours.[57]

3.3.2.4 Conclusion: The IPS Was Unrealistic

129. The magnitude of deficiencies in the Project's IPS was a consistent concern as SNC failed to adequately manage the IPS schedule and fulfill the industry practices that "*Schedules are realistic and understood*."[58] After SNC assumed control of the IPS in VCM 17, SNC inaccurately portrayed actual progress and forecasted progress, which resulted in mis-informed management decisions and exacerbated known problems that contributed to additional delays, avoidable cost growth, and quality deficiencies.

130. Rather than show delay, a series of unrealistic adjustments were made to the schedule forecast which masked delay and reported (artificial) adherence to the schedule. SNC reduced durations, divided activities into multiple smaller scopes, changed constraints, revised logic, and postponed activities to later periods and after testing started to maintain the completion dates.

[57] November 11, 2019, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 20/21, page 10.
[58] March 29, 2017, Plant Vogtle Units 3&4 Project Management Board, page 3.

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131. J.S. Held's analysis demonstrates the disconnect between the actual progress achieved in the progress curves to the reported progress and forecasted finish dates in the IPS which rendered the IPS unrealistic and unreliable. Subsequently, the execution of the Project using the unrealistic IPS contributed to overall Project delay, poor productivity, and increased costs.

3.3.3 Unrealistic CPI Projections Impacting Cost Management

132. The multitude of issues discussed throughout this Report which were encountered in the development of Units 3 and 4 materialized in labor inefficiency and cost increase. A direct measure of this, as it specifically relates to cost, is the CPI. Equations that use a performance index like CPI and/or Schedule Performance Index (SPI) should consider the stability of this factor because it is used to forecast future work. An unreliable result such as an unrealistic EAC and management of Project resources may occur if the CPI and/or SPI are not stable. Therefore, CPI is crucial to Project management to inform on current and historic project conditions, forecast future performance, and form the basis of management decisions.

133. The CPI achieved throughout the duration of the Project was exceedingly poor and continued to worsen, and SNC, Bechtel, and the remaining Project stakeholders were aware of this issue. Despite this, SNC and Bechtel failed to make informed decisions based on the historical performance of the Project and, ultimately, reported unrealistic EACs.

134. The Project consistently failed to achieve planned CPI rates and SNC failed to fully appreciate the drivers of these failures, how to remediate them, and ultimately forecasted that performance would improve despite observed trends pointing to a continued decline. AACE cites that many years of project data have shown that project managers tend to be optimistic when evaluating EACs.

> *Research has also shown that beyond 15-20% project complete, significant improvement in the cost performance index is rarely achieved.* [59]

135. Specifically, the VPMB, comprised of representatives from each of the members of the ownership group, stated in the monthly progress presentations that production had not achieved expectations and CPI was worsening month-over-month, and yet continued to forecast an improvement in CPI in each of the months to come. One example of this repeated behavior was observed in the June 2021 VPMB presentation where the VPMB acknowledges that the Project is failing to meet CPI forecasts

[59] AACE International Recommended Practice, 80R-13, Estimate at Completion (EAC), Rev. December 3, 2019.

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in multiple areas and yet still forecasts improvements.

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136. This demonstrated improper use of CPI as an aspirational target rather than a historically informed, achievable measure of cost efficiency. SNC was continually forecasting unrealistic CPI values on a go-forward (also referred to as "to-go") basis as shown below in **Figure 3.3-17 Actual v. Project CPIs for Direct Labor in Unit 3**, which shows the actual CPI compared to the projected CPI for direct labor in Unit 3.[61]

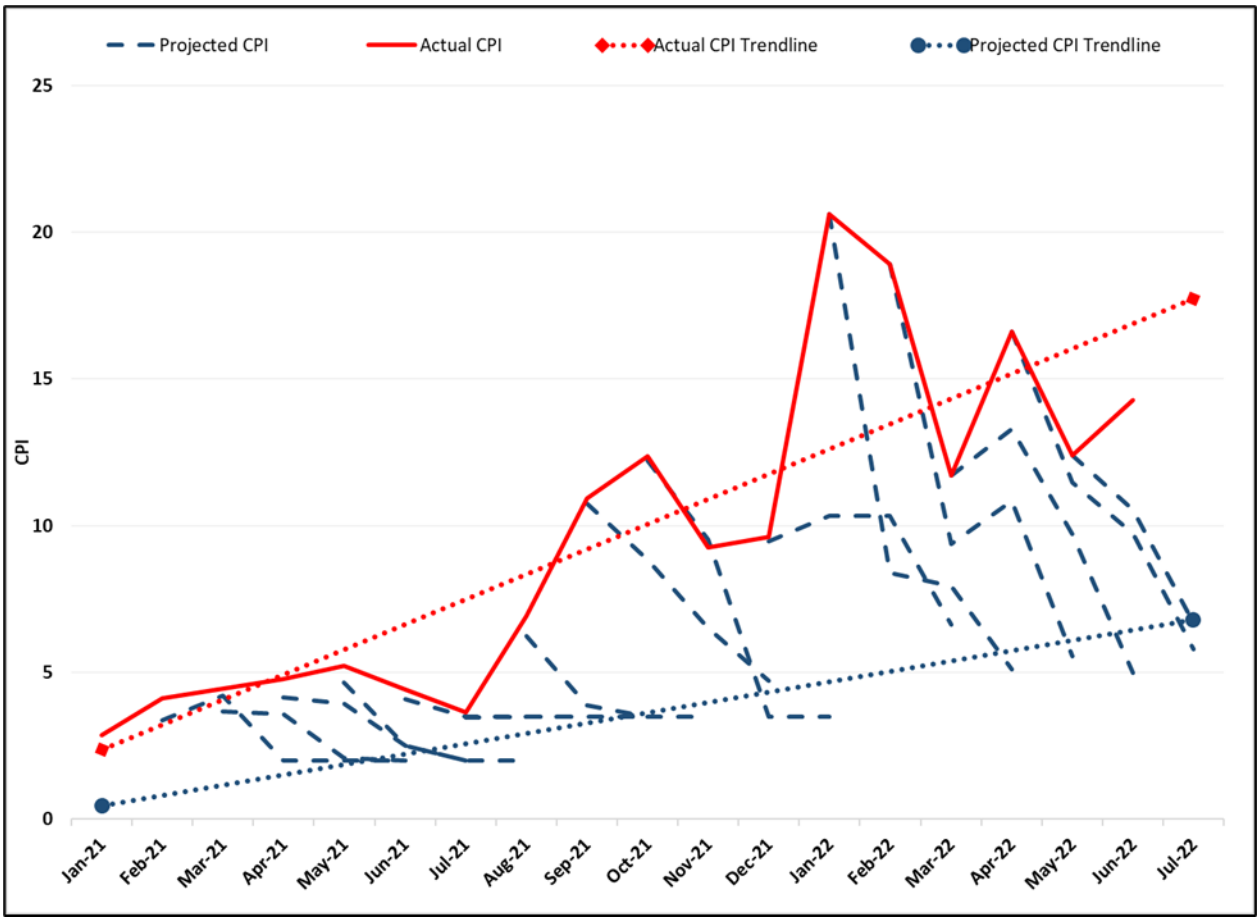
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[60] June 30, 2021, Plant Vogtle Units 3&4 Project Management Board, pages 11 and 13.

[61] The reported CPI values in Figure 3.3-17 were observed in the January 2021 through July 2022 Vogtle Project Management Board presentations.

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Figure 3.3-17 Actual v. Projected CPIs for Direct Labor in Unit 3

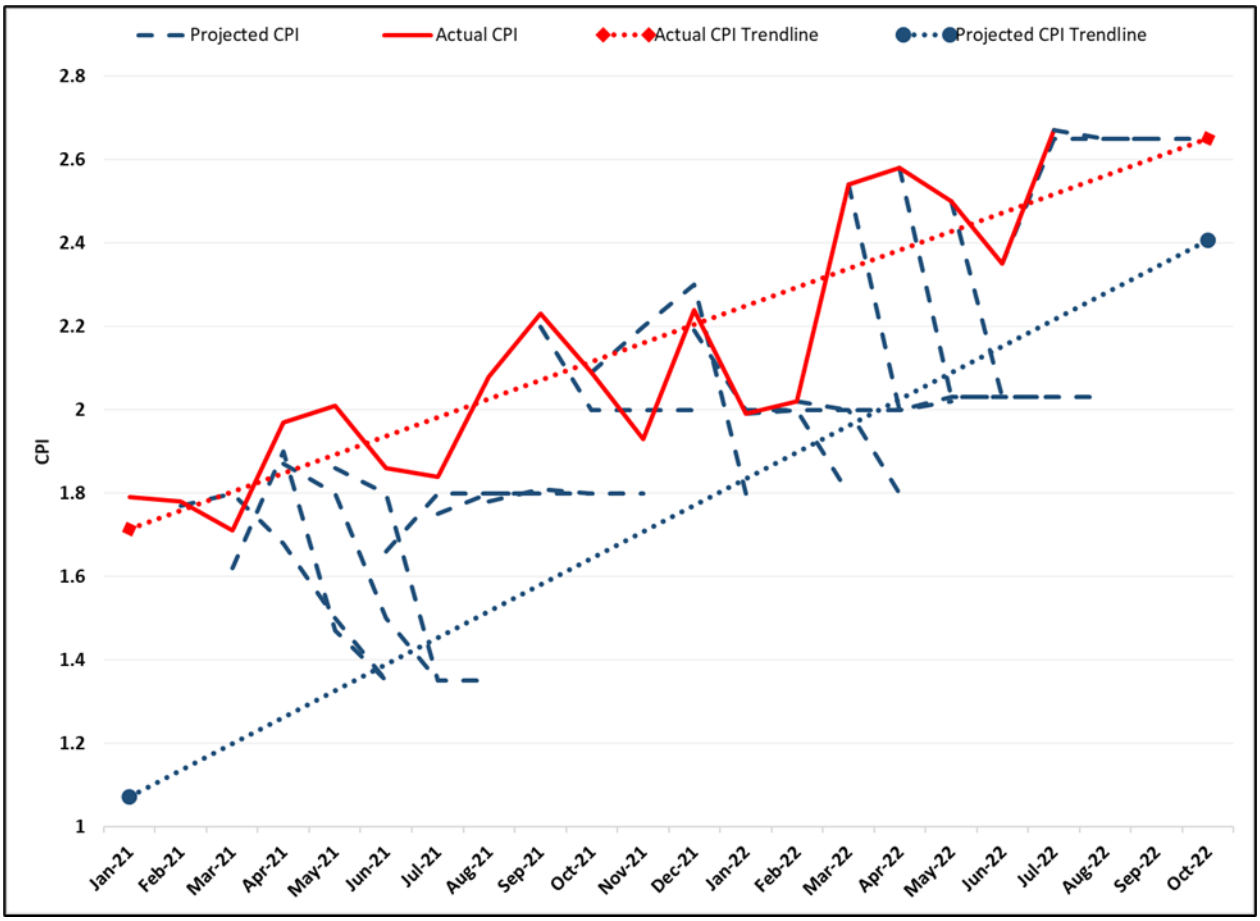


137. While the overall magnitude of the Unit 4 CPI was not as bad as Unit 3, a similar trend was observed as shown below in **Figure 3.3-18 Actual v. Projected CPIs for Direct Labor in Unit 4**.[62]

[62] The reported CPI values in Figure 3.3-18 were observed in the January 2021 through October 2022 Vogtle Project Management Board presentations.

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Figure 3.3-18 Actual v. Projected CPIs for Direct Labor in Unit 4

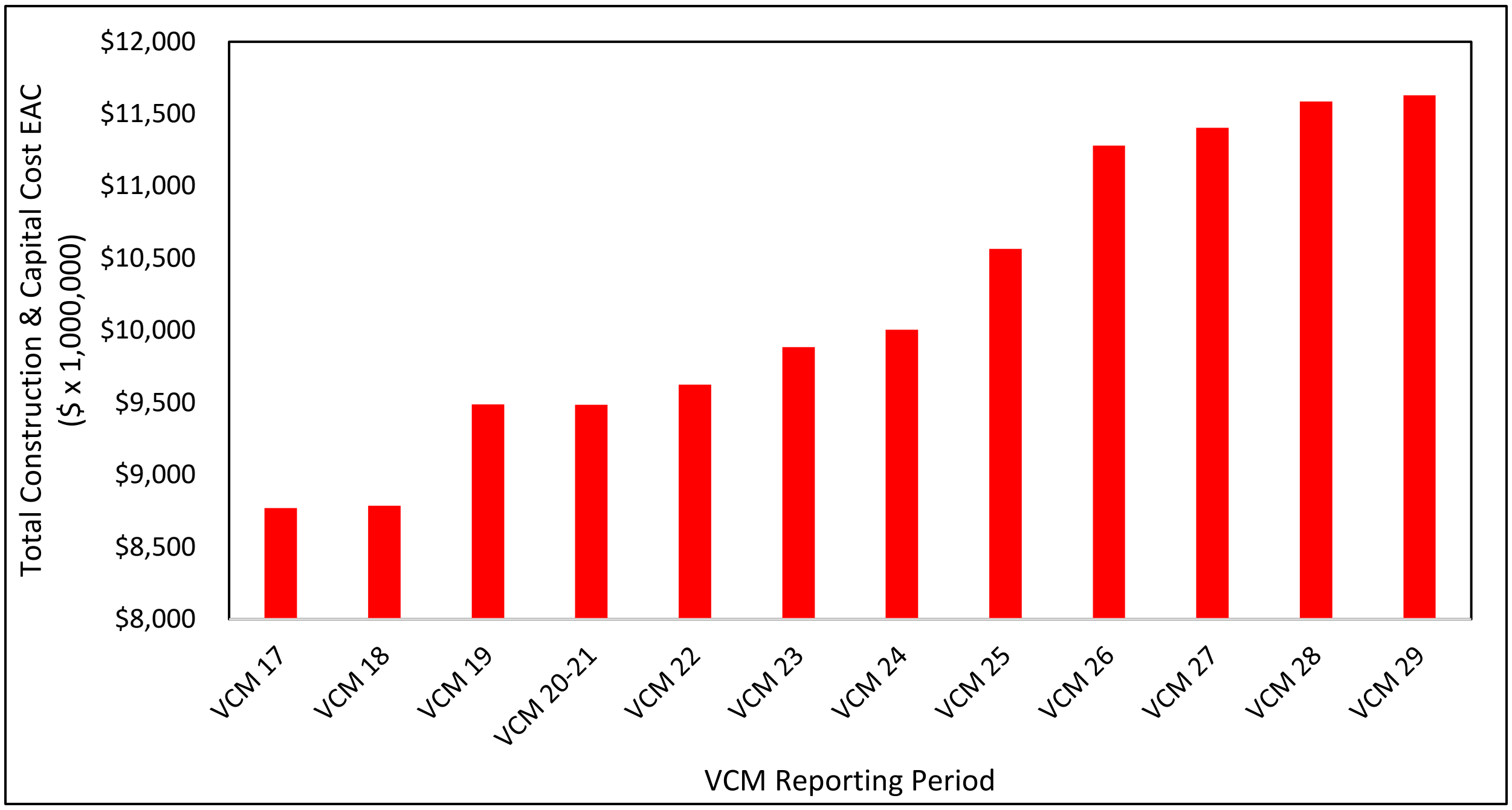


138. Failure to manage and estimate CPI properly impacts the success of a project in a variety of different ways. An accurate CPI forecast is necessary for the development of an accurate EAC, which serves as the underlying basis for further funding and overall project decisions. Bechtel and SNC's poor and unrealistic CPI projections directly supported the reporting of unachievable, misleading EACs to the Company and Co-owners. The Company in turn presented these EACs to the Commission. This trend becomes obvious looking at the regularly reported increases to the Project's final EAC. As shown in **Figure 3.3-19 Final EAC**, the Company reported an increase to the Project's final EAC for both units in nearly every VCM reporting period after VCM 17.[63]

[63] The reported Total Construction & Capital Cost EAC in Figure 3.3-19 were observed in the VCM 17 through VCM 29 reports.

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Figure 3.3-19 Final EAC



139. However, the severity of the overall increase to the EAC would have been known or more accurately represented if SNC had properly utilized the realistic CPI.

3.3.4 Transition from Bulk Construction to System Testing

140. Power plant construction requires the protracted and repetitive installation of piping and electrical systems, and typically initially focuses on the "bulk" installation of these items and the requisite racks, hangers, and structural components, to gain the efficiency of labor, equipment, safety measures, and scaffolding working in the same areas and managing congestion. Using this process, different piping, and electrical systems, including different sizes and material types, can be installed simultaneously as the work crews move through constructing multiple systems simultaneously.

141. The shift to testing the systems typically occurs when the system components and connection have reached a completion point benefiting from scale which minimizes the testing processes by maximizing the completeness of the respective system. In essence, more complete systems can be tested and turned over more efficiently. Bechtel described this approach.

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142. When Bechtel joined the Project in 2017, it planned that the transition to system turnover would occur after completion of the bulk installation and each plant system would be tested and turned over from construction to operations in a complete, or near complete state. This was reflected in the Project schedule.

143. In October 2018, SNC changed this approach and the ITP process from the "bulk" method originally planned, to a series of "partial releases" to accelerate the Project schedule. Bechtel described the change in approach which led to the PRT process and indicated the Project schedule was changed by SNC from the bulk approach to the partial system testing process.

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144. Bechtel subsequently observed that despite the changes in planning, the focus on system turnovers would not result in meeting the Target Completion Date.

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145. The change to the system approach was an effort to improve schedule performance and achieve specific milestone activities at a point of completion sooner than originally planned. Despite the change in approach, there has not been any indication that any analysis was performed by SNC that would suggest how these changes would impact productivity. The resulting impact was growth in the PRT process and documentation that was not contemplated when the process and procedures were implemented. There was a significant number of partial releases that were never anticipated

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within Bechtel's original execution planning. The result was described by Bechtel within its Change Order Request.

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146. The Bechtel Monthly Status Report (MSR) for March 2018 was the first to include a narrative section (Section 4.4) dedicated to System Turnover representing the planning involved in the switch from Bulk System Turnover to Partial Turnovers. Bechtel noted this "break out," which was a small portion of the schedule showing a targeted system, to accelerate Project turnover ahead of the progression of logic originally developed in the schedule.[69] Subsequent reports issued by Bechtel continued to include the schedule excerpts for notable systems. The decision to switch to the systems testing approach forced Bechtel to reprioritize work based on the turnover milestones.

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147. Bechtel noted that work that did not *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX* was being deferred until some later date. This included work that was previously critical path and preempted logic that was built into the schedules. Deferring work also led to the growth in utilizing both the PRT and the Construction Work Authorization (CWA) processes.

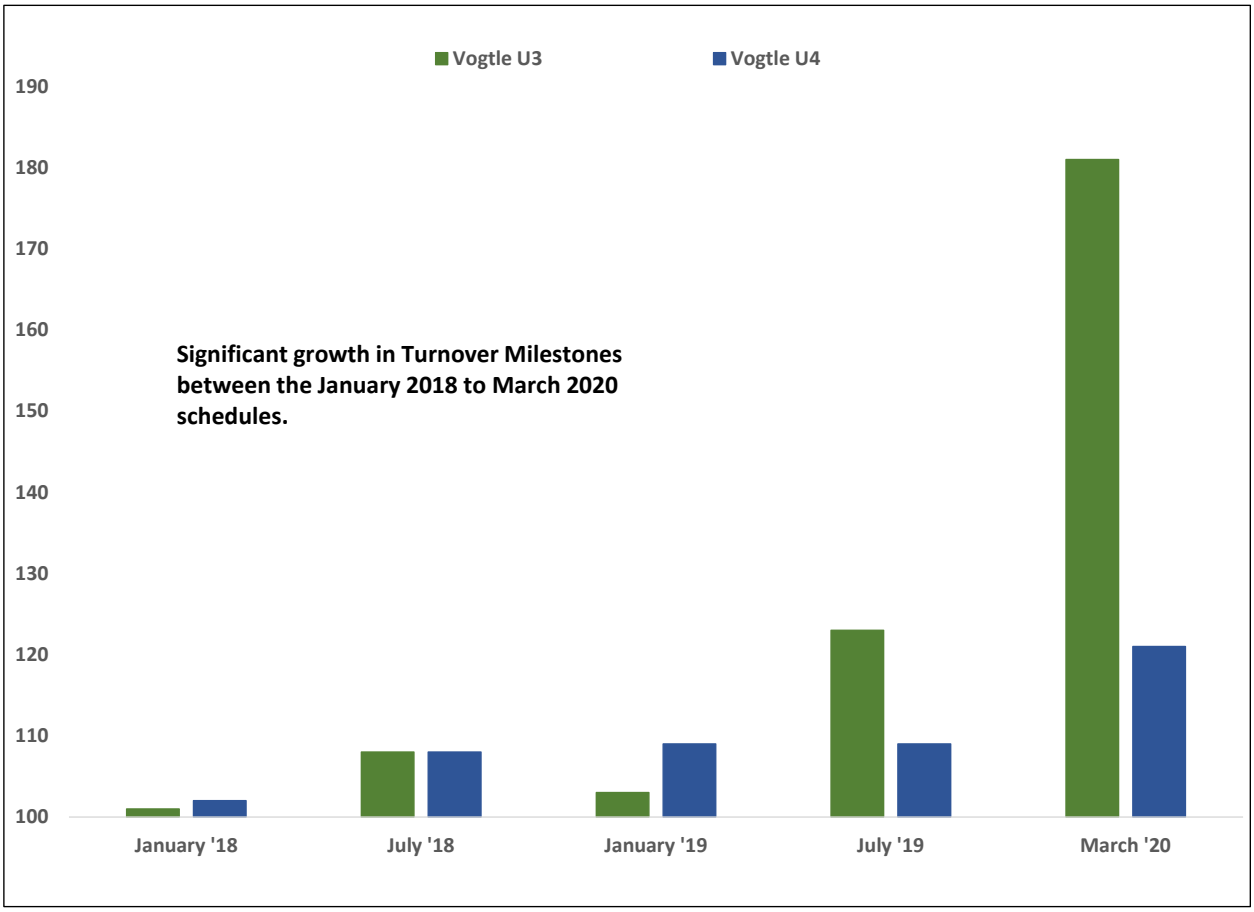
148. To prioritize the testing process, the planned systems were subdivided into smaller components in both the Project schedule and in the daily Project planning. In some instances, complete systems were redefined into multiple systems within the Project schedule and these systems were then often further reduced in the field to complete the testing. As shown below in **Figure 3.3-20 Turnover Milestones**, the result was a significant increase in subsystem milestones within the IPS.

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[67] February 3, 2022, letter from SNC to SNC, Subject: Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope Impacts from April 20, 2019 through May 2, 2021, page 3.
[68] Bechtel named its Change Order Request "PEIAS" or Procurement, Engineering, ITP (Initial Testing Program) and Additional Scope.
[69] March 2018, Bechtel Monthly Status Report, page 27.
[70] July 2019, Bechtel Monthly Status Report, page 50.

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Figure 3.3-20 Turnover Milestones



149. A comparison of the system completion milestones in the IPS using the January 2018 and March 2020 schedules indicated the total system milestones grew from 101 to 186, an 86 percent increase. While some of this can be part of the expected further definition of Project activities within a schedule as a Project progresses, the growth was due to the subdivision of complete systems, as shown for selected systems within **Table 3.3-1 Turnover Milestone Comparison**, due to the focus on completing certain partial systems, which deferred the remaining work within that system.

Table 3.3-1 Turnover Milestone Comparison

System	January 2018	March 2020	Growth
CAS	1	6	500%
DWS	1	4	300%
ECS	2	11	450%
EFS	1	5	400%
MHS	1	5	400%

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Table 3.3-1 Turnover Milestone Comparison			
System	**January 2018**	**March 2020**	**Growth**
RCS	2	6	200%
RXS	1	5	400%
SES	1	6	500%
SFS	1	3	200%
SGS	1	5	400%
Total	**101**	**186**	86%

150. Throughout Bechtel's Monthly Status Reports between April 2018, and December 2020, there were a significant number of references to impacts, delays, and prioritizations due directly to changes related to system turnover. Examples included the following:

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[71] July 2019, Bechtel Monthly Status Report, page 49.
[72] August 2019, Bechtel Monthly Status Report, page 55.
[73] October 2019, Bechtel Monthly Status Report, page 55.
[74] January 2020, Bechtel Monthly Status Report, page 49.
[75] November 2019, Bechtel Monthly Status Report, page 55.

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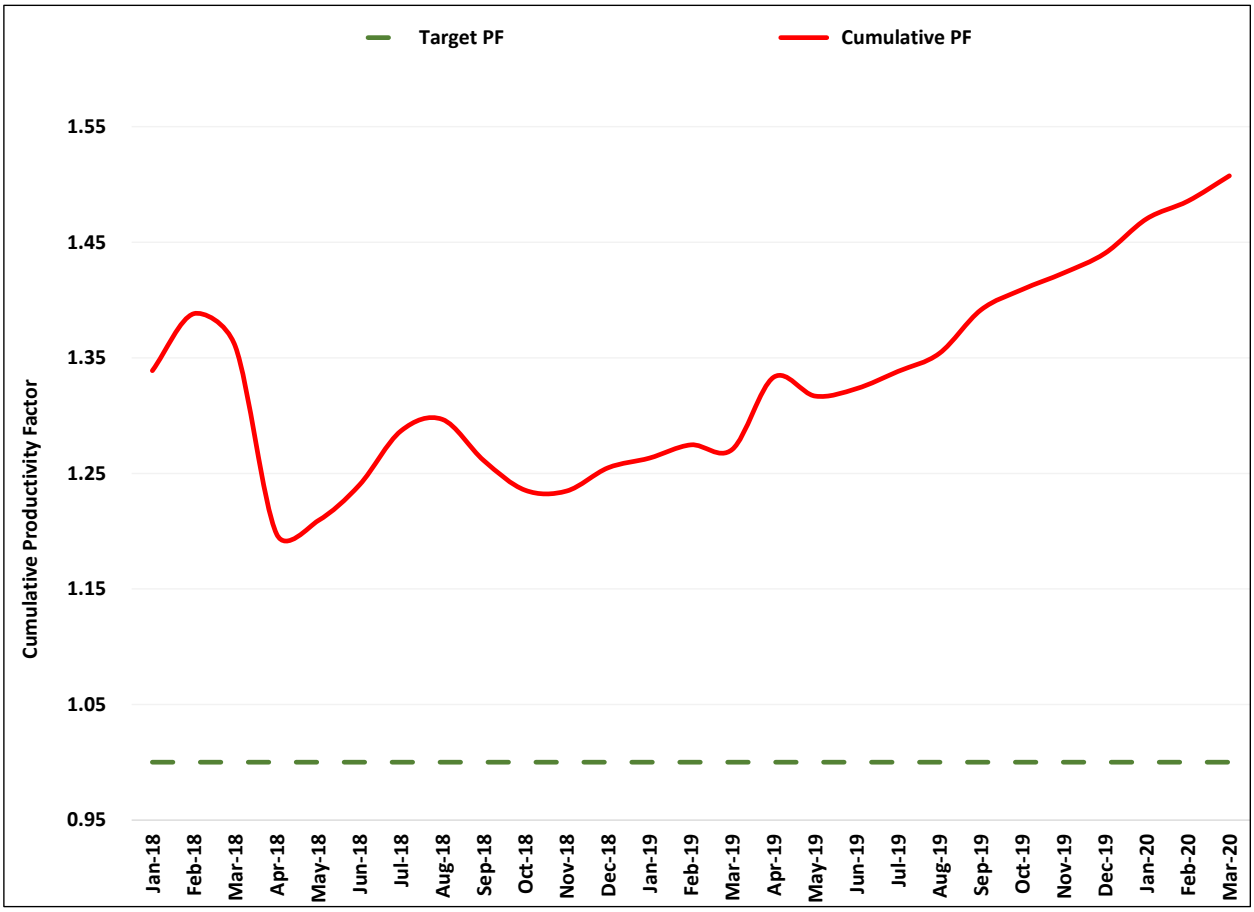
151. Avoidance of the disruptive and inefficient conditions that Bechtel cited, including congestion, deferred work, scaffold coordination, bulk electrical progress, and day to day labor resource management, was precisely the reason for progressing the bulk installation further and deeper into the Project schedule as originally planned prior to the start of testing. The contemporaneously maintained progress, quantity and labor data by Bechtel confirms the negative impact to productivity resulting from SNC's decision to prematurely transition from bulk construction to system turnover.

152. An example of the declining labor productivity after the transition to the systems approach was the Unit 3 containment building. Prior to the shift from bulk construction to systems testing, productivity was trending in a positive manner, as shown by the improving productivity factor. After the change, the labor productivity factor began a continuous decline that occurred into 2020. The trend is shown in **Figure 3.3-21 Unit 3 Containment Building Productivity Factor**.

[76] December 2019, Bechtel Monthly Status Report, page 51.
[77] June 2020, Bechtel Monthly Status Report, page 60.

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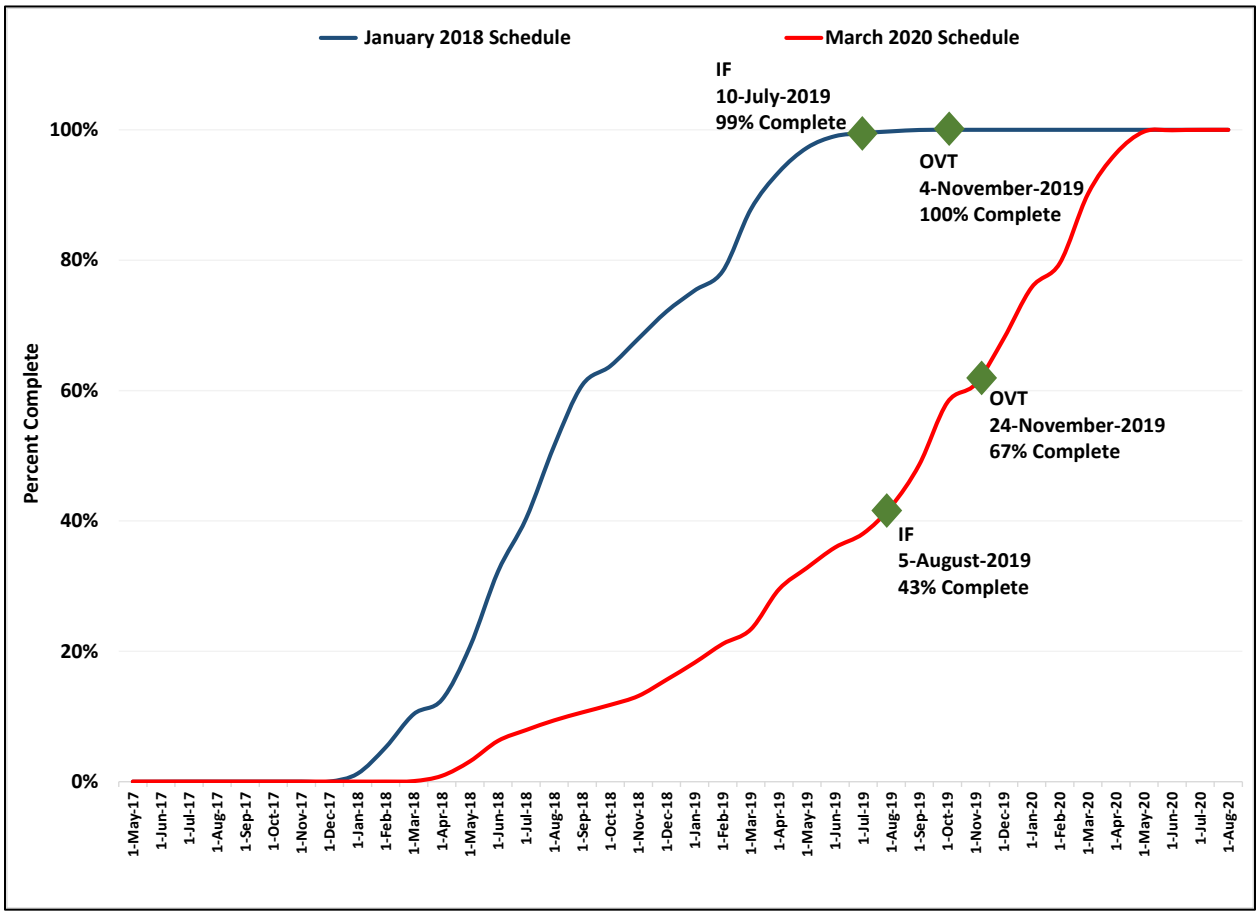
Figure 3.3-21 Unit 3 Containment Building Productivity Factor



153. Bechtel also noted the push to complete the specific systems that were mandatory predecessors to the Unit 3 Open Vessel Testing (OVT) milestone. The effectiveness of this can be examined utilizing an analysis of the Unit 3 Main Power System (ECS) and the Unit 3 Steam Generator System (SGS) as it related to the Integrated Flush Start (IF) and OVT milestones as depicted in the charts below, **Figure 3.3-22 Unit 3 Main Power System (ECS)** and **Figure 3.3-23 Unit 3 Steam Generator System (SGS)**. The figures below demonstrate milestone testing performed at an earlier completion percentage than originally planned as well as delayed achievement of these milestones. The two milestones, IF and OVT were originally planned just prior to 100% completion. In actuality, the IF and OVT milestones were performed between 30-40% and 60% completion, respectively.

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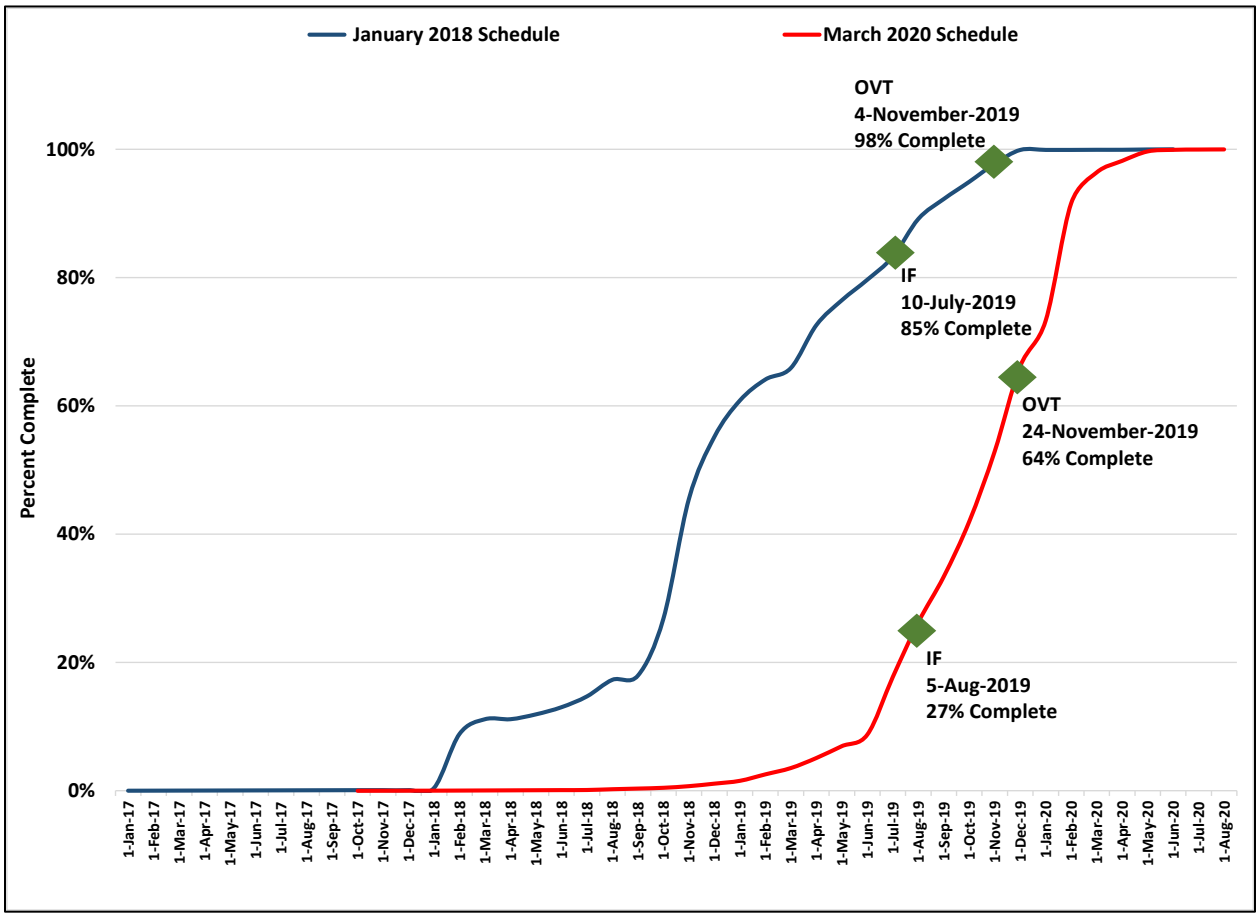
Figure 3.3-22 Unit 3 Main Power System (ECS)



154. Analysis of the Unit 3 Steam Generator System (SGS) yielded similar findings.

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Figure 3.3-23 Unit 3 Steam Generator System (SGS)



155. While SNC may have achieved its short-term objectives of advancing certain milestones, these circumstances and conditions became a source of both delays and cost growth, negating the benefit to the overall Project that SNC was attempting to achieve. There was also growth in the number of scheduled activities within some systems indicating the continued cutting of work scope into smaller and more numerous work packages. This is shown in **Table 3.3-2 ECS System Activity Growth**.

Table 3.3-2 ECS System Activity Growth		
System / Schedule	**January 2018**	**March 2020**
ECS		
Construction Schedule	1,061	678
ITP Schedule	441	4,950
ECS Totals	**1,502**	**5,628**

156. In September 2020, Bechtel noted in its Lessons Learned log the decision to switch from bulk construction to partial release for testing continued to change and added complexity to maintaining

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Project records and completing work packages, many of which had multiplied from the original work breakdown.

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157. In January 2022, the Company submitted notice of Significant Construction Defects, ND-22-0012, to Bechtel in reference to completed signoffs and Project documentation.

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158. Bechtel responded to these findings and highlighted the delays and disruptions from the decision to switch to PRT.

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159. On February 3, 2022, Bechtel submitted a formal Change Order Request to SNC for Procurement, Engineering, Initial Testing Program, and Increased Scope Impacts from April 20, 2019, through May 2, 2021. In which, Bechtel stated:

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[78] Bechtel Lessons Learned Log, LL# 1522.
[79] January 7, 2022, letter from Georgia Power to Bechtel, Subject: CCA Section 15.5(i) Notice.
[80] January 18, 2022, letter from Bechtel to SNC, Subject: Response to ND-22-0022, Section 15.5(i) Notice, page 2.

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160. The shift to system turnover necessitated a focus on the ITP process sooner than likely anticipated given the progression of the work and the completeness of the bulk piping and electrical. This led to unanticipated coordination issues, demands for labor resources, and increases in the use of the PRT and the CWA and procedures within the turnover process.

3.3.5 Management of the ITP Program

161. The Initial Test Program was the key process that governed the transition of the plant systems from the construction phase, through testing, and to the initial operating phases, ceding jurisdiction of the plant from construction to utility operations. SNC, as the COL licensee, had control of the ITP, but as the construction manager, it also had responsibility for coordinating all aspects of the work from construction through ITP.

162. The ITP group was an integrated Bechtel and SNC operation that provided the transition and turnover from construction to commercial operations. During the Turnover, SNC operations controls the plant activities with the ITP group in support and the process was governed by the Vogtle Initial Test Program Administrative Manual (VIAM).[82]

163. The Plant Vogtle Units 3 and 4 Project Execution Plan defined three phases of testing:

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[81] February 3, 2022, letter from Bechtel to SNC, Subject: Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope from April 20, 2019, through May 2, 2021.
[82] April 2018, SNC Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 69.
[83] April 2018, SNC Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 68.

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164. The Bechtel procedure System Completion and Turnover defined the administrative process, responsibilities, and organizational interfaces for completion and turnover of *XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXX*[84] within Bechtel's scope to the ITP program or SNC operations.

165. The Bechtel procedure also included the PRT process. The PRT process was the mechanism to release *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX.*X[85] Included within the process was the CWA procedure which was the control mechanism for transitioning the work from the ITP back to construction if needed and provided for *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXX*[86] of the ITP Program Director or SNC operations.

166. To summarize, the PRT process was utilized for turnover of components or specific systems from construction (Bechtel) to operations (SNC) in anticipation of the eventual integration of multiple systems in the Startup Testing. The CWA procedure was utilized if Bechtel needed to re-access components, systems, or areas that were already turned over to SNC.

167. The Bechtel procedure System Completion and Turnover appeared to contemplate that work in areas after PRT would be minimized to XXXXX*XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*X and that the CWA process will be used primarily to *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[87] This description was consistent with the approach of completing bulk installation work ahead of system testing.

168. SNC's decision to shift its focus and resources from the bulk installation to the system testing affected the planning and execution of all the work, including both construction and system testing. SNC's modification of the planning approach resulted in the systems being separated into more and smaller parts resulting in growth in the number of PRTs, each of which had its own discrete impact

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[84] November 11, 2020, System Completion and Turnover, 26139-000-4MP-T81C-N1601. REV. 10, page 5.
[85] November 11, 2020, System Completion and Turnover, 26139-000-4MP-T81C-N1601. REV. 10, page 25.
[86] November 11, 2020, System Completion and Turnover, 26139-000-4MP-T81C-N1601. REV. 10, page 3.
[87] November 11, 2020, System Completion and Turnover, 26139-000-4MP-T81C-N1601. REV. 10, Attachment L, page 52.

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on other work activities, labor and equipment management, and the corresponding production and productivity of all work. According to Bechtel, the *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX* in what it deemed *XXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXX*[88] Each required extensive documentation planning and oversight, the magnitude of which was not anticipated in the Project planning and scheduling process.

169. According to Bechtel, the early use of PRT process was not considered when it developed its initial schedule and cost plans which was based upon XXXXXXXXXXXXXXXXXXXXXX[89] Bechtel indicated the process caused unplanned work stoppages, unplanned lock out of equipment and systems, and uncoordinated mobilization, demobilization, and comeback work. The systems approach inserted additional layers of management and coordination into the construction process, necessitating the significant usage of the PRT and CWA processes.

170. The early shift to system testing necessitated reducing the scope of systems into smaller, incremental work packages. For example, within the Project schedule, the Main AC Power System (ECS), grew from two (2) systems in January 2018 to eleven (11) in March 2020. Each of these partial systems then further devolved into multiple work packages, each of which required separate and discrete testing in the field as well as collecting and assembling all the documentation required for work package closeout.

171. There were generally three (3) different types of work packages: American Society of Mechanical Engineers (ASME) Section III, Legacy Packages, and Bechtel Work Packages. Each type of work package required a thorough and complete assembly that necessitated engineering and support services to confirm it complied with the jurisdictional and corporate requirements.

172. The ASME Work Packages (WPs) consisted of six (6) sections: XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX. The key components are described as follows:

- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

[88] February 3, 2022, letter 26139-000-TC-GAM-00357, from Bechtel to GPC and SNC, Subject: Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope Impacts from April 20, 2019, through May 2, 2021, page 3.
[89] February 3, 2022, Change Order Request for Procurement, Engineering, Initial Testing Program, and Increased Scope Impacts from April 20, 2019, through May 2, 2021.

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173. The Bechtel Work Packages (WPs) consisted of six (6) sections: XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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174. The direct impact of the increasing division of work in the field and the partial release of systems and components for testing resulted in disjointed coordination and necessitated the utilization of

[90] The ITAAC process is described by NRC as follows: "*A combined license enables the licensee to construct a plant and to operate it once construction is complete if certain standards identified in the combined license are satisfied. These standards are called Inspections, Tests, Analyses, and Acceptance Criteria, or ITAAC. The ITAAC are typically derived from one of two sources. The majority of ITAAC are from the design certification for the particular reactor technology the plant uses. The remaining ITAAC are site specific and are submitted in the licensee's combined license (COL) or early site permit (ESP) applications.*" https://www.nrc.gov/reactors/new-reactors/how-we-regulate/oversight/itaac.html.

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temporary facilities. The following includes some of the requirements:

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175. An additional complication necessitated with the increase in PRT process usage was the increased necessity to turnover tested areas back to construction after testing was completed. This was required due to both deferred work and the incompleteness of the systems. Subdivided, partial testing of systems that were intended to be constructed in a more complete manner, created additional interfaces between components that were not originally contemplated within the planning and schedule development. To return a system back to Construction, the CWA was utilized.

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177. The System Turnover procedure provided a relatively simple process for utilizing the CWA. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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[92] November 11, 2020, System Completion and Turnover, 26139-000-4MP-T81C-N1601. REV. 10, Attachment L, page 52.

[93] November 11, 2020, System Completion and Turnover, 26139-000-4MP-T81C-N1601. REV. 10, Attachment L, page 52.

[94] November 11, 2020, System Completion and Turnover, 26139-000-4MP-T81C-N1601. REV. 10, Attachment L, page 52.

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181. The CWA process was not overly proscriptive or excessively formal, however the original intent was for the related work to be limited in nature as well as the use of CWAs themselves to be infrequent. What occurred due to the partial release process was that the CWAs became more common and the scope of many were greater than originally expected given the frequency.

182. Bechtel noted numerous instances in which the transition to the testing program and the utilization of the CWA's impacted its planning and execution of the work.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[98]XXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

[95] November 11, 2020, System Completion and Turnover, 26139-000-4MP-T81C-N1601. REV. 10, Attachment L, page 52.
[96] June 2019, Bechtel Monthly Status Report, page 50.
[97] July 2019, Bechtel Monthly Status Report, page 49.
[98] March 2020, Bechtel Monthly Status Report, page 53.

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183. The coordination and work issues associated with the partial testing strategy in Unit 3 continued through 2021 and 2022. Bechtel cited instances within its monthly reports in which it was impacted or disrupted by conditions related to the CWAs, Lock Out Tag Outs (LOTOS), and partial release requirements. These impacts were not anecdotal or isolated. The impacts were recorded contemporaneously and were endemic in the work. They were a significant component of performance deficiencies with causes rooted in the SNC decisions to pursue a testing strategy.

184. Bechtel identified the CWA process which incorporated LOTO requirements as impacting work and causing inefficiency all through 2021 and 2022. The coordination required for the CWAs and integration of these requirements with the ongoing construction was not planned or anticipated by Bechtel.

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[99] January 2021, Bechtel Monthly Status Report, page 54.
[100] April 2021, Bechtel Monthly Status Report, page 51.
[101] July 2021, Bechtel Monthly Status Report, page 59.
[102] August 2021, Bechtel Monthly Status Report, page 55.
[103] August 2021, Bechtel Monthly Status Report, page 56.
[104] August 2021, Bechtel Monthly Status Report, page 55.
[105] December 2021, Bechtel Monthly Status Report, page 54.

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185. Bechtel also raised the concern regarding the CWA process and the proliferation to have an impact during the HFT electrical and room closeout.

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CWA Count

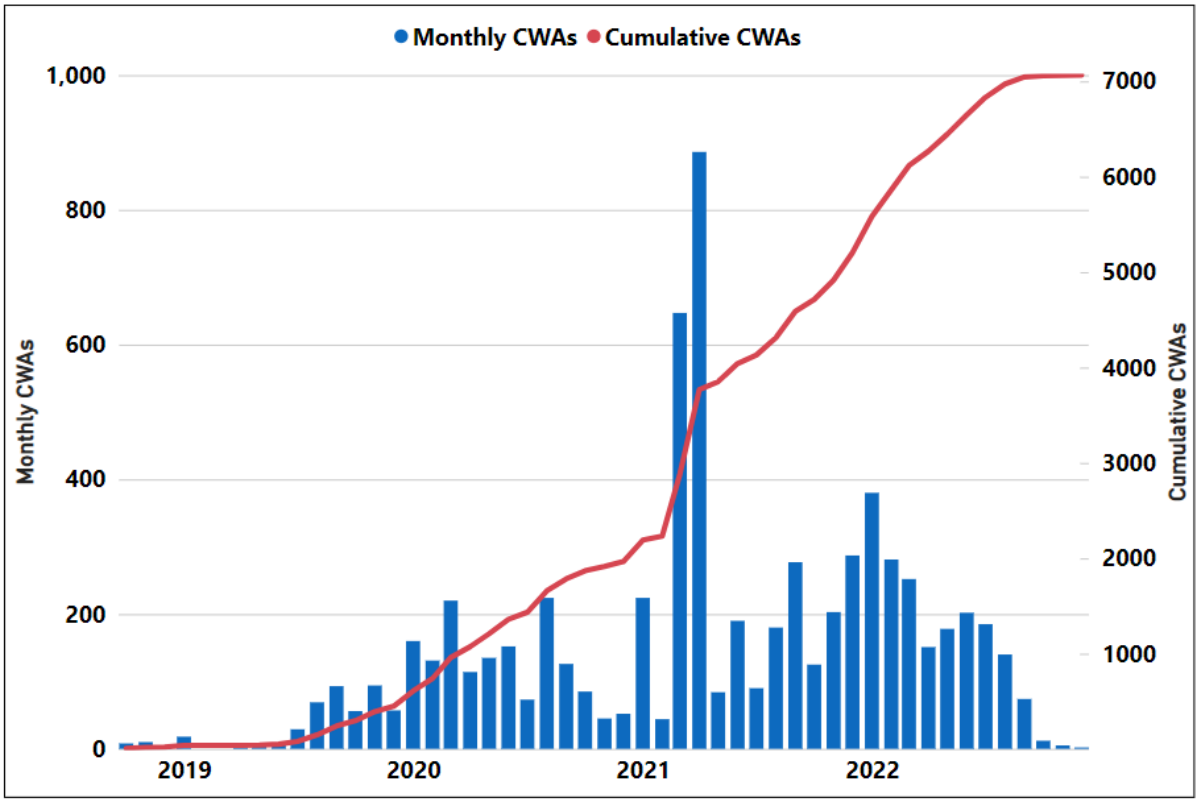
186. Bechtel never anticipated the widespread requirement and use of the CWA process concurrent with and intertwined with ongoing construction and partial releases. Analysis of the overall count of

[106] January 2022, Bechtel Monthly Status Report, page 54.
[107] February 2022, Bechtel Monthly Status Report, page 51.
[108] May 2022, Bechtel Monthly Status Report, page 53.
[109] June 2022, Bechtel Monthly Status Report, page 52.
[110] May 2022, Bechtel Monthly Status Report, page 54.
[111] April 2021, Bechtel Monthly Status Report, page 51.
[112] April 2021, Bechtel Monthly Status Report, page 52.
[113] February 2022, Bechtel Monthly Status Report, page 52.

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CWAs written for Unit 3 shown in **Figure 3.3-24 Count of U3 CWAs** indicated they began to increase at the end of 2020 and continued steadily through 2022 as partial system testing continued. The mix of construction and testing along with re-entry for additional construction efforts had a direct impact on efficiency and was directly linked to SNC's decision to pursue its testing strategy.

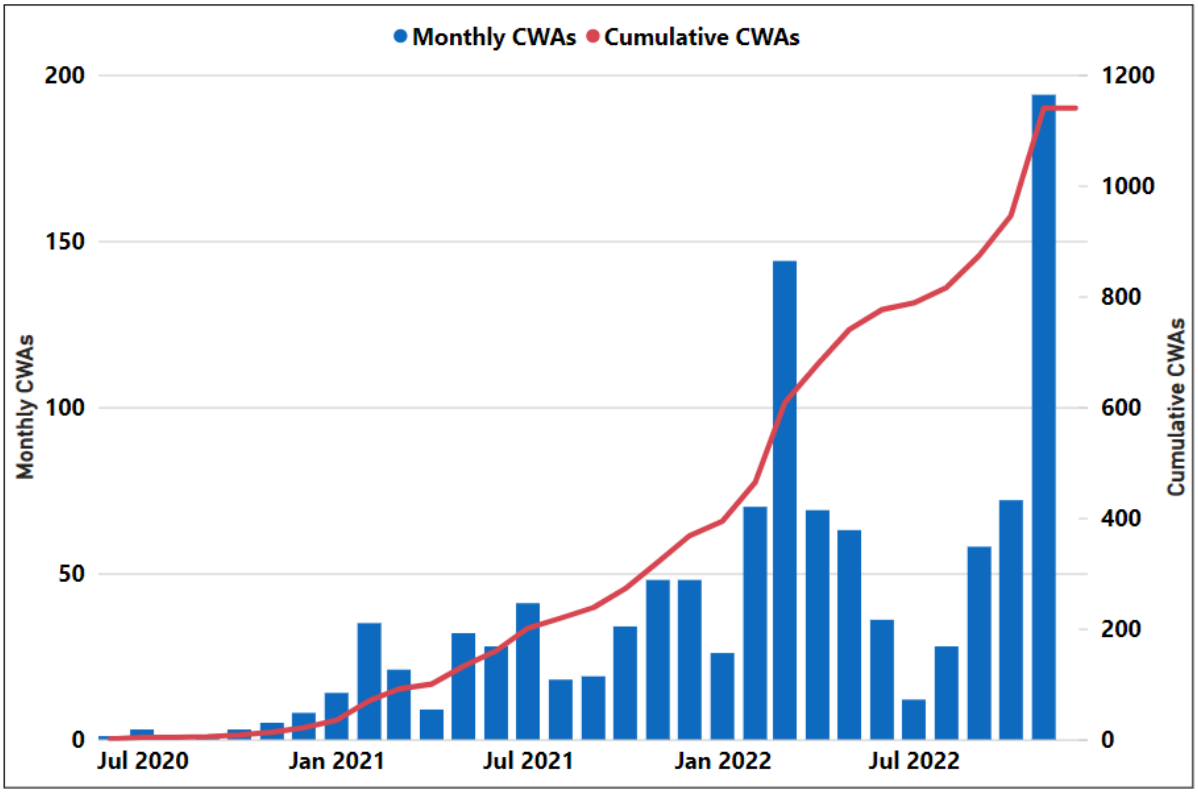
Figure 3.3-24 Count of Unit 3 CWAs



187. As shown in **Figure 3.3-25 Count of Unit 4 CWAs**, below, the trend of CWAs issued for Unit 4 proceeded like Unit 3, however, the overall number was significantly less.

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Figure 3.3-25 Count of Unit 4 CWAs



188. The distribution of CWAs by discipline was predictably focused on electrical representing 80 percent of the total coded within the CWA logs.[114] The extensive use of the CWAs, unanticipated by Bechtel at the level faced, represented an additional draw on electrical resources, including the planning and management functions, which contributed to the delays and cost increase. **Table 3.3-2 CWA Initiating Department Distribution** below, highlights the distribution of CWAs initiated on the Project.

Table 3.3 2 CWA Initiating Department Distribution		
Initiating Department	**Unit 3 Count**	**Unit 4 Count**
Electrical	5,758	940
Mechanical	697	167
I&C	356	36
CTF	158	51
Other	96	37
Total	7,065	1,231

[114] CWA Logs. Unit 3 CWA Tracker_Rev1.1.xlsx; Unit 4 CWA Tracker_Rev1.1.xlsx

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Audit Findings

189. SNC performed an internal audit of the Vogtle 3 and 4 Initial Testing Program Schedule Management in September 2022. The scope of audit was described as an *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[115] The audit covered the time from October 2021 through June 2022.

190. The audit identified numerous shortcomings in the ITP program that were deemed at various levels of risk by the audit team. Findings are shown in **Table 3.3-3 XXXXXXX XXXXXXXXXXX XXXXXXX XXXXXX XXXXXXX**

Table 3.3-3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
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191. The audit revealed significant findings that directly impacted the ITP planning and scheduling processes.

- The long-term efforts of compressing the schedule, a condition seemingly occurring due to the early adoption of the systems testing approach, caused *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXX* which limited the reliability of the schedule and its function as a schedule planning tool.[116]

[115] September 21, 2022, Internal Audit Report from Southern Company, Re: Vogtle 3&4 Initial Testing Program (ITP) Schedule Audit, page 1.
[116] September 21, 2022, Internal Audit Report from Southern Company, Re: Vogtle 3&4 Initial Testing Program (ITP) Schedule Audit.

- There was a high instance of ITP work orders (815) that were not represented in the IPS as activities. This limited the reliability of the schedule and its function as a schedule planning and forecasting tool.
- Schedule adherence related to the Unit 3 ITP activities was *extremely low*.

192. In addition, the audit team cited several issues related to the CWA form and process. Submission of the CWA form was required to ensure the integrity of the completed testing and the related systems, structures, and components. In addition, the CWA is required to evaluate if the planned construction could affect completed testing and/or require retesting of the system or components. The internal audit teams observations included the following:[117]

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3.3.6 Incomplete Engineering and Inadequate Engineering Management

193. The execution of the work was impacted by conditions related to engineering management that were not consistent with the contract expectations and were not fully integrated into the Project planning.

- Overstatement of the level of engineering progress during the transition from the EPC contract to the Bechtel cost reimbursable arrangement.
- Late and incomplete engineering drawings.
- Significant amount of Engineering Service Requests (ESR) and Engineering and Design Coordination Reports (E&DCR).

[117] September 21, 2022, Internal Audit Report from Southern Company, Re: Vogtle 3&4 Initial Testing Program (ITP) Schedule Audit.

194. At the end of 2016, the Monthly Project Review Meeting reported that engineering was 96.7 percent complete through December 2016.[118] Subsequently, information provided at the May 2017 Monthly Project Review Meeting reported that Engineering had progressed to 97.8 percent complete though April 2017.[119]

Redacted

195. During this time, the Project began transitioning to the new construction contractor, Bechtel, in advance of the VCM 17 analyses and proceedings. At 97.8 percent complete as represented in April 2017, it was reasonable for Bechtel to expect that the significant engineering deliverables and requirements were complete and the engineering representation in the field likely had a high level of familiarity with the design and what little appeared to remain to complete.[120] However, as the work progressed after VCM 17, the completeness of engineering did not appear as advanced as represented within the Monthly Project Review Meetings. This was evident in several specialized engineering functions including the following:

- The extent and frequency of drawing issues and revisions
- The processing and sheer number of Engineering Service Requests (ESR)
- The number and processing of Engineering and Design Coordination Reports (E&DCR)

196. In 2018 and 2019, Bechtel reported engineering issues that were impacting its Project execution.

[118] January 18, 2017, Vogtle Units 3 & 4, Monthly Project Review Meeting, page 7.
[119] January 18, 2017, Vogtle Units 3 & 4, Monthly Project Review Meeting, page 7; May 16, 2017, Vogtle Units 3 & 4, Monthly Project Review Meeting, page 17.
[120] Bechtel indicated it understood the percent complete at takeover was about 95% complete based upon the publicly available VCM reports and the Notice of Motion of Georgia Power Company for an Order Lifting the Automatic Stay to Allow it to Terminate Rejected Engineering, Procurement and Construction Agreement, August 25, 2017, pages 5 and 8.

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This included incomplete electrical designs, design conflicts and details, engineering holds, and the processing of engineering documentations, notably ESRs and E&DCRs.

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197. Bechtel also noted engineering priorities related to completion of the hot functioning testing milestone were causing deferral of items necessary to complete the fuel load work.

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198. It was apparent that the engineering was not as complete as would be expected given the progress percentages reported before VCM 17. One assessment of the engineering progress is the analysis of the engineering deliverables issued during a specific period. The engineering and design deliverables

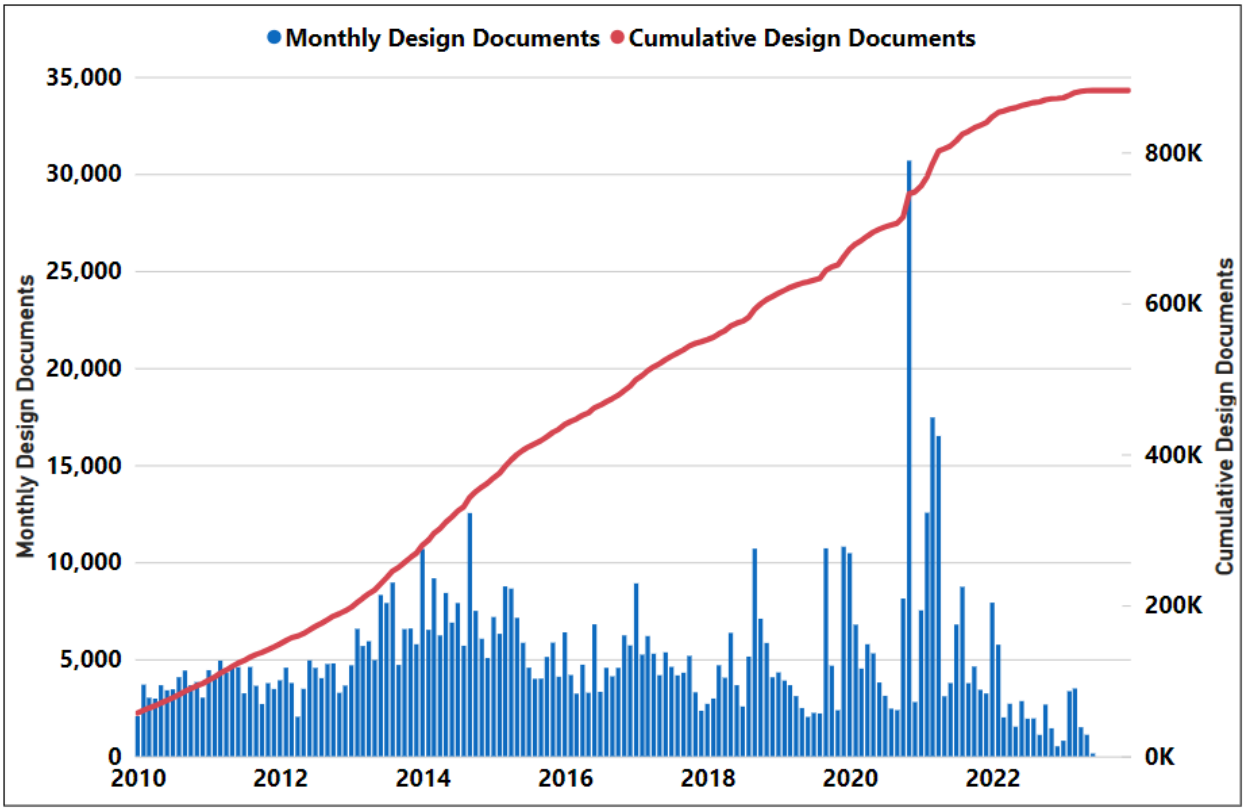
[121] January 2018, Bechtel Monthly Status Report, page 23.
[122] July 2018, Bechtel Monthly Status Report, page 43.
[123] October 2018, Bechtel Monthly Status Report, page 44.
[124] November 2018, Bechtel Monthly Status Report, page 44.
[125] February 2019, Bechtel Monthly Status Report, page 42.
[126] July 2019, Bechtel Monthly Status Report, page 49.
[127] July 2019, Bechtel Monthly Status Report, page 49.
[128] April 2021, Bechtel Monthly Status Report, page 52.

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included the original, first issue engineering and design drawings (R0), and revised engineering and design drawings and related documents.

199. To assess the potential impacts of the engineering distribution, the total number of design documents issued by month and the cumulative total from 2010 through 2022 were examined and are shown in **Figure 3.3-26 Total Design Documents**, below. The total number of documents included in the source log is about 881,000.[129]

Figure 3.3-26 Total Design Documents

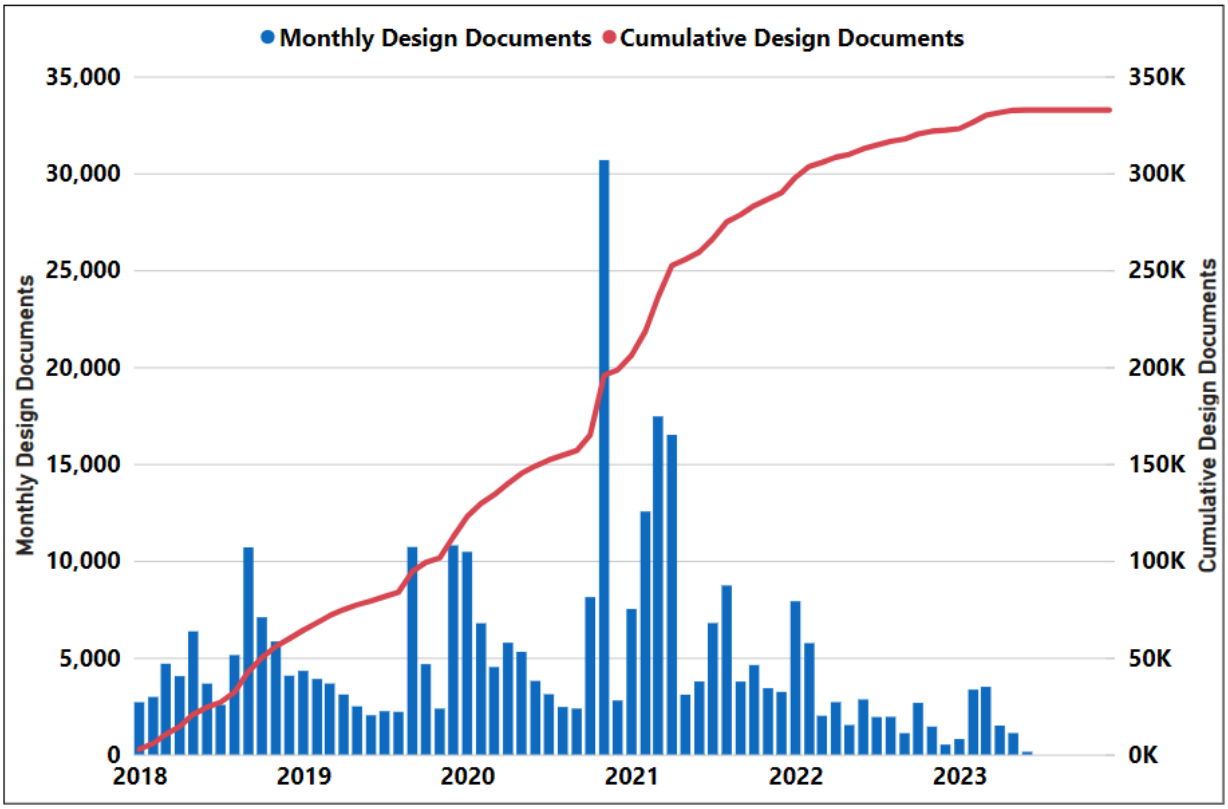


200. As shown in **Figure 3.3-27 Total Design Documents 2018 – 2023**, below, assessing the period from 2018 through 2022, which included the timeframe in which Bechtel was onboard as the replacement construction contractor and had begun acclimating to the Project and the work site, revealed that about 325,000 design documents were issued during this period.

[129] Design Document Log. TS Attachment STF-239-1-a-Design Docs - All Revs 2023_06_05.xlsx

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Figure 3.3-27 Total Design Documents 2018 – 2023



201. Despite representation that over 95 percent of engineering was completed in early 2017, about 37 percent of the total design documents were issued from 2018 through 2022, after the contractor and management transition. The number of documents and revisions was not consistent with the level of completeness that was reported.

202. Another component of the engineering process is the ESR. ESRs are defined in the Engineering Service Request procedure as follows:

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*
> *XXXXXXXXXXXX*[130]

203. The ESR process is critical for maintaining the control and management between engineering and construction, and ultimately maintaining conformance with the design and requirements. It is through this process that issues, inconsistencies, conflicts, and questions emerging in the field are

[130] March 16, 2022, Engineering Service Request, ND-EN-VNP-024, Version 6.1, page 5.

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resolved by the engineering staff.

204. Late in 2018, Bechtel began reporting impacts from ESR processing, among other engineering documents.

> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[131] XXXXXXXXXX

205. In 2019, Bechtel's reporting of impacts from ESRs increased. This was focused primarily on electrical components, but also included piping, structural components, and communications design.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[138]

[131] September 2018, Bechtel Monthly Status Report, page 45.
[132] July 2019, Bechtel Monthly Status Report, page 49.
[133] July 2019, Bechtel Monthly Status Report, page 49.
[134] July 2019, Bechtel Monthly Status Report, page 52.
[135] September 2019, Bechtel Monthly Status Report, page 55.
[136] September 2019, Bechtel Monthly Status Report, page 55.
[137] September 2019, Bechtel Monthly Status Report, page 55.
[138] September 2019, Bechtel Monthly Status Report, page 55.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXX*[139] XXXXXXXX

206. In 2020, Bechtel's reporting of ESR impacts began to focus on the sheer number of items and the timeliness of responses. At one point Bechtel noted as many as 1,000 ESRs were open at *XXXXXXXXX XXXXXXX*[140]

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207. The management and amount of ESRs continued to impact Bechtel in 2021 and 2022 as noted in Bechtel's Monthly Status Reports. The timeliness and apparent difficulty of the engineering staff in resolving the backlog was an ongoing impact on the work.

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208. In 2022, Bechtel continued to identify specific instances in which it was being impacted by the

[139] October 2019, Bechtel Monthly Status Report, page 54.
[140] January 2020, Bechtel Monthly Status Report, page 47.
[141] January 2020, Bechtel Monthly Status Report, page 47.
[142] January 2020, Bechtel Monthly Status Report, page 49.
[143] January 2021, Bechtel Monthly Status Report, page 54.
[144] January 2021, Bechtel Monthly Status Report, page 55.
[145] April 2021, Bechtel Monthly Status Report, page 54.
[146] September 2021, Bechtel Monthly Status Report, page 58.

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processing of ESRs. This included impacts on schedule and worker productivity as well as resolving the quality issues that were part of the cable separation conditions.

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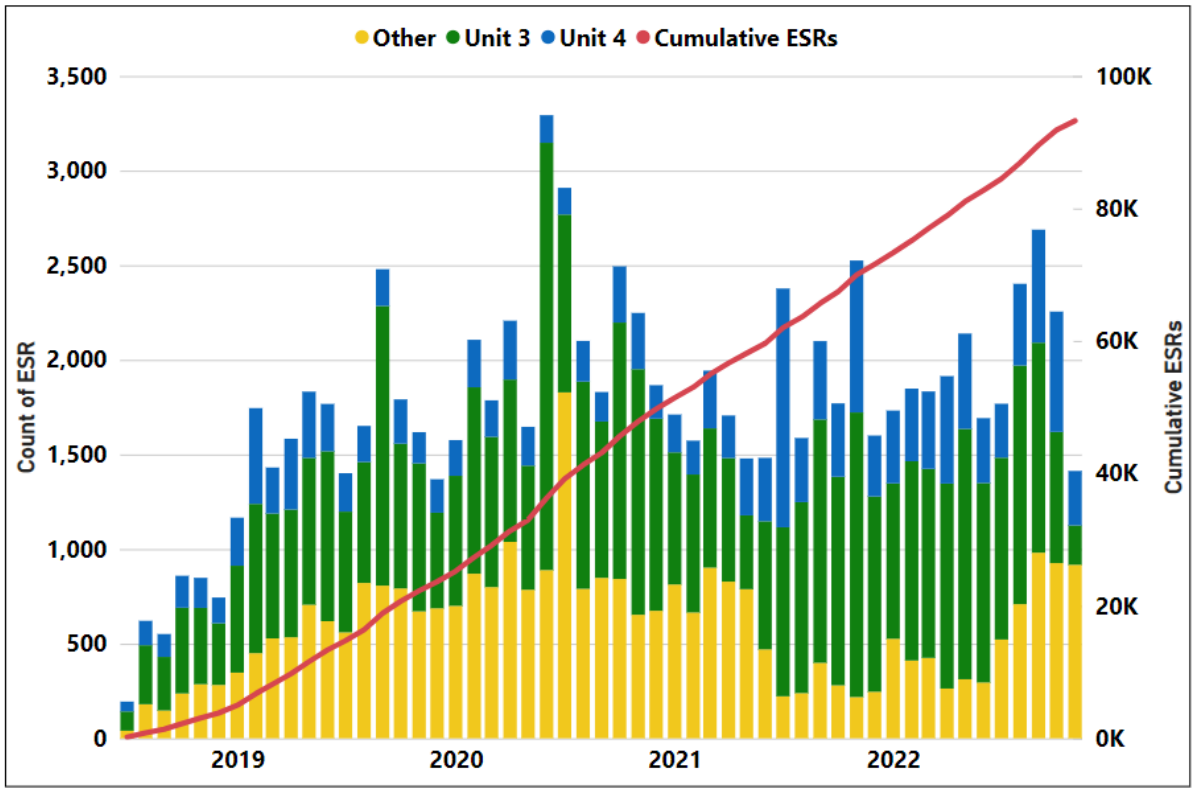
209. The number of ESRs for Unit 3 and Unit 4 from 2019 through 2022 is shown in **Figure 3.3-28 Total**

[147] January 2022, Bechtel Monthly Status Report, page 55.
[148] January 2022, Bechtel Monthly Status Report, page 54.
[149] April 2022, Bechtel Monthly Status Report, page 53.
[150] May 2022, Bechtel Monthly Status Report, page 54.
[151] August 2022, Bechtel Monthly Status Report, page 49.
[152] August 2022, Bechtel Monthly Status Report, page 49.

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ESR Amount and the cumulative totals is about 95,000.[153]

Figure 3.3-28 Total ESR Amount

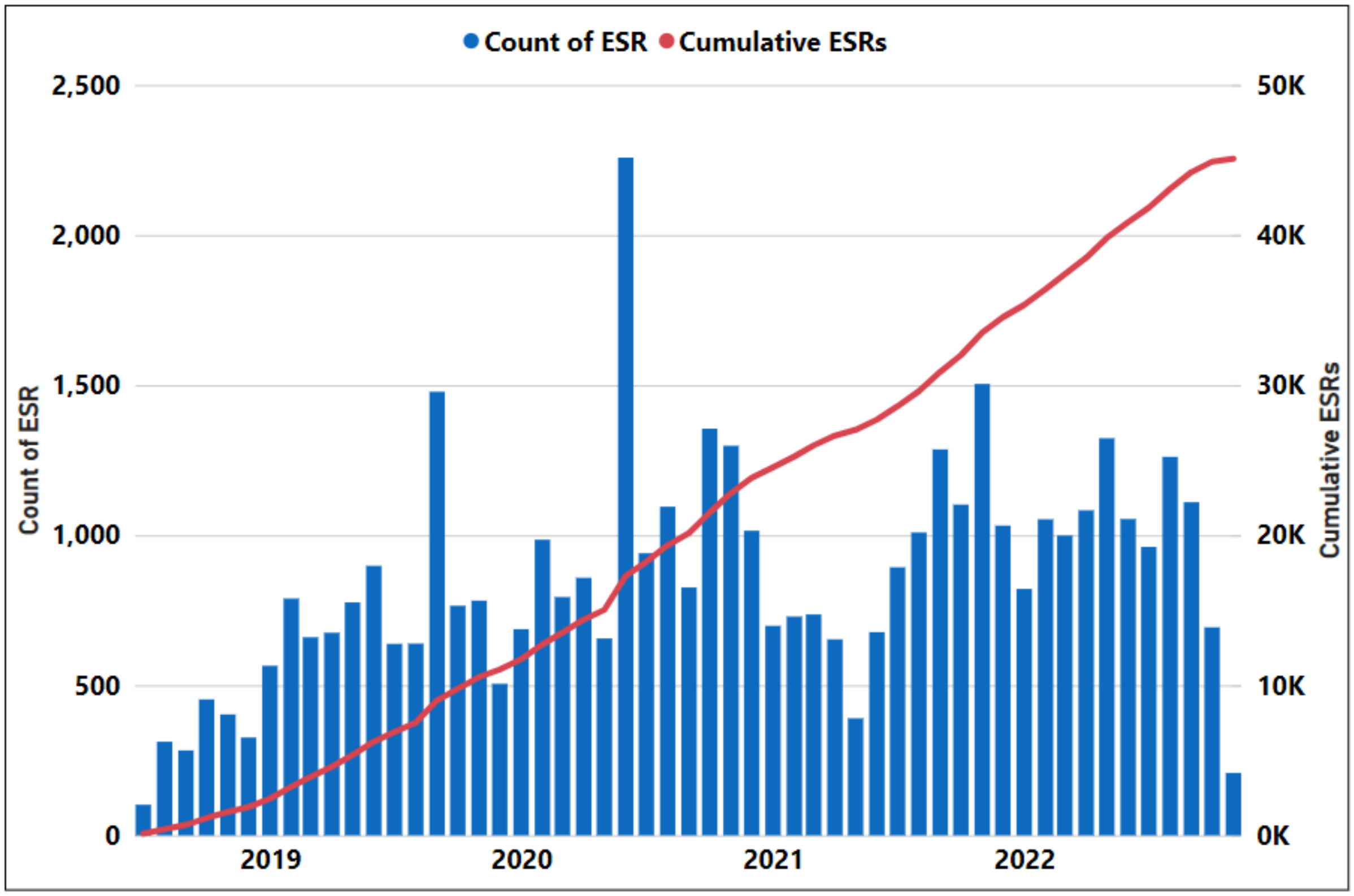


210. The ESRs processed in Unit 3 beginning in 2019 through 2022 are shown in **Figure 3.3-29 Unit 3 Total ESR Amount 2019 – 2022**. As indicated in the figure, the amount required during this period was significantly higher than expected for a project that was 95 percent complete. This is indicative of incomplete engineering that requires resolution of issues as the design is being implemented in the field. The sheer number of engineering deliverables impacts the entire Project, including the efficiency of both engineering staff and construction labor across all disciplines.

[153] Engineering Service Requests for Unit 3 and Unit 4 from 2019 through 2022. TS Attachment STF-239-1-d-1_ESR PSC_Rev1.0

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Figure 3.3-29 Unit 3 Total ESR Amount 2019 – 2022



211. In addition to the unexpected total amount of ESRs issued during the work, Bechtel noted long cycle times in the processing of ESRs. Bechtel calculated response times for the ESRs issued from 2019 through 2021, which are show in **Table 3.3-4 Bechtel Calculated ESR Times.**[154]

Table 3.3-4 Bechtel Calculated ESR Times	
Average Initial Response Time	27.94 Days
Median Response Time	12 Days
Average ESR Closure Time	43.45 Days
Median Closure Time	18 Days

212. According to Bechtel, *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXX*[155]

[154] February 3, 2022, letter from SNC to SNC, Subject: Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope Impacts from April 20, 2019, through May 2, 2021, page 17.
[155] February 3, 2022, letter from SNC to SNC, Subject: Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope Impacts from April 20, 2019, through May 2, 2021, page 18.

E&DCR Growth

213. The E&DCR process, defined in APP-GW-GAP-420, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXX[156] XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX [157] The E&DCR is the document to process the request and the review must be made by the original discipline(s) that issued the design document.

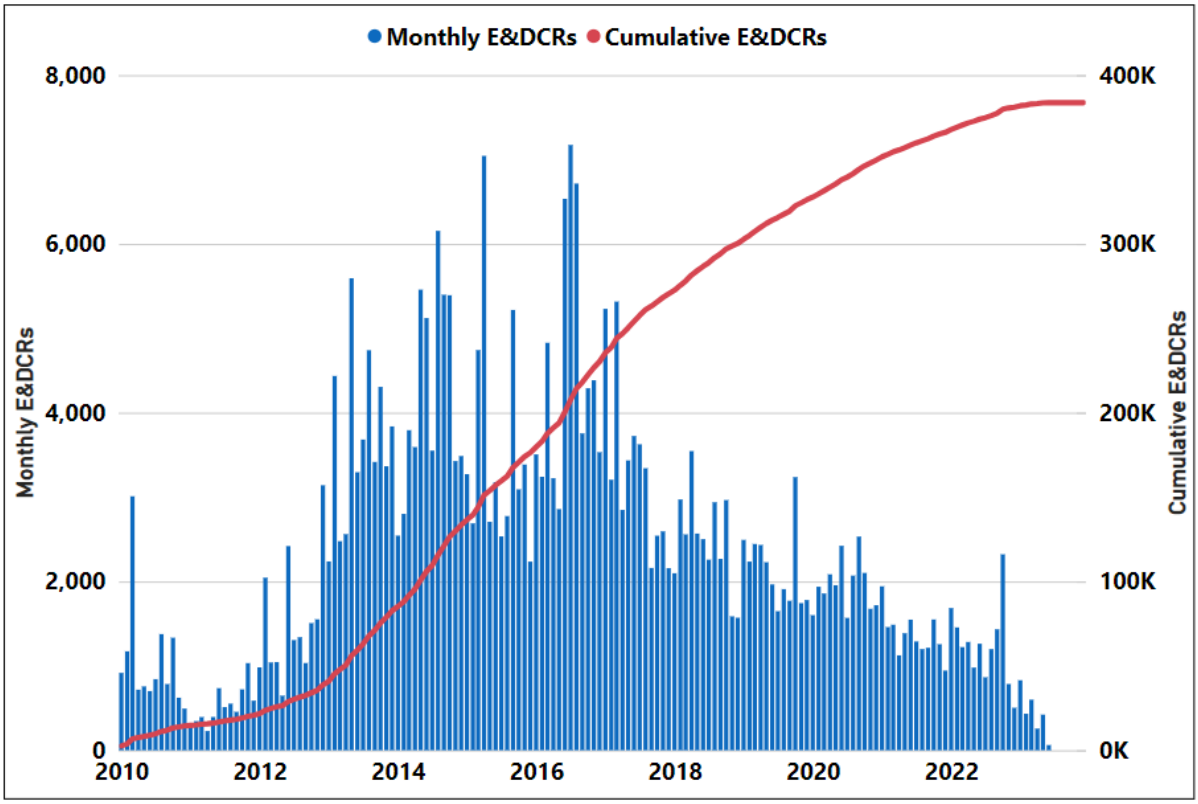
214. The governing procedure, APP-GW-GAP-420, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXX

215. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[158] The number of E&DCRs distributed during the Project is shown in **Figure 3.3-30 Total E&DCRs**; the cumulative total amount in the log is 383,613.[159]

[156] APP-GW-GAP-420, Engineering and Design Coordination Reports.
[157] APP-GW-GAP-420, Engineering and Design Coordination Reports.
[158] February 3, 2022, letter from Bechtel to SNC, Subject: Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope from April 20, 2019, through May 2, 2021.
[159] June 5, 2023, Engineering and Design Coordination Reports, with impacts.

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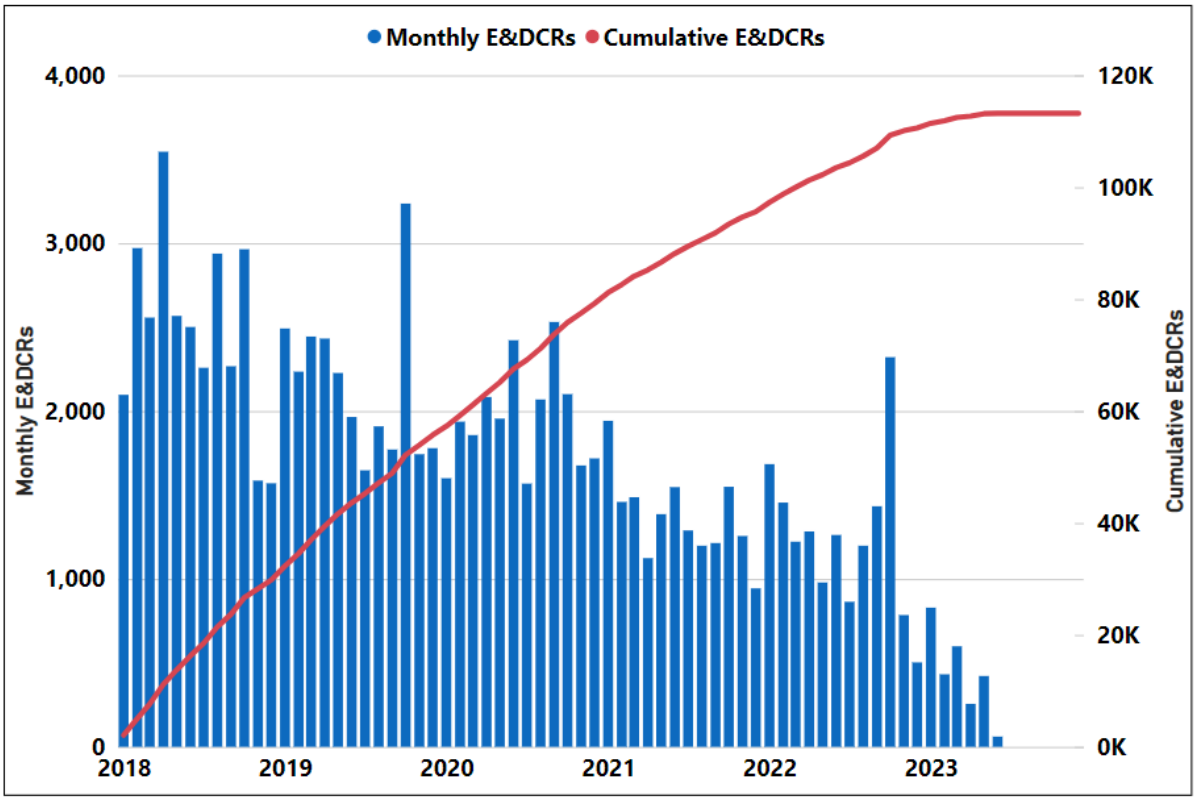
Figure 3.3-30 Total E&DCRs



216. The number of E&DCRs distributed during the Project from 2018 through 2022 is shown in **Figure 3.3-31 Total E&DCR 2018 – 2023**; the cumulative total amount in the log is 113,202 or 30% of the overall total.

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Figure 3.3-31 Total E&DCR 2018 – 2023



217. The E&DCRs represented changes proposed after the design documents were completed. Given the expected completeness of engineering when Bechtel came aboard, estimated to be about 95 percent, the level of changes requested from 2018 through 2023 represented a disconnect between design and construction, as well as the accuracy of the reported completion of engineering.

218. The distribution of the approximate cycle times to resolve E&DCRs during the Project is shown in **Table 3.3-5 E&DCR Response Time**.[160]

Table 3.3-5 E&DCR Response Time		
Time Period	**>30 Days**	**>100 Days**
2010 – 2022	26%	7%
2018 – 2022	28%	8%

219. The management of engineering documents including the lack of complete design, the steady stream of numerous engineering design documents, the pervasive and extensive number of ESRs

[160] June 5, 2023, Engineering and Design Coordination Reports, with impacts. Estimated based upon the E&DCR log. TS Attachment STF-239-1-b-_EDCRs - With Impacts 2023_06_05.xlsx.

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and E&DCRs, and the oftentimes slow time response times all combined to hamper Bechtel's ability to efficiently plan and complete the work, ultimately contributing to Project delays and cost increases.

3.3.7 Procurement Deficiencies and Materials / Modules Management

220. The execution of the work was impacted by equipment and material conditions that were not in conformance with the contract expectations and were not integrated into the Project planning. SNC identified risks associated with procurement, manufacturing defects, and long lead items in VCM 17. SNC committed to mitigating this risk through the following measures:

> *Georgia Power and Southern Nuclear have* ***continuously monitored key procurement items over the duration of the Project****. [...] Southern Nuclear* ***will continue to maintain a robust oversight program for procurement and will add resources to oversee vendors who are not performing to expectation or where additional oversight resources are otherwise deemed appropriate****.*[161] ***[Emphasis Added]***

221. SNC has continued difficulty in mitigating the procurement risks identified on the Project. As shown in **Figure 3.3-32 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX** below, SNC's identified procurement risk averaged XXXXXXXXXXX between 2018 and 2022.[162] While there were decreases in the procurement risk over time, as of 2022 there remains XXXXXXXXXXXXXX in procurement related risk.

[161] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, page 96.
[162] May 23, 2020, Project Risk Register, tab "Dashboard Data".

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Figure 3.3-32 XXXXXXXXXXXXXXXXXXXXXXX

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<u>Bechtel Change Order Request</u>

222. Despite assurances by SNC to mitigate risk, there were several issues related to procurement that resulted in additional costs and schedule delays. Bechtel submitted a change order request on XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXX*[163] Within this request, Bechtel cited SNC's inability to effectively manage a procurement program on the jobsite which led to added Bechtel costs and delays.

223. Bechtel stated that SNC did not meet the obligations of the Construction Completion Agreement (CCA),

[163] February 3, 2022, Change Order Request for Procurement, Engineering, Initial Testing Program, and Increased Scope Impacts from April 20, 2019, through May 2, 2021.

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224. Bechtel highlighted several areas of impact related to procurement of materials that resulted in additional cost and schedule delays, these included:

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225. Each of these items is discussed below.

<u>Delays in Equipment, Material Delivery and Shortages</u>

226. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX[165]

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228. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXX[167]XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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[164] February 3, 2022, Change Order Request for Procurement, Engineering, Initial Testing Program, and Increased Scope Impacts from April 20, 2019, through May 2, 2021, page 2.
[165] Review of Bechtel Monthly Status Reports was performed from January 2018 through September 2022.
[166] June 2018, Bechtel Monthly Status Report, page 35.
[167] September 2018, Bechtel Monthly Status Report, page 44.

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229. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[168]

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[168] December 2018, Bechtel Monthly Report, page 36.
[169] January through April 2019 Bechtel Monthly Status Reports, Section 5.4.
[170] July through December 2019 Bechtel Monthly Status Report, Section 5.4.
[171] May 2019, Bechtel Monthly Status Report, page 48.
[172] March 2020, Bechtel Monthly Status Report, page 54.

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[173] February 2021, Bechtel Monthly Status Report, page 51.
[174] January through November 2021 Bechtel Monthly Status Reports, Section 5.4.
[175] August through December 2021 Bechtel Monthly Status Reports, Section 5.4.
[176] May through September 2022 Bechtel Monthly Status Reports, Section 5.4.

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241. Later in 2022, specific procurement issues threatened the completion of systems work. Vendor testing and delivery issues along with late design changes were impacting completion of the work related to the HFT.

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177 December 2021, Lesson Learned Log, LL #2352.
178 September 2022, Bechtel Monthly Status Report, page 49.
179 February 3, 2022, Supplement No. 1 to Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope Impacts from April 20, 2019, through May 2, 2021, page 7.

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242. Procurement issues affecting Unit 4 also revealed the priority of Unit 3 and impacts to civil, electrical, instrumentation and controls, and mechanical. This item was representative of the ripple impact a single valve can have on multiple disciplines and involving procurement and engineering issues (E&DCR), and system design changes.

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<u>Unplanned On-Site Fabrication</u>

243. As a result of the procurement and material availability issues on site, Bechtel was forced to fabricate parts on site. This was not originally anticipated and resulted in additional incurred costs. By April 2019, Bechtel highlighted this challenge.

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244. This continued to be an issue in May 2019:

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[180] May 2022, Bechtel Monthly Status Report, page 57.
[181] August 2022, Bechtel Monthly Status Report, page 52.
[182] April 2019, Bechtel Monthly Status Report, page 45.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[183] *XXXXXXXXXXXX*

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246. The resulting impacts of missing materials and delayed shipments resulted in additional cost and delays incurred by Bechtel. There was no solution provided by SNC to mitigate these challenges, and as a result, Bechtel continued to fabricate and assemble materials on site.

247. Equipment and materials that did not conform to the design due to delays and changes. Similarly, redesign of existing systems delayed procurement of long lead items which impacted the Project schedule. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXX

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[183] May 2019, Bechtel Monthly Status Report, page 48.
[184] February 3, 2022, Supplement No. 1 to Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope Impacts from April 20, 2019, through May 2, 2021, pages 6-7.

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252. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXX

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[185] March 2018, Bechtel Monthly Status Report, page 29.
[186] September 2018, Bechtel Monthly Status Report, page 44.
[187] August 2019, Bechtel Monthly Status Report, page 56.
[188] December 2018, Bechtel Monthly Status Report, page 36.
[189] January 2020, Bechtel Monthly Status Report, page 51.
[190] August through November 2021 Bechtel Monthly Status Reports.

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254. These issues were continually observed by Bechtel and noted in their Monthly Progress Reports throughout 2018 through 2022.[192] These impacts were pervasive and continuous resulting in additional costs and schedule delays.

3.3.8 Quality Management Issues

255. SNC experienced quality management issues on the Project including related to its management of Bechtel's work. This is demonstrated not only in the SNC policies and procedures, but is evidenced through the quality issues, rework, and schedule delays exhibited throughout the Project lifecycle.

3.3.8.1 SNC Project Execution Plan (VPEP and SNC Policies)

256. In 2017, SNC highlighted several risks related to quality assurance and quality management that could impact the Projects cost and schedule. These included *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXX* and *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXX*[193] These risks did materialize in the form of the following issues.

- Cable Separation/IEEE 384 Issues

[191] February 3, 2022, Supplement No. 1 to Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope Impacts from April 20, 2019, through May 2, 2021, page 21.
[192] January 2022, Bechtel Monthly Status Report.
[193] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, page 95.

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- Documentation Turnover Issues
- Improper Preventative Maintenance prior to Bechtel control

257. SNC further stated these risks would be mitigated through SNC's oversight of the quality assurance program.

> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXX*[194]

3.3.8.2 SNC Internal Audits

258. SNC performed internal audits, separate from the CAP audits, of the Project on an annual basis XXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*,[195] which were defined on an annual basis in the SNC Project Execution Plan. These audits spanned over 30 different reporting areas; the most frequent occurrence of audits included the following.[196]

- Budget and Cost Management
- Information Management
- Risk Management
- Schedule Management

259. Internal audits highlighted several issues related to schedule and risk management that were not effectively managed throughout the life of the Project. For example, XXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXX This was further compounded by the fact that in 2018, over a year after Bechtel was brought on as the primary construction contractor, Internal Audit issued two Reportable Findings as part of the Schedule Management Audit, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXX

> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXX*[197] *XXXXXXXXXXX*

[194] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, page 95.
[195] September 25, 2012, Budget and Cost Management Assessment, Report No. GPC2012-13, page 1.
[196] See Workpaper "Log of SNC Internal Audits.xlsx" for complete list of details.
[197] July 31, 2018, SNC memo from Deb Key to Steve Owen, Re: Vogtle 3&4 Scheduling Assessment, Report No. GPC2018-08, Schedule Management, As of August 14, 2018, page 1.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXX*[198]

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263. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[202]

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265. More than three (3) years after the 2019 audit, the same issues are observed again. XXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX. XXXX

[198] July 31, 2018, SNC memo from Deb Key to Steve Owen, Re: Vogtle 3&4 Scheduling Assessment, Report No. GPC2018-08, Schedule Management, As of August 14, 2018, page 1.
[199] September 21, 2022, Internal Audit Report from Southern Company, Re: Vogtle 3&$ Initial Testing Program (ITP) Schedule Audit, page 3.
[200] March 2017, Vogtle Units 3 & 4 Senior Management Update, page 18.
[201] March 1, 2018, PMB Meeting Notes, page 2.
[202] August 24, 2018, Schedule Review Package, page 5.
[203] September 9, 2019, letter from SC, Re: Vogtle 3 & 4 Assessment, page 8.

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266. Despite performing both internal and Nuclear Development Quality Assurance Manual (NDQAM) audits, and having a Corrective Action Program in place, SNC was unable to significantly improve performance and continued to suffer from quality and schedule impacts. This is confirmed in the testimony of Steven D. Roetger and William R. Jacobs.

> *The Company's failure to install electrical commodities in accordance with requirements and the failure to properly utilize the Corrective Action Program to identify these issues as soon as possible has resulted in massive rework and schedule delays for the Project.* [205]

3.3.8.3 Corrective Action Program and Nuclear Development Quality Assurance

267. The Nuclear Development CAP was implemented to satisfy the requirement for SNC's Nuclear Development (ND) organization to ensure safety by establishing the necessary measures and governing procedures to promptly identify, control, document, classify, and correct conditions adverse to quality in a timely manner.[206]

268. The overall goal of the program was to ensure that the conditions adverse to quality are promptly reported, reviewed for significance, investigated, and resolved in a timely manner. [207]

269. The CAP was audited yearly from 2009 through 2023. The scope of the audit included the following XXXXXXXXXXXXX[208]

- XXXXXXXXXX
- XXXXXXXXXXXXXXXXXXXXXXX

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[204] September 21, 2022, Internal Audit Report from Southern Company, Re: Vogtle 3&$ Initial Testing Program (ITP) Schedule Audit, page 11.
[205] December 1, 2021, Direct Testimony and Exhibits of Steven D. Roetger, William R. Jacobs, JR., PhD., VCM 25, page 28.
[206] April 1, 2022, Nuclear Development Corrective Action Program, ND-AD-002, Version 32.0.
[207] April 1, 2022, Nuclear Development Corrective Action Program, ND-AD-002, Version 32.0.
[208] February 20, 2014, Intercompany correspondence from SNC, Re: Nuclear Development Quality Assurance (NDQA) Audit, ND-CS-CAP-2014, of ND Performance Improvement and Corrective Action Program (PI & CAP).

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<u>Nuclear Development Quality Assurance</u>

271. SNC created a NDQAM that established the quality assurance policy for the Project. The NDQAM also requires internal and external audits to be performed throughout the lifecycle of the Project.

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272. SNC performed Nuclear Development Quality Assurance (NDQA) audits of the Project on a planned and periodic basis to meet the requirements of 10 Code of Federal Regulations (CFR) 50 Appendix B.

273. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

3.3.8.4 Cable Separation

<u>Background</u>

274. As the Project began processing Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) related to cable installation, the group responsible noted several instances in which the cable separation distance between high voltage electrical cables did not meet the minimum separation distances required under Institute of Electrical and Electronics Engineers (IEEE) 384 design

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[209] December 20, 2022, Quality Assurance Manual, Version 23.0, page 61.

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standards. The minimum separation distances were required to reduce the risk of interference and electrical arc, which have the potential to cause a fire.

275. The systemic increase of IEEE 384 related cable separation violations appeared to be first documented in the Condition Reports (CR) in Unit 3 in July 2020, in CR 50055012.[210] Additional cable separation violations and the subsequent CRs were issued in October and November 2020. The majority of related CRs appeared in December 2020 following CR 50072803 which identified an "*Electrical Installation Quality Adverse Trend*".[211,212] CR 50072803 was the first identified reference in SNCs CAP from December 2020.

276. CR 50075757 and Corrective Action Record (CAR) 80004436 were created in January 2021, which initiated an Extent of Condition (EOC) investigation as part of the corrective measure.[213] Subsequently, a Root Cause Determination (RCD) was initiated in accordance with ND-AD-006, "*Nuclear Development Cause Analysis and ND-AD-006-001, Cause Analysis and Corrective Actions Guideline.*"[214] The Root Cause Determination Report was issued by SNC in March 2021 and stated the main cause of the violations were construction related.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[217] *XXXXXXXXXXXXXX*

277. Bechtel stated in their January 2021 Monthly Status Report that a recurring training program related to the IEEE 384 issues was established and would be completed monthly to prevent further

[210] July 4, 2020, CR Audit Report.
[211] December 19, 2020, CR Audit Report, page 188.
[212] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, Version 9.0, page 4.
[213] January 2021, CR Audit Report.
[214] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, Version 9.0, page 4.
[215] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, Version 9.0, page 4.
[216] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, Version 9.0, page 5.
[217] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, Version 9.0, pages 5-6.

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nonconformities.[218] The training was to be provided by WEC for the benefit of Superintendents, General Foremen, Foremen and Field Engineers.

278. Analysis of Bechtel's CR log indicated November 2020 through January 2021 was the peak period of IEEE 384 non-conformance issues. The majority of these CRs were issued for Unit 3. The same IEEE 384 issues were identified in Unit 4 only a few months later, though there were significantly fewer violations observed. The below **Figure 3.3-33 XXXXXXXXXXXXXXXXXXXXXXXXXXX** detailed the NRC sequence of inspections and findings along with the monthly number of Unit 3 CRs.

Figure 3.3-33 XXXXXXXXXXXXXXXXXXXXXXXXXXXX

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279. By February 2021, the electrical installation issues were highlighted in a monthly VPMB presentation, which indicated the scope of the IEEE separation issues were expanded to "*include 14 additional cable separation issues.*"[219]

[218] January 2021, Bechtel Monthly Status Report, page 82. States: *"XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXX"*

[219] February 24, 2021, Plant Vogtle Units 3 & 4 Project Management Board, page 32.

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280. In an XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXX[220] XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

<u>NRC Inspections</u>

281. On June 21, 2021, the NRC Special Inspection began based on information from December 2020, specifically CAR 80003772 (U3 battery rack installation issues) and CR 50072803 (cable separation issues).

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282. The NRC performed the Special Inspection in Unit 3 with its regional, resident, and headquarters inspectors during the period starting June 21, 2021, and running through July 2, 2021. The NRC

[220] April 29, 2021, letter ND-21-0430, from GP to Bechtel Power.

[221] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 – NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and – Preliminary White and Greater than Green Findings for Unit 3.

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described the inspections as follows.

> *During the inspection, NRC inspectors reviewed the plant's operator, Southern Nuclear Operation Company's quality assurance process, corrective actions, and root cause analysis related to the electrical raceway system.*
>
> *… They also interviewed electrical craftspeople, superintendents, work planners, field engineers and quality control employees, and reviewed dozens of condition reports, technical evaluations, and work packages.*[222]

283. The preliminary conclusions were described by the NRC as follows.

> *The NRC inspectors found that* ***Southern Nuclear did not adequately separate safety and nonsafety-related cables*** *for reactor coolant pumps and equipment designed to safely shut down the reactor. They also found instances where the company did not identify and report construction quality issues related to the safety-related electrical raceway system and enter then into its corrective action program.* [223] ***[Emphasis Added]***

284. The NRC stated in their August 2021 Special Inspection Report.

> *… as a result of increased walkdowns, the licensee identified other examples of SR and non-safety-related (NSR) cables not meeting cable separation provisions and initiated an RCD, documented in condition action record (CAR) 80004436, to further examine the causes of the nonconformances.*[224]

285. The NRC also highlighted the results from SNC's root cause determination and noted that the cable separation issues were missed by QC inspections as far back as November 2019, nearly seven (7) months before the first issue was identified in Unit 3 and a full year before most cable separation issues were identified by Bechtel and SNC.

> *On April 28, 2021, the licensee completed the RCD for CAR 80004436, and identified that several of the cable raceway installation nonconformances were missed during the quality control (QC) inspections. Specifically, QC inspections were performed however, not all the cable separation and seismic/structural nonconformances were being identified during the QC inspections. The licensee concluded that "****the root cause lay in a culture across the construction organization where standards were not being followed or enforced and leadership did not consistently correct improper worker behaviors in the area of electrical installations. This culture allowed electrical***

[222] August 27, 2021, United States Nuclear Regulatory Commission, NRC News, Office of Public Affairs, Region II, No. II-21-021.
[223] August 27, 2021, United States Nuclear Regulatory Commission, NRC News, Office of Public Affairs, Region II, No. II-21-021.
[224] August 26, 2021, Letter from USNRC to SNC, Subject: Vogtle Electric Generating Plant, Units 3 and 4 – NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and – Preliminary Whie and Greater than green Findings for Unit 3, page 5.

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> ***commodities to be installed, and in some cases, inspected and turned over while not meeting all applicable quality requirements.****" Based on the work packages that the NRC inspectors reviewed during the SI, some examples of cable installation issues missed during QC inspections occurred in November and December 2019, as well as from August through December 2020.* [225] ***[Emphasis Added]***

286. This was further highlighted by the NRC below.

> *The inspectors reviewed the RCD for CAR 80004436 to determine if the licensee appropriately identified the cause of the issues and to determine if the scope of the RCD appropriately addressed the nonconformances associated with the installation of SR cables in raceways. The inspectors noted that there were s****everal cable separation nonconformances*** *identified in the RCD that* ***had not been previously entered into the CAP****, which was a* ***missed opportunity to identify the adverse trends sooner****.* [226] ***[Emphasis Added]***

287. Further, the NRC stated the RCD performed by SNC was limited in scope and was a missed opportunity to capture larger programmatic issues.

> *The inspectors reviewed the RCD for CAR 80004896 and the EOCa of the RCD for CAR 80004436 and did not identify any performance deficiencies. However, the inspectors noted that the EOCa that was documented in the RCD for CAR 80004896 was limited in that it looked only at the programmatic issues associated with NSR and SR work interactions. […] The inspectors also reviewed additional audits and assessments that occurred during this same timeframe but outside of the EOCa evaluation. The inspectors determined that the EOCa scope of the RCD for CAR 80004896 represented a missed opportunity to capture broader programmatic issues.* [227]

288. Further, the NRC identified an Information Notice issued specifically for this cable installation nonconformance, as well as similar issues identified at a nuclear construction site in Japan from 2015. This represents a missed opportunity by SNC/WEC to clarify and improve the electrical design.

> *In addition to missing related generic communications, such as Information Notice 85-11, "Licensee Programs for Inspection of Electrical Raceway and Cable Installations," which described several examples of cable separation nonconformances that occurred in the 1980s in U.S. nuclear plants under construction, the inspectors noted the licensee also missed a related electrical separation issue stemming from original construction*

[225] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 – NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and – Preliminary White and Greater than Green Findings for Unit 3, pages 5-6.
[226] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 – NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and – Preliminary White and Greater than Green Findings for Unit 3, page 11.
[227] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 – NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and – Preliminary White and Greater than Green Findings for Unit 3, pages 13-14.

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> *activities discovered in 2015 at the Kashiwazaki Kariwa site in Japan. The inspectors determined that limited identification and subsequent use of CE/OE [Construction/Operating Experience] was a missed opportunity to capture and apply industry lessons learned to the SNC root cause determination. This issue was documented in the licensee's CAP as CR 50098201.* [228]

289. Finally, the NRC highlighted three main failures of the licensee and contractor.

> *Contrary to the above, since 2019,* ***the licensee failed to promptly identify and correct conditions adverse to quality*** *associated with the installation of Class 1E cables and associated raceways.* [229] ***[Emphasis Added]***
>
> *Contrary to the above, on or before April 20, 2021,* ***the licensee failed to accomplish activities affecting quality*** *using prescribed documented instructions, procedures, or drawings, of a type appropriate to the circumstances.* [230] ***[Emphasis Added]***
>
> *Contrary to the above, prior to June 21, 2021, installation of seismic Category I raceways and connections* ***were not accomplished in accordance with instructions, procedures, or drawings, …*** [231] ***[Emphasis Added]***

290. On November 17, 2021, NRC issued its Notice of Violation[232] specific to the white finding identified in its August 26, 2021, report.

Condition Reports

291. SNC's CR log was reviewed to analyze the frequency and significance of IEEE and related cable separation condition reports.[233] The cable separation issues were first identified on the overall Project, in January 2015 and assigned to the manager "ENGSUPRTMGR", indicating the initial origin of the cable separation issues may be engineering related.[234]

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[228] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 – NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and – Preliminary White and Greater than Green Findings for Unit 3, page 14.
[229] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 – NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and – Preliminary White and Greater than Green Findings for Unit 3, page 18.
[230] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 – NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and – Preliminary White and Greater than Green Findings for Unit 3, page 21.
[231] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 – NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and – Preliminary White and Greater than Green Findings for Unit 3, page 24.
[232] November 17, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Unit 3 – Final Significance Determination of a Preliminary White Finding, A Preliminary Greater Than Green Finding, Notice of Violation, and Assessment Follow-Up Letter; NRC Special Inspection Report 05200025/2021011.
[233] November 11, 2022, Condition Report Log.
[234] EPC TS Attachment STF-93-3-a, EPC Trade Secret Information Subject to Restricted Procedures.

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292. At this time, it is unclear how prevalent the cable separation nonconformance was within the completed work. An additional CR, *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX* was issued on November 29, 2016, for a similar issue.[235] This CR and the previous CR identified in January 2015 were not associated with any specific Unit, and may be a document control/engineering related CR. It is unclear whether they are directly related to the issues that resulted in NRC findings.

293. The later widespread IEEE cable separation violations were identified in Unit 3 in July 2020 and documented by the SNC Site Projects Lead through a CR.[236] Additional CRs were identified in October (7 CRs) and November (85 CRs) 2020, but the majority of CRs appeared in December 2020 (309 CRs in December 2020) and January 2021 (486 CRs) following CR 50072803. A total of 888 CRs were issued through January 2021 relating to IEEE 384 and cable separation.[237]

294. CR 50072803, issued on December 22, 2020[238] appears to be the primary catalyst for the issues related to cable separation in the subsequent NRC investigation.[239] CR 50075757, issued on January 25, 2021, related to cable separation issues, required a CAR to close out the CR.[240] CAR 80004436 was initiated on January 27, 2021, and required an RCD to determine the origin and significance of this issue. The primary root cause was determined by SNC to be as follows.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXX[241]

295. Further excerpts from the RCD are below.

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[235] November 11, 2022, Condition Report Log.
[236] July 4, 2020, Update to TS Attachment STF-156-1, CR 50055012, page 159. Vogtle 3 & 4 Aggregate Trend Report, SNC, Bechtel and Stone & Webster, Third Quarter 2020: July 2020 – September 2020.
[237] November 11, 2022, Condition Report Log.
[238] December 19–25, 2020, CR Audit Report, page 188.
[239] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units and 4 – NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and – Preliminary White and Greater Than Green Findings for Unit 3.
[240] January 23, 2021, January 2021 Update to TS Attachment STF-156-1, page 405.
[241] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, page 4.

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296. The Bechtel Monthly Status Report from January 2021 identified the cable and conduit separation issues as having an impact on the Unit 3 critical path to Fuel Load.

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297. The cable separation issues were reported in the February 19, 2021, Monthly Project Review meeting.

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298. Within the Bechtel Monthly Status Report there was a section dedicated to Quality Evaluation. The following was noted with respect to the condition reports and IEEE violations.

- *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*

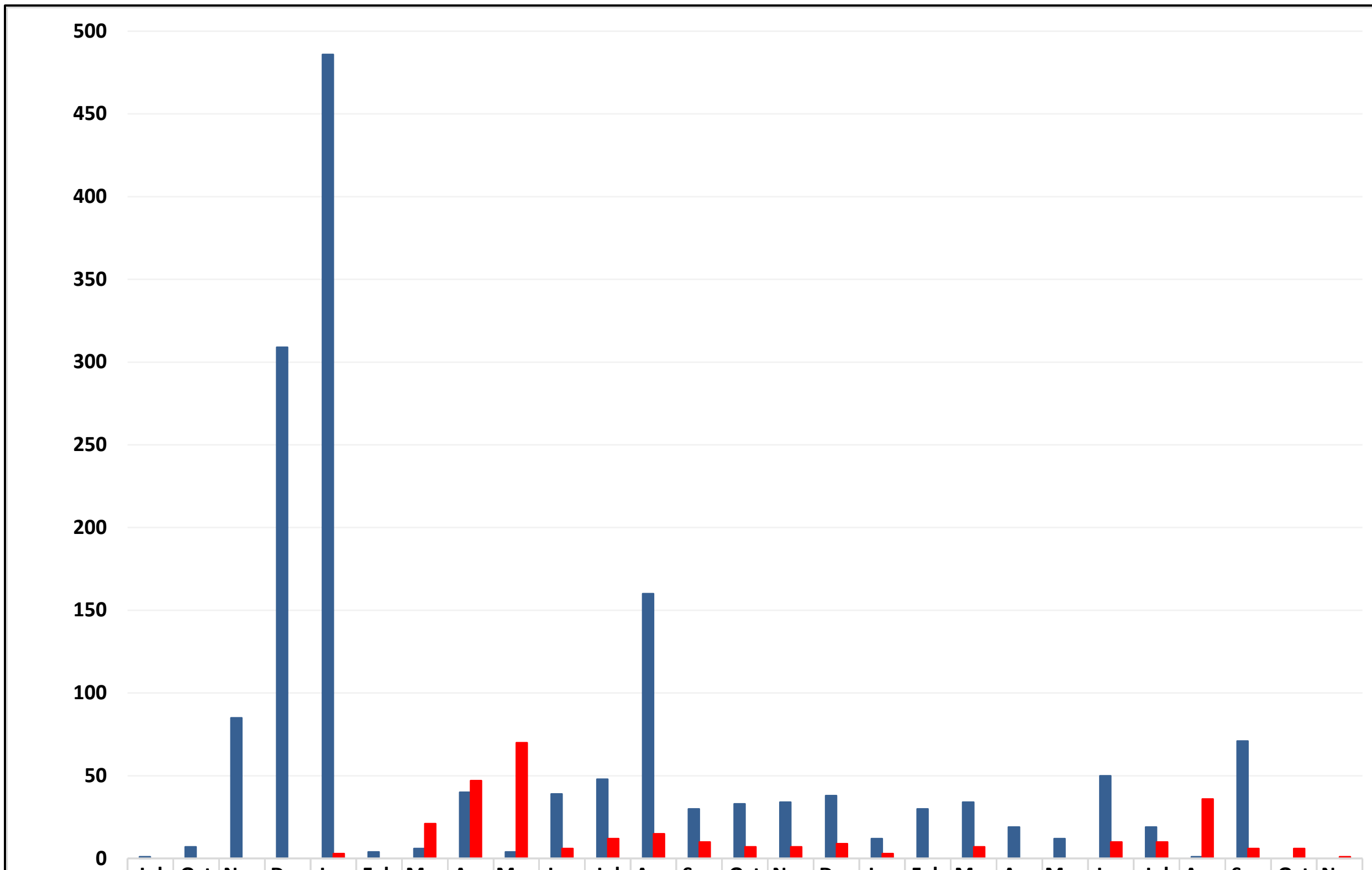
[242] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, page 5.
[243] January 2021, Bechtel Monthly Status Report, page 2.
[244] February 19, 2021, Report of the Georgia Public Service Commission, Plant Vogtle 3 and 4 Construction Monitor, Monthly Project Review Meeting, page 3.

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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[245] *XXXXXXXXXXXXXX*

299. Within the CR log there appears to be 1,798 CRs related to the IEEE 384 work, which is 70% of all IEEE related CRs. As shown below in **Figure 3.3-34 Units 3 and 4 IEEE 384 CRs (Initiation Date)**, for Unit 3, there were 1,572 CRs which span from July 2020 through September 2022. The graph below shows the initiation date for each of the CRs.[246] As observed in the graph below, the majority of IEEE 384 related CRs for Unit 3 occurred from November 2020 through January 2021, which was the peak month.

Figure 3.3-34 Units 3 and 4 IEEE 384 CRs (Initiation Date)



	2020				2021												2022										
	Jul	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Unit 3	1	7	85	309	486	4	6	40	4	39	48	160	30	33	34	38	12	30	34	19	12	50	19	1	71		
Unit 4					3		21	47	70	6	12	15	10	7	7	9	3		7			10	10	36	6	6	1

[245] Report of the Georgia Public Service Commission, Plant Vogtle 3 and 4 Construction Monitor, Monthly Project Review Meeting on March 24, 2021, page 3.
[246] CR PSC_Rev1.1". Note CR 50072803 or 50075757 which were the two initiating CRs for IEEE 384 do not include IEEE 384 in the CR description, but IEEE is mentioned in the issued CR documents.

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300. Despite SNC being aware of the cable separation issues in Unit 3 as early as October 2020, the review of the CR log indicated there was a spike in cable separation issues for Unit 4 several months later in May 2021. As shown in **Figure 3.3-34 Units 3 and 4 IEEE 384 CRs (Initiation Date)** above, a second spike was also noted between June and September 2022 for both Units 3 and 4. Further indicating SNC had not fully resolved the issue.

Trend Reports

301. SNC, Bechtel and Stone & Webster produced project control reports on a quarterly basis referred to as Aggregate Trend Reports. The purpose of this report was described as follows.

> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[247] XXXXXXXXXXXXX*

302. The Aggregate Trend Reports classify three different types of trends: Adverse, Monitoring and Under review. SNC defines an "Adverse Trend" as follows.

> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[248]*

303. The trend relating to cable separation work was identified as an "Adverse Trend" by SNC during the fourth quarter of 2020.[249] The Bechtel Project Quality Trend Report (included within the Aggregate Trend Report file) stated the following.

> *XXXXXXXXXXXXX*
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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXX.*

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[247] Vogtle 3 & 4 Aggregate Trend Report, SNC, Bechtel and Stone & Webster, Fourth Quarter 2020: October 2020 – December 2020, page 1.
[248] Vogtle 3 & 4 Aggregate Trend Report SNC, Bechtel and Stone & Webster, Fourth Quarter 2021: October 2021 – December 2021, page 1.
[249] Vogtle 3 & 4 Aggregate Trend Report, SNC, Bechtel and Stone & Webster, Fourth Quarter 2020: October 2020 – December 2020, page 2.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[250]

304. A more detailed discussion stated that this trend will be evaluated in the subsequent Q1 2021 Trend Report.

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305. The Q4 2020 Aggregate Trend Report included attachment 3 – NCRs with Trend Codes, which contained a series of Electrical (Cable), Electrical (Conduit), and Electrical (Tray/Support) trend codes that have the IEEE 384 violation noted. There were also two issue numbers with the Process/Procedure (Deficiency) trend code, shown below.[252]

[250] Vogtle 3 & 4 Aggregate Trend Report, SNC, Bechtel and Stone & Webster, Fourth Quarter 2020: October 2020 – December 2020, page3.

[251] Vogtle 3 & 4 Aggregate Trend Report, SNC, Bechtel and Stone & Webster, Fourth Quarter 2020: October 2020 – December 2020, page 14.

[252] Vogtle 3 & 4 Aggregate Trend Report, SNC, Bechtel and Stone & Webster, Fourth Quarter 2020: October 2020 – December 2020, page 67.

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Redacted

306. One year later, a review of the Q4 2021 Aggregate Trend Report included *"Electrical Installation Quality/Bechtel "Separation Violation""* as an Adverse trend that had still not been resolved.[253] Additionally, there was another trend included in this report titled *"Adverse Trend U4 IEEE 384, including X-X, Separation Requirements"* which also noted as an Adverse Trend. There were no additional details regarding the estimated resolution date or any potential cost and schedule impacts for these two trends.

307. Bechtel tracked potential cost impacts in their Monthly Status Reports. These reports included the Active Trend Register, which was the latest estimated cost impact for various trends. Based on the trend analysis, Bechtel estimated the total impact to be XXXXXXXXXXXX based on analysis of the July 2022 active trends, shown in **Table 3.3-6 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

Table 3.3-6 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[254]

Trend #	XXXXXXXXXXXXX	XXXX XXXXXXXX XXX	XXXXXX
SITE-0259	XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXX	XXXXXXXX	XXXXXX
SITE-0259A	XXXXXXXXXXXXXXXXXXXXXXXX XXXX	XXXXXXXX	XXXXXX
SITE-0259AP	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXX	XXXXXX
SITE-02598	XXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXX	XXXXXX
SITE-0259P	XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXX	XXXXXXXX	XXXXXX
SITE-0342	XXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXX	XXXXXXXX	XXXXXX
SITE-0342P	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXX	XXXXXXXX	XXXXXX
		XXXXX	**XXXXXX**

308. Furthermore, there are two Bechtel subcontractor's trends that are also related to additional costs

[253] Vogtle 3 & 4 Aggregate Trend Report SNC, Bechtel and Stone & Webster, Fourth Quarter 2021: October 2021 – December 2021, page 2.
[254] August 15, 2022, letter 26139-000-TC-GAM-00383, from Bechtel to SNC, Subject: Monthly Status Report for July 2022.

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for IEEE totaling XXXXXXXXXXXXXXX, summarized in **Table 3.3-7 XXXXXXXXXX XXXXXXXXXXXXXX 2022**, below.

Table 3.3-7 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[255]			
Subcontractor	**XXXXXXXXX**	**XXXXX XXXXX**	**XXXXXX**
FE Moran – 56770	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXX	XXXXXXXX	XXXXXX
FE Moran – 56770	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXX	XXXXXX
		XXXXX	**XXXXXX**

309. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[256]

> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXX*

310. The cable separation conditions resulted in the direct cost of replacement, rework, and mitigation measures to design and implement the corrective actions. The corrective work and rework caused disruption to the ongoing systems and bulk work including the reintroduction of work into areas that were cleared through the ITP process for system turnover.

311. Review of the CWAs indicated nearly ten (10) percent of the items were related to cable separation inspection or rework activities. Each of these instances, which were avoidable had the installation been completed within the code requirements, generated the CWA, which necessitated the required turnover steps from operations to construction, and back, and all the related coordination between technical requirements, engineering, ongoing construction, and ongoing system turnovers. Specific examples of work activities that occurred within the CWA constraints included the following:

- Cables were de-terminated and pulled back, the conduit, cable tray, or raceway was adjusted, cables were repulled and re-terminated, and then re-tested.

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[255] August 15, 2022, letter 26139-000-TC-GAM-00383, from Bechtel to SNC, Subject: Monthly Status Report for July 2022.

[256] February 3, 2022, letter from Bechtel to GPC, SNC, Subject: Change Order Request for Procurement, Engineering, Initial Testing Program and Increased Scope Impacts from April 20, 2019, through May 2, 2021, page 51.

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- CWAs were generated for opening cabinets to inspect cables for minimum separation. Any instances of required rework resulted in a revised CWA and included the cable ID.
- Cables were de-terminated and pulled from equipment, relocated, re-terminated, and then re-tested.

312. Each of these scenarios represented instances of straight rework including the de-energization and retesting of work that was within operations-controlled jurisdictions.

3.3.9 Resource Management Issues

313. SNC highlighted several significant risks when recommending the Project to proceed in 2017. One such risk that was historically present and documented by WEC and continued to be an issue for Bechtel was the availability of resources.

> *Can the labor force and craft maintain the productivity improvements seen recently as the number of craft is increased as required to meet the new schedule?*[257]

314. Bechtel identified the availability of craft labor as a risk to Project cost and schedule.[258] SNC also stated the risks included proper resource management.

> *Personnel factors, such as not having sufficient field engineering resources available for a period of time, also fall into project execution risk.*[259]

315. Contemporaneous reporting indicated labor resources were not working efficiently and SNC struggled in its continuous specific efforts to improve.

316. Between 2016 and 2019 Vitale & Associates (Vitale) provided the Company with detailed analyses of the craft productivity. The results of these analyses show craft productivity was extremely low. More importantly, there were no demonstrable improvements to craft direct work hours or

[257] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, page 9.
[258] July 28, 2017, Cost and Schedule Assessment for the Completion of Construction for southern Nuclear Operating Company's Vogtle Units 3 & 4, page 7. Bechtel states: "*Other issues also could negatively affect labor costs and productivity, including among other things: rework and out-of-sequence construction resulting from scope changes or changes in detailed engineering; shortages of skilled labor; and delays in delivery or availability of quantities and equipment.*"
[259] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, page 94.

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decreases in idle time during these four (4) years.

317. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[260] XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXX*[261]

Table 3.3-8 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
XXXXXXXXX	**XXXXXXXXXXXXXXXXXXX**	**XXXXXXXXXXX**
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XXXX [264]	XXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXX
XXXX [265]	XXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXX

318. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[266] XXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[267]

319. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

[260] March 2017, Vitale & Associates, Preliminary Report, Vogtle 3 & 4 Units Fluor, Productivity Analysis Studies, page 3.
[261] March 2017, Vitale & Associates, Preliminary Report, Vogtle 3 & 4 Units Fluor, Productivity Analysis Studies, page 7.
[262] August 29 – October 5, 2016, Vitale & Associates, Vogtle 3 & 4 Units Fluor, Productivity Analysis Studies, pages 3-4.
[263] March 2017, Vitale & Associates, Preliminary Report, Vogtle 3 & 4 Units Fluor, Productivity Analysis Studies, page 3.
[264] June 27 – August 10, 2018, Vitale & Associates, Vogtle No. 3 & 4 Units RCC Productivity Analysis, page 3.
[265] July 22 – August 17, 2019, Vitale & Associates, Vogtle No. 3 Unit RCC, Productivity Analysis, page 2.
[266] March 2017, Vitale & Associates, Preliminary Report, Vogtle 3 & 4 Units Fluor, Productivity Analysis Studies.
[267] March 2017, Vitale & Associates, Preliminary Report, Vogtle 3 & 4 Units Fluor, Productivity Analysis Studies, page 5.

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320. Vitale recommended the following to improve productivity, *XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[270]

321. Although it was unclear if these weekly walkdowns were ever performed, it was clear there was no improvement in jobsite productivity. As demonstrated in the results of the Vitale study from 2019, Direct Work percentages decreased and idle time increased. Vitale included the same comments as 2018 when discussing Direct Work.

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322. Another example of inefficient resource management was poor electrical production exhibited on the jobsite. Management noted throughout construction efforts to improve production. Electrical Improvement Plans were developed and updated throughout the Project with the goals of improving productivity, craft efficiency, and overall quality.[272,273,274]

Bechtel issued a near-term Electrical Production and Productivity Improvement Plan on 10/5/19.[275]

[268] June 27 – August 10, 2018, Vitale & Associates, Vogtle No. 3 & 4 Units RCC Productivity Analysis.
[269] June 27 – August 10, 2018, Vitale & Associates, Vogtle No. 3 & 4 Units RCC Productivity Analysis, page 3.
[270] June 27 – August 10, 2018, Vitale & Associates, Vogtle No. 3 & 4 Units RCC Productivity Analysis, page 7. Richmond County Constructors (RCC) represents Bechtel's supplier of subcontracted craft labor.
[271] July 22 – August 17, 2019, Vitale & Associates, Vogtle No. 3 Unit RCC, Productivity Analysis, page 2.
[272] October 11, 2019, Georgia Power Weekly Report.
[273] July 19, 2020, Electrical Improvement Plan Overview – Electrical.
[274] April 29, 2022, Georgia Power Weekly Report.
[275] October 11, 2019, Georgia Power Weekly Report.

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323. In March 2020, SNC stated the following regarding inadequate quality control resources and the resulting impact on electrical production.

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324. By May 2020, SNC held a "brainstorming session" to improve productivity in Unit 3. Some highlighted improvements suggested relating to added resources.

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325. Only a couple months later in July 2020, Bechtel highlighted the challenges in adding and maintaining craft labor.

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326. Despite the efforts made by Bechtel, these improvement plans did little to affect construction performance and resulted in further cost and schedule delays. As will be discussed in detail later in

[276] March 30, 2020, email from Thomas Saunders to David McKinney, Subject: Electrical Performance Improvement Plan – Gaps, page 2.
[277] May 8, 2020, email from Thomas Griffin to George Koucheravy, Subject: Notes from the U3 NS Electrical Productivity Improvement Session Held Tuesday 05MAY20, page 2.
[278] July 2, 2020, email from Glen Chick to Brian Reilly, Subject: Electrician Recruiting Efforts.

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this Report, the labor productivity continued to trend worse as the job progressed.

3.3.10 COVID-19 Pandemic

327. The Project was impacted by the effects of the COVID-19 pandemic along with the related changes in law and mitigation measures mandated by the various governmental and regulatory agencies. These impacts to the Project could not have been anticipated by SNC.

328. On March 13, 2020, President Donald Trump declared a national emergency due the outbreak of the COVID-19 virus. On March 14, 2020, Governor Brian Kemp of the State of Georgia issued the Executive Order Declaration of Public Health State of Emergency.[279]

329. The Vogtle team reacted by adjusting its daily planning and work practices. The March 17, 2020, Monthly Project Review Meeting, was held via conference call due to what was described as "*the unprecedented situation caused by the corona virus."*[280] The SNC CEO indicated Vogtle Unit 3 and Unit 4 was a *"critical Project"* that would be "*fully staffed and manned*" and would include a "*safe work environment through prevention and mitigation efforts."*[281] The Bechtel President expressed in his closing comments the expected COVID-19 impacts would add to the challenges already experience with electrical production.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXX*[282]

330. Bechtel provided its first written notice of COVID-19 Impacts to the Company and SNC within a letter dated March 19, 2020.[283] Bechtel indicated it anticipated impacts from COVID-19, specifically, actions by SNC or Company, and Governmental agencies, including local, national and international, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

[279] March 14, 2020, The State of Georgia, Executive Order
[280] March 17, 2020, Report of the Georgia Public Service Commission Plant Vogtle 3 and 4 Construction Monitor Monthly Project Review Meeting, page 1.
[281] March 17, 2020, Report of the Georgia Public Service Commission Plant Vogtle 3 and 4 Construction Monitor Monthly Project Review Meeting, page 2.
[282] March 17, 2020, Report of the Georgia Public Service Commission Plant Vogtle 3 and 4 Construction Monitor Monthly Project Review Meeting, page 8.
[283] March 19, 2020, letter 26139-00-TC-GAM-00229, from Bechtel to SNC, Subject: Letter: Coronavirus (COVID-19) Impacts.

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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[284] Bechtel's letter communicates it will be performing its work in a manner not originally planned and under conditions it could not have anticipated. Specific COVID-19 related conditions and impacts already known or incurred, as described within the Bechtel letter, included the following.

- Travel Bans
- COVID-19 Screening
- COVID-19 Infected Vogtle Personnel (Potential)
- Quarantine Vogtle Personnel
- XXXXXXXXXXXXXXX
- XXXXXXXXXX

331. Bechtel's capacity to claim additional time and costs as it related to COVID-19 was governed by its contract, the Construction Completion Agreement dated as of October 23, 2017.[285] Within the written notice, Bechtel included the specific clauses it deemed relevant.[286]

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[284] March 19, 2020, letter 26139-00-TC-GAM-00229, from Bechtel to SNC, Subject: Letter: Coronavirus (COVID-19) Impacts.
[285] October 23, 2017, Construction Completion Agreement Between Georgia Power Company, for Itself and as Agent for Oglethorpe Power Corporation (An Electric Membership Corporation), Municipal Electric Authority of Georgia, Meag Power Spvj, Llc, Meag Power Spvm, Llc, Meag Power Spvp, Llc, and the City of Dalton, Georgia, Acting by and through its Board of Water, Light and Sinking Fund Commissioners, as Owners and Bechtel Power Corporation.
[286] March 19, 2020, letter 26139-00-TC-GAM-00229, from Bechtel to SNC, Subject: Letter: Coronavirus (COVID-19) Impacts.

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332. At the end of March 2020, Bechtel was continuing with its electrical productivity plan that in its then current form was implemented in October 2019.[287] Supervision indicated the COVID-19 impacts were exacerbating the known productivity issues with the electrical labor resources. This follows the reference made to both known production issues and potential COVID-19 impacts referenced by Bechtel during the previous Monthly Project Review Meeting.

333. SNC also acted proactively at the start of the COVID-19 to mitigate procurement and subcontract management issues. In a series of letters issued in March 2020 and April 2020, SNC informed its vendors, suppliers, and subcontractors by indicating the designation of the Vogtle Project as "Critical Infrastructure," along with the entire Electricity Sector, as identified by the Cybersecurity and Infrastructure Security Agency of the United States Department of Homeland Security (CISA). The designation was essential to maintaining the work effort on the Project as the CISA guidance recognized XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[288]

334. When relevant, SNC noted state-specific regulations as exhibited in its notice to its vendor Ellis & Watts Global Industries, based in California, dated March 24, 2020.

> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[289]

335. These state specific regulations were examples of the changed environment not only within government and regulatory entities on a national level and within the State of Georgia on a local level, but also stretching into jurisdictions of multiple states and overseas. These state specific notes were included in the notices issued by SNC to its vendors, suppliers, and subcontractors. Another example is the notice to General Cable in Connecticut, dated March 24, 2020, which notes potential impacts to its local operations in Connecticut as well to its supplier, Prysmian North America, which has locations and operations worldwide. [290]

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[287] March 30, 2020, XXXXXXXXXXXXXXXXXXXXXXXXXXXX, Subject: Electrical Performance Improvement Plan -Gaps.

[288] March 24, 2020, letter ND-20-0313, from SNC, Subject: Urgent: Critical Infrastructure Exception for Vogtle Project.

[289] March 24, 2020, letter ND-20-0313, from SNC to Ellis & Watts Global Industries, Subject: Urgent: Critical Infrastructure Exception for Vogtle Project.

[290] March 24, 2020, letter ND-20-323, from SNC to General Cable, Subject: Urgent: Critical Infrastructure Exception for Vogtle Project.

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336. As a further measure to assist and inform its worksite teams, SNC instituted a "self-identification" process and notified WEC and Bechtel of the new site rule. The process was intended as a health and safety measure that applied to all onsite contractors, subcontractors, and vendors.[291] The process allowed individuals with chronic medical conditions to self-identify and be afforded precautions and accommodations based on individual work status and work responsibilities.

337. On April 15, 2020, SNC acknowledged the notice provided by Bechtel on March 19, 2020, and agreed to toll contractual requirements regarding submission of notices and change orders related to COVID-19.[292] The management team agreed to not challenge claims based upon missed contractual deadlines until further notice that the tolling agreement was removed. This was a contractual administrative effort to facilitate the change order process during the COVID-19 event.

338. Further mitigation efforts in April 2020 included the planning and implementation of reductions in force for both craft labor and field non manual personnel. The process commenced with SNC requesting a survey by Bechtel of its subcontracted craft labor, supplied by Richmond County Constructors (RCC), to determine how many RCC employees in each craft would accept the furlough offer.[293] Concurrently and in short order, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[294]

339. On April 17, 2020, Bechtel was directed by SNC to commence the layoffs of workers who agreed to participate in the reduction in force.[295] Shortly thereafter, on April 22, 2020, SNC indicated the number of workers who agreed to voluntary participate in the reduction in force was insufficient.[296] SNC subsequently directed Bechtel to direct its subcontractor RCC to proceed with the reduction in force.

340. The Project was continuously impacted in 2020 across all management and construction areas due

[291] April 2, 2020, letter ND-20-0390, from SNC to WEC, Subject: Vogtle 3 & 4: COVID-19 Self-Identification Process; April 2, 2020, letter ND-20-0391, from SNC to Bechtel, Subject: Vogtle 3 & 4: COVID-19 Self-Identification Process.
[292] April 15, 2020, letter ND-20-0454, from SNC to Bechtel, Subject: Tolling Contractual Submission Deadlines During COVID-19 Response.
[293] April 15, 2020, letter ND-20-0451, from SNC to Bechtel, Subject: Craft Survey for Furlough Volunteers.
[294] April 15, 2020, letter ND-20-0453, from SNC to Bechtel, Subject: Field Non Manual Reduction in Force.
[295] April 17, 2020, letter ND-20-0486, from SNC to Bechtel, Subject: Commencement of Voluntary Workforce Reduction.
[296] April 22, 2020, letter ND-20-0499, from SNC to Bechtel, Subject: Further Workforce Reduction.

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to the impacts of COVID-19. Examples included the following:

- Inability of Bechtel to anticipate its labor staffing forecasts due to the uncertainty caused by COVID-19.[297]
- Staffing shortfalls were occurring across all areas.
- High absenteeism affected the scaffolding functions causing Bechtel to hire additional resources to provide the required total workforce.[298]
- Absenteeism of superintendents and field engineers forced Bechtel to shift supervisory resources across work areas and locations. [299]
- High rates of COVID-19 among the leadership staff forced the rescheduling and conversion to virtual of various daily Plan of the Day (POD) meetings, Challenge meetings, weekly leadership meetings, staff meetings, and safety meetings.[300]
- COVID-19 resulted in entire work crews being absent and certain activities being significantly reduced in labor resource capacity.[301]

341. On April 20, 2021, Bechtel submitted the 2020 COVID-19 Impact Evaluations. [302] The analysis was performed to determine the impacts of the COVID-19 pandemic from March 2020 through December 27, 2020. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

342. Bechtel subsequently provided its Notice of Adjustment and Impact Evaluations. The Impact Evaluation documented the COVID-19 mitigation measures implemented by Bechtel.[303] The following items were noted to have impacted the Project Schedule and work performance.

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[297] May 8, 2020, email from Thomas Griffin to George Koucheravy, Subject: Notes from the U3 NS Electrical Productivity improvement session held Tuesday 05MAY20.
[298] August 4, 2020, email from Paul Tooze, to Scott Briggs, Subject: Condenser Vacuum Dates Slippage.
[299] August 4, 2020, email from Paul Tooze, to Scott Briggs, Subject: Condenser Vacuum Dates Slippage.
[300] November 15, 2020, email from Paul Tooze to Glen Chick, Subject: In Person Meetings for the Next Two Weeks.
[301] December 22, 2020, email from SNC to Bechtel, Subject: EPA Termination Burndown – 21-Dec-20, page 2.
[302] April 20, 2021, letter 26139-000-TC-GAM-00304, from Bechtel to GP and SNC, Subject: 2020 COVID-19 Impact Evaluation – Change Order Request.
[303] April 20, 2021, letter 26139-000-TC-GAM-00304, from Bechtel to GP and SNC, Subject: 2020 COVID-19 Impact Evaluation – Change Order Request.

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343. Bechtel submitted it First Supplement to the 2020 COVID-19 Impact Evaluation on June 17, 2021, which covered the period from December 28, 2020, through May 2, 2021.[304]

344. In a letter dated August 20, 2021, Bechtel informed SNC that impacts to its labor force were continuing and were recognized in July 2021.

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345. The Second Supplement to the 2020 COVID-19 Impact Evaluation was submitted on September 17, 2021, and covered primarily the period from July 5, 2021, through August 29, 2021.[306]

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[304] June 17, 2021, letter 26139-000-TC-GAM-00319, from Bechtel to GPC and SNC, Subject: Vogtle 3 & 4 Construction Completion Agreement, Bechtel Job No: 26139, Transmittal: First Supplement to the 2020 COVID-19 Impact Evaluation – Change Order Request, Rev. 1.

[305] August 20, 2021, letter 26139-000-TC-GAM-00328, from Bechtel to GPC and SNC, Subject: Vogtle 3 & 4 Construction Completion Agreement, Bechtel Job No: 26139, Notice: Sections 10.4 & 11.4 Notice of Adjustment Event – Coronavirus Impacts – July 2021.

[306] September 17, 2021, letter 26139-000-TC-GAM-00319, from Brian Reilly (Bechtel) to David McKinney (GPC) and Steve Kuczynski and Glen Chick (SNC), Subject: Vogtle 3 & 4 Construction Completion Agreement, Bechtel Job No: 26139, Transmittal: Second Supplement to the 2020 COVID-19 Impact Evaluation – Change Order Request.

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346. In a letter dated October 21, 2021, Bechtel informed Company and SNC that impacts were continuing and had been recognized in September 2021.

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347. The COVID-19 impacts were still occurring in December 2021.

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348. In a letter dated February 22, 2022, Bechtel informed Company and SNC that impacts continued and were recognized in January 2022.

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349. In a letter dated August 3, 2022, Bechtel informed Company and SNC that impacts continued.

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[307] October 21, 2021, letter 26139-000-TC-GAM-00340, from Bechtel to GP and SNC, Subject: Vogtle 3 & 4 Construction Completion Agreement, Bechtel Job No: 26139, Notice: Sections 10.4 & 11.4 Notice of Adjustment Event – Coronavirus Impacts – September 2021.

[308] January 21, 2022, letter 26139-000-TC-GAM-00354, from XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXX, Subject: Notice: Section 10.4 & 11.4 Notice of Adjustment Event – Coronavirus Impacts – December 2021.

[309] February 22, 2022, letter from Bechtel to GP and SNC, Subject: Vogtle 3 & 4 Construction Completion Agreement, Bechtel Job No: 26139, Notice: Sections 10.4 & 11.4 Notice of Adjustment Event – Coronavirus Impacts – January 2022, Letter 26139-000-TC-GAM-00362.

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350. Bechtel submitted its Third Supplement to the 2020 COVID-19 Impact Evaluation on August 3, 2022, covering the period from August 30, 2021, through April 10, 2022.[311]

351. The Fourth Supplement provided the following cost categories and analysis.

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352. Bechtel's Fourth Supplement provided a summary total of XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXX. The totals by period are shown in **Table 3.3-9 XXXXXXXXXXXXXXXXXXX**

[310] August 3, 2022, letter 26139-000-TC-GAM-00380, from Bechtel to GP and SNC, Subject: Transmittal: Third Supplement to the 2020 COVID-19 Impact Evaluation – Change Order Request.

[311] August 3, 2022, letter 26139-000-TC-GAM-00380, from Bechtel to GPC and SNC, Subject: Transmittal: Third Supplement to the 2020 COVID-19 Impact Evaluation – Change Order Request.

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Table 3.3-9 XXXXXXXXXXXXXXXX						
	2020 COVID-19 Impact Evaluation	First Supplement	Second Supplement	Third Supplement	Fourth Supplement	Total
Category Section(s) Cost	**4/20/2021**	**6/17/2021**	**9/17/2021**	**8/3/2022**	**11/3/2022**	
Hours and Dollars Charged by Craft to COVID-19 Cost Codes ($)	XXXXXXX	XXXXXXX	XXXXXXX		XXXXXXX	XXXXXXX
CMSC COVID-19 Cost ($)	XXXXXXX	XXXXXXX	XXXXXXX		XXXXXXX	XXXXXXX
Direct Hire Subcontractor COVID-19 Costs ($)	XXXXXXX	XXXXXXX	XXXXXXX		XXXXXXX	XXXXXXX
Delay Cost ($)	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX
Direct Impact Cost ($)	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX
Contractor Managed Subcontractors ($)	XXXXXXX	XXXXXXX	XXXXXXX		XXXXXXX	XXXXXXX
Total COVID-19 Costs ($)	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX
Schedule Impacts – Days Requested	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX	XXXXXXX

The Company's Estimated COVID-19 Impact

353. By February 2021, in VCM 24, the Company disclosed their estimated disruption to cost, and schedule related to COVID-19.

> *Through the end of December 2020, it is estimated that productivity impacts of the COVID-19 pandemic have consumed approximately three to four months of schedule margin previously embedded in the site work plans for both units, with an estimated cost of $150-190 million.* [312]

354. In April 2021, the Commission requested additional support to determine how these cost and schedule impacts were quantified. This request was included in the Staff Data Request, STF-199.[313]

355. The Company produced the requested documents in May of 2021 as part of Data Request STF-199.[314]

356. In the Company's Prudency Application filing in September 2023, they cited STF-199 as the basis of support for their COVID-19 cost impact. At this time, the Company increased the COVID-19 impact from $150-190 million up to $200 million.

[312] February 2021, Twenty-Fourth Semi-Annual Vogtle Construction Monitoring Report, page 5.
[313] April 13, 2021, letter from GPSC to GPC, Re Data Request from Commission Staff (STF-199), page 14.
[314] April 13, 2021, letter from GPSC to GPC, Re Data Request from Commission Staff (STF-199).

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> *The Project incurred $200 million in costs related to the impacts of the COVID-19 pandemic. […] The Project Team's estimate of COVID-19 costs was shared with the Staff in response to Staff Data Request STF-199.* [315]

357. The Company included $200 million of quantifiable costs, reasonably and prudently incurred, for COVID-19 Costs (Schedule and Mitigation). This $200 million is inclusive of the following:

- $40 million – establish and staff onsite medical village, vaccines, testing, masks, hand sanitizer, cleaning stations, mitigation measures.
- $160 million – schedule impacts due to productivity challenges, social distancing requirements, and disruption.

358. The Company added:

> *Finally, these costs incorporate the impacts from the Project's reduction in force measures taken at the onset of the pandemic to create greater physical separation and less workspace congestion on site. The Project Team's estimate of COVID-19 costs was shared with the Staff in response to Staff Data Request STF-199.* [316]

359. STF-199-18 included the Company's Impact Assessment for cost and schedule impacts as of April 2021 (Impact Assessment). This Impact Assessment quantified XXXXXXXXXXXXXXX in impacts and a 3-to-4-month schedule delay.

360. As shown in **Table 3.3-10 Company COVID-19 Impact Assessment**, below, the Impact Assessment included costs for 4 months of hotel load, discrete costs incurred by several parties and forecasted costs through June 2021.[317]

Table 3.3-10 Company COVID-19 Impact Assessment (per STF-199-18)

	Low	High
Hotel Load	XXXXXXXX	XXXXXXXX
Discrete Costs – Work Isolation	XXXXXXXX	XXXXXXXX
Discrete Costs – Infrastructure	XXXXXXXX	XXXXXXXX
Total	**XXXXXXXX**	**XXXXXXXX**

[315] Georgia Power Company's Application to Adjust Rates to Include Reasonable and Prudent Plant Vogtle Units 3 and 4 Cost, page 31.
[316] Georgia Power Company's Application to Adjust Rates to Include Reasonable and Prudent Plant Vogtle Units 3 and 4 Cost, page 31.
[317] Georgia Power Company's Application to Adjust Rates to Include Reasonable and Prudent Plant Vogtle Units 3 and 4 Cost, page 31.

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361. Work isolation costs represent costs incurred through December 2020 as well as forecasted costs through March of 2021. Similarly, infrastructure costs represent incurred costs through December 2020 and forecasted costs through June 2021. The discrete costs for work isolation and infrastructure include costs incurred by SNC, WEC, Bechtel, and other subcontractors.

362. The Impact Assessment also includes an estimated 3 to 4 months of schedule impact and included analysis in the following areas:

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Comparison of Methodologies between the Company Impact Assessment and Bechtel's COVID-19 Claim

363. The Company Impact Assessment for COVID-19 was estimated to be between $326-416 million and 3-4 months of delay for March 2020 through June 2021. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

364. Both estimates calculated additional costs attributable to the Hotel Load for manpower. However, the daily rates utilized are significantly different.

- Company: $90 million per month or $3,000,000 per day.
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365. Both the Company and Bechtel calculated lost time and efficiency due to increases in CPI.[318] Similarly, both parties used historical 2019 CPI performance as the basis for their estimate. Both

[318] SNC and Bechtel routinely referred to factors defined as Actual Hours / Earned Hours and Actual Cost / Earned Cost as CPI.

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parties use cumulative CPI for the Project (Unit 3 + Unit 4+ BOP), which are consistent with historical production. However, the specific CPIs utilized in each estimate are different:

- Company – Used 2019 historical data and a regression formula to calculate a predictive CPI.[319] This was then compared to the actual monthly CPI to calculate the lost productivity. The CPI varies monthly, ranging between 1.20 and 1.41.[320]
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Table 3.3-11 XXXXXXXXXXXXXXXXXXXXXXX	
Lost Opportunity	**Absenteeism** (Productivity Impacts Due to Disruption)
XXXX	XXXX

<u>Direct Costs for COVID-19 Mitigation</u>

366. Both parties' reference specific cost codes created to track mitigation and resulting disruption costs related to COVID-19. Bechtel estimated XXXXXXXXXXXXXXXXXX COVID-19 Mitigation Costs with the majority, approximately XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXX[321] XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[322]

367. There is a correlation between the Company Impact Assessment and Bechtel's COVID-19 Claim for XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[323]

[319] January 2020 through January 3, 2021, CPI Data.
[320] XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXX
[321] November 3, 2022, Bechtel Fourth Supplement to the 2020 COVID-19 Impact Evaluation, Table 11, page 12.
[322] April 2021, Draft 2020 COVID-19 Impact Assessment, Summary of Discrete Costs table, page 1.
[323] XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXX

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368. The J.S. Held Evaluation of the cost impact is contained in Section 6 of this Report.

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4 Project Management / Performance

4.1 Introduction

369. This section of the Report contains the analysis of SNC management of risks relative to the primary Project objectives of quality, time (schedule), and costs. The analysis focused on the period after WEC's bankruptcy within the framework of SNC obligations, NRC regulatory requirements, common industry practices and standards, and SNC's represented procedures including the Vogtle Project Execution Plan (VPEP) and project management procedural documents.

370. Because of WEC's bankruptcy, the Company, through SNC, elected to assume and control all aspects of the management of the Project execution. By SNC's own admission, SNC took on overall responsibility and was involved in the day-to-day management of the Project.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXX*[325]

371. As such, SNC's obligations included management and coordination of engineering, procurement, and on-site construction works by Bechtel and other subcontractors.[326] Equally important, SNC was obligated to manage the risks on the Project.

372. At the time of WEC's bankruptcy (VCM 17) the Project had been underway for years, including advanced construction at the site. Based on its level of involvement, pre-WEC bankruptcy, SNC knew or should have known the conditions on the Project. These conditions encompassed the status of design and construction, as well as the unique characteristics and risks presented by this Project, including: the scale and complexity of a mega project and the unique characteristics of the AP1000 design, including the smaller footprint, which was congested vertical construction, as opposed to horizontal construction that provides greater flexibility in work sequencing.

373. In fact, the Project risks contained in VCM 17 confirmed SNC's advanced understanding of the

[324] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 10.
[325] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 12.
[326] Post WEC bankruptcy, WEC through a separate agreement continued to provide engineering and procurement services.

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Project and the associated risks in achieving the Project objectives of quality, time, and cost.

374. To accomplish its management roles and obligations, it was expected that SNC would develop integrated processes and procedures (including tools) for planning, monitoring and control across all functions and throughout the Project's life cycle. As will be shown below the requirements and procedures all serve to manage and mitigate risks to achieving the Project objectives. The analysis determined that although project management controls and procedures were in place, they were not effectively employed.

375. The analysis is presented below, and organized as follows:

- Overview of Roles and Responsibilities
- Project Primary Objectives
- Methodology and Standards
- Management of Key Processes

4.2 Overview of Roles and Responsibilities

376. Throughout the entire Project execution period, the Company, through SNC, had in place a layered organizational structure intended to inform about the Project primary objectives of quality, time (schedule), and safety. Initially, WEC was the fixed price EPC contractor, with overall responsibility across functional areas, including responsibility to manage the EPC risks on the Project.

377. The parties' roles and responsibilities were drastically altered when, after WEC's bankruptcy, SNC undertook the role as the overall project manager. As the project manager, SNC was now responsible for coordinating, monitoring, and controlling the execution of the Project including the Project risks. Although the analysis focused on SNC's performance after WEC's bankruptcy, to the extent necessary, J.S. Held also reviewed SNC's and Company's role and responsibilities prior to the bankruptcy. This primarily served the purpose of understanding SNC's familiarity of conditions on the Project in terms of status, risks and unique circumstances emanating from construction of the Vogtle Unit 3 and Unit 4 AP1000 design.

4.2.1 Company's and SNC's Role Prior to WEC Bankruptcy

378. During WEC's tenure as EPC Contractor, the Company employed a layered compliance structure

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generally described as follows:[327]

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- Additional roles of SNC in part entailed:

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4.2.2 Company's and SNC's Role/Organizational Structure after WEC Bankruptcy

379. Post WEC bankruptcy, SNC, as agent for Company, was the project manager with ultimate responsibility for successful completion of the Project. The SNC organizational structure was aligned

[327] August 2016, Plant Vogtle Units 3&4 Project Execution Plan, Version 7.1, pages 10-11.
[328] August 2016, Plant Vogtle Units 3&4 Project Execution Plan, Version 7.1, page 29.
[329] August 2016, Plant Vogtle Units 3&4 Project Execution Plan, Version 7.1, pages 38-39.
[330] August 2016, Plant Vogtle Units 3&4 Project Execution Plan, Version 7.1, page 20.
[331]August 2016, Plant Vogtle Units 3&4 Project Execution Plan, Version 7.1, page 43.

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around an integrated Project execution focus, with a singular point of accountability for all SNC and contractor resources. SNC set up an extensive and robust organizational structure to manage its obligations and the risks associated with achieving the Project primary objectives.

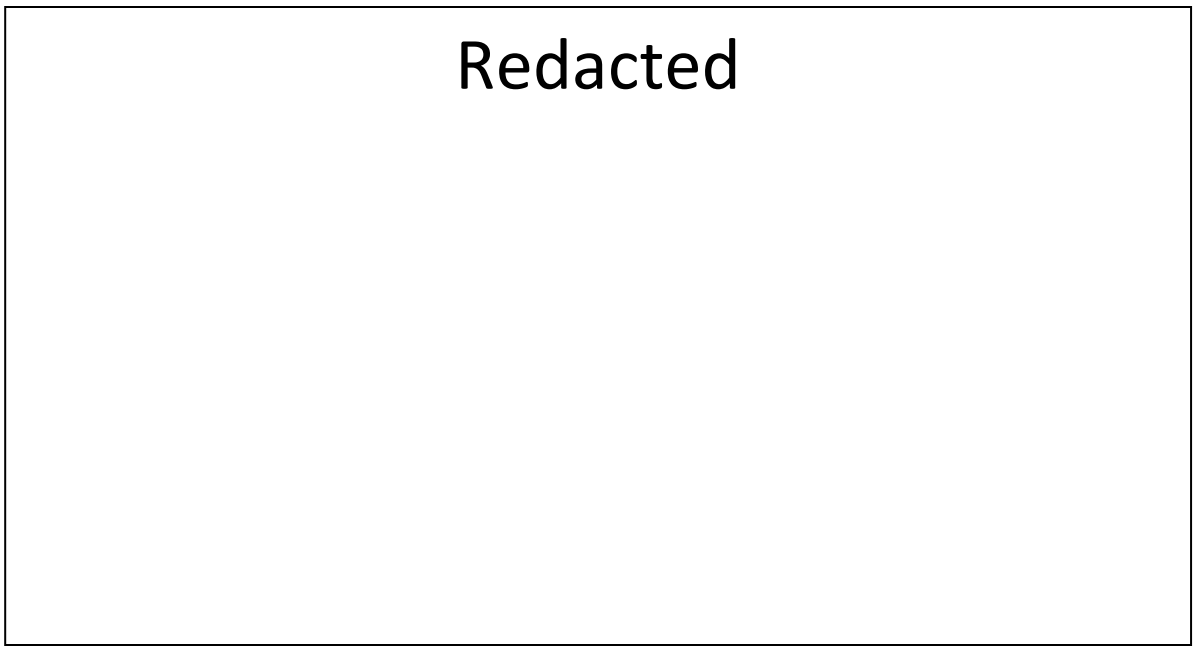
380. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[332]

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381. Given its role, SNC established a deep organizational structure for construction. This structure was instituted to enable SNC to manage and direct the overall and *day-to-day* execution of the Project.[333]

[332] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 6.
[333] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 14.

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382. As illustrated in the image above, and further detailed in the VPEP and SNC's various procedures, SNC's organizational structure was set up to manage across the Project phases and functional areas including engineering, procurement and construction. Further, the organization was structured to ensure that the Project primary objectives of quality, time (schedule) and costs were achieved. For instance, project controls contemplated management of schedule, reporting, risk management, and cost management. Further, controls in part were contemplated for work management and quality assurance.

4.2.3 Contractual Roles and Responsibilities

383. SNC was broadly responsible to successfully meet Project objectives through management and coordination across the EPC functions, as well as performing system testing, commissioning and assisting in startup. Bechtel was responsible for construction and testing of its installations. SNC obligations are listed below, followed by Bechtel obligations.

4.2.3.1 SNC obligations

384. SNC's obligations in part included the following:[334]

Broad Management Obligations

[334] Bechtel Construction Completion Agreement, Exhibit A - Scope of Work/Division of Responsibilities.

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<u>Time (Schedule) Management Obligations</u>

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<u>Quality Management (QA/QC) Obligations</u>

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<u>Risk Management Obligations</u>

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4.2.3.2 Bechtel Obligations

385. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[335]

[335] Bechtel Construction Completion Agreement, Exhibit A - Scope of Work/Division of Responsibilities.

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Construction Obligations

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Time (Schedule) Management Obligations

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Quality Management (QA/QC) Obligations

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Risk Management Obligations

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4.3 Project Primary Objectives

386. SNC indicated that successful Project execution is best characterized in part by three primary cornerstones consisting of quality, schedule, and cost.[336] SNC obligations and associated procedures were intended to mitigate and/or avoid the risks in achieving the Project objectives. To provide context, a brief description of the importance of each objective is discussed below.

4.3.1 Quality

387. A critical objective for successful completion of a Project (including by the project milestones) is to complete the work scope in conformance with the contractual quality requirements. Quality objectives span across all phases and functions of the Project – including, the quality of engineering, and the conformance to contractual requirements of the procured materials/ equipment and the installation/ construction. As set out below, one of SNC's core responsibilities included the management of quality in the work carried out by Bechtel and other subcontractors and vendors.

388. Management of quality broadly entails the following: development of a quality management plan (including policies, objectives and allocation or responsibilities), quality assurance (such as development of quality control requirements, surveillance/inspections, and review of quality control results), and quality control (such as inspections and tests). Given the nuclear nature of this Project, management of quality rises to a higher level than most other Projects, accordingly, the required documentation proving the installations meet specifications is rigorous and it includes ITAAC submittals to the NRC. This then becomes an added layer of requirements (and added risk) that exceeds most other projects. These requirements were known by SNC before and after taking on the overall management oversight.

389. SNC understood the significance of quality management, and it adopted common practices and regulatory requirements designed to achieve the quality objectives of the Project. (See Sections 3.3.8 and 4.4 of this Report for additional information relating to this topic.)

[336] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 5.

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390. Although SNC QA/QC procedures and tools generally conformed with regulatory requirements and common practices, the management of quality was ineffective. Despite timely and relevant quality management information such as unfavorable trends, deficiencies in installations and audits of quality management, persistent quality issues indicate ineffective risk management of quality. By way of example:

- In March 2021, the Root Cause Determination (RCD) Report for the cable separation found inadequate enforcement of construction standards and behaviors related to electrical installations. [337] In addition, the sample of work packages reviewed by the root cause team did not include any documented examples of in-process surveilling and monitoring activities on the inspection reports, as defined in N1204. [338]

- Likewise, "*The NRC inspectors found that Southern Nuclear did not adequately separate safety and non-safety-related cables for reactor coolant pumps and equipment designed to safely shut down the reactor. They also found instances where the company did not identify and report construction quality issues related to the safety-related electrical raceway system and enter them into its corrective action program.*" [339]

- NRC also highlighted the results from SNC's RCD and noted that the cable separation issues were missed by QC inspections as far back as November 2019, nearly seven (7) months before the first issue was identified in Unit 3 and a full year before most cable separation issues were identified by Bechtel and SNC.

- Internal audits highlighted several issues related to schedule and risk management that were not effectively managed throughout the life of the Project. XXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXX

391. Section 4.5 of this Report elaborates on risk management shortfalls. See also Section 3.3 of this Report for further information relating to the management of the Project and related issues.

[337] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, Version 9.0, page 4.
[338] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, Version 9.0, pages 5-6.
[339] United States Nuclear Regulatory Commission, NRC News, Office of Public Affairs, Region II, No. II-21-021, August 27, 2021.

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4.3.2 Time (Schedule)

392. The management of time is crucial in handling the risks associated with disruption (inefficiency) and delay. Standard practice prescribes the implementation of a time (schedule) management system against which the execution of the Work (across all functions and phases) can be planned, monitored and controlled. Appropriate schedule procedures serve to organize and execute the work in an efficient, logical and coordinated manner that conforms to contractual requirements and deadlines. They also provide a structured approach to measuring progress, thereby allowing for early warnings of delays and allowing the Project team to formulate a structured and measurable approach to mitigating delays and excess costs.

393. Given SNC's obligations, the schedules were a crucial management tool for coordination, control and reporting the separate functions and phases of engineering, procurement, and construction across both Units. Appropriate and effective time management also serves to provide timely risk identification and facilitates a structured and measurable approach to mitigation measures.

394. As examined in Sections 4.2 and 4.4 of this Report, SNC obligations and commitments relating to time management were comprehensive and robust, with the intent of providing meaningful processes and tools for planning, monitoring and controlling the execution of the Project scope. Further, SNC procedures were generally consistent with industry practices.

395. Despite developing procedures that generally conformed to its obligations, management's implementation of these procedures was ineffective as it relates to managing risk. Further, the information generated by these procedures was not effectively employed by SNC to manage risks related to progress and labor productivity. For example:

- Internal audits highlighted several issues related to schedule and risk management that were not effectively managed throughout the life of the Project. XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXX
- For a major portion of the Project period, the schedule updates did not depict accurately the level of progress and productivity being experienced during construction execution, thereby masking the actual progress delays and inaccurately depicting the actual recovery in the April 2019 Re-baseline forecast. As indicated in Section 4.4 of this Report, the progress information generated by the time management process is crucial to effectively manage risks relating to

disruption and delay on the Project. The inaccurate information hampered management's ability to objectively evaluate performance, timely identify emergent risks and employ foresight to avoid and /or mitigate risks to progress and productivity (inefficiency in labor).[340]

- Despite the atypical early transition to testing, there is no evidence of a formal cost-benefit risk analysis of the schedule. The absence of such an analysis impaired management's ability to use foresight to manage and mitigate risks to progress and labor productivity (efficiency).

396. See Section 5 of this Report for an expanded review of SNC's management of time.

4.3.3 Cost

397. Regulatory requirements, industry standards and SNC's own policies and procedures emphasize the importance of providing robust systems for monitoring, controlling, and reporting of costs. SNC was obligated to deploy integrated systems that provided an accurate assessment of incurred costs against an established baseline, reported to management and the Commission, and adjusted as appropriate, utilizing a formal change management process.

398. Despite developing procedures to meet its obligations, the information generated by these procedures was not effectively employed by SNC to manage risks related to cost growth. Instead, management proceeded in the same manner that had produced the unfavorable trends. This approach to risk management conflicts with SNC obligations and common industry practice and precludes the primary purpose of risk management – using foresight to mitigate risks. For example:

- Despite consistent negative trends that pointed to a sustained worsening in CPI, project management repeatedly forecasted that performance would improve.
- The monthly VPMB progress presentations indicated that production had not achieved expectations and CPI was worsening month-over-month. Nevertheless, management continued to forecast an improvement in CPI in each of the months to come.

4.3.4 Project Risks

399. Risks are present on all construction projects. The severity of a risk is governed by the nature and scale of a project as well as management decisions on the project. Risks can be present at the start

[340] As indicated in Section 3.3.1 of this Report, it appears that management was schedule driven and therefore placed a higher priority on meeting certain milestones, albeit at a reduced level of completion, at the expense of productivity and cost.

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of construction, or they may emerge during construction.

400. The management of risk is generally defined through a process of identifying, evaluating, transferring, and monitoring as well as developing mitigation strategies if the risks materialize. There are a variety of processes and tools that are employed in the industry for managing risks to achieve the project objectives relating to quality, time, cost, and safety. Broadly, these include the following:

- Risk management tools, such as risk registers.
- Time management tools – such as schedules.
- Quality management tools, such as quality assurance/quality control procedures and periodic audits.
- Cost management tools, such as earned value.

401. These tools provide information from project activities which is routinely collected as the project progresses such as schedule performance, quality performance, and costs incurred/productivity performance. The relevant data includes related trend reports and key performance indicators (KPI), such as productivity factors, SPI, and cost variance through earned value management and CPI. These metrics provide timely and crucial information regarding the risk management process, including identifying and monitoring risks, as well as developing appropriate mitigation strategies.

402. The risks on this Project may be segregated into three major categories: known and foreseeable risks as of VCM 17, emergent risks during construction execution, and unanticipated or unknown risks. A brief description of each category follows immediately below.

Known and Foreseeable Risks as of VCM 17

403. VCM 17 included several risks known at that time. Those specific to construction included the following.[341]

- The risk that the labor force and craft will be unable to maintain their productivity improvement.

[341] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A., pages 92-99.

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The risk that the Project cannot execute in accordance with the forecasted rates of production comprises a significant project execution risk. This risk also encompasses higher than anticipated rates of rework, or greater than expected design changes.[342]

- VCM 17 goes on to indicate that if these risks materialize, they will impact the schedule and the costs on the Project.
- The risk that the Project will be unable to continue to meet FOAK challenges.

One FOAK risk unique to this Project is the possibility of a delay to fuel load as a result of ITAAC closure, licensing challenges, or inadequate quality assurance documentation. One possible source of a delay is challenges in closing one or more ITAAC to enable fuel load.[343]

There is also a potential risk of discovery of an issue that calls the quality assurance pedigree of a component into question. ***…Late discovery of quality assurance problems could delay fuel load while the problems are resolved.***[344] ***[Emphasis Added]***

- Unidentified Scope Risk.

Examples include design changes that cause the need for rework or that make performing the work more difficult than the SNC ETC currently projects. These changes could result from constructability concerns or because of NRC-driven design changes.

SNC and Georgia Power will exercise oversight over the design change process with a goal of ensuring that certified-for-construction drawings and work packages are available*, with all identified design changes processed and reviews for constructability complete, well in advance of construction need.*[345] ***[Emphasis Added]***

As explained above, project execution risk covers the risk that Project management is unable to execute to the forecasted production rates and productivity. ***Causes for this risk include lack of available work fronts, lack of available field resources, or an overestimation of the rate at which the work can be completed.***[346] ***[Emphasis Added]***

[342] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A., page 94.
[343] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A., page 94.
[344] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A., page 95.
[345] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A., pages 96-97.
[346] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimates and Construction Schedule Pursuant to O.C.G.A., page 97.

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404. These risks did materialize, and they caused various degrees of delay and cost growth. See Section 3.3 and Section 4.5 of this Report for examination of these risks. Additional analysis relating to management of time and cost is found in Sections 5 and 6 of this Report, respectively.

Emergent Risks During Construction Execution

405. The decision to undertake an early transition to the testing phase was a significant change in execution strategy. As indicated in Section 3.3.4 of this Report, this was a substantial deviation from Bechtel's construction plan, and it was a deviation from common industry practices. This change in strategy introduced new risks such as planning and coordination of CWA and PRT packages, as well as amplifying known risks such as labor productivity issues. By way of example:

- The decision affected the planning and execution of all the work, including both construction and system testing. This resulted in the systems being separated into more and smaller parts resulting in growth in the number of PRTs, each of which had its own discrete impact on other work activities, labor and equipment management, and the corresponding production and productivity of all work.
- Bechtel noted in its Lessons Learned log XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

406. See also Section 4.5 of this Report for additional analysis of this issue.

Unanticipated Risks

407. The COVID-19 pandemic was an unanticipated risk that caused material delays and labor productivity issues. See Section 3.3.10 of this Report for further analysis of this issue.

4.4 Methodology and Standards

408. This section provides an overview of SNC management responsibilities and how it contemplated contemporaneously to execute those responsibilities. It also provides an overview of some of the internationally recognized practices and standards that apply to the provision of project management services to provide a benchmark in terms of SNC performance as the manager of the Project.

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4.4.1 Standard of Care Basis (Structure of Assessment)

409. SNC management responsibilities and practices are generally defined by:

- SNC's own VPEP and the information that was contained in the many versions of the VPEP that were issued during SNC's carrying out its management responsibilities[347]
- SNC's Agreement with Bechtel
- Regulatory Requirements
- Common industry practices and standards.

410. This evaluation therefore considered SNC's management in relation to its obligations and industry practices and requirements. This included examining the approach taken in relation to management across the Project functions (engineering, procurement, and construction) and the approach to the management of the risks in achieving key project objectives including quality, schedule, and costs. The evaluation also considered what was known and foreseeable or should have been known at the time of VCM 17, after WEC's bankruptcy, and the management of those known risks and conditions, that posed a threat to achieving the Project objectives relating to quality, time and cost.

411. The standards that have been selected are generally regarded within the industry as fundamental to a sound project management operation. It is well recognized that the use of judgment in executing these processes must be exercised within express guidelines (Consistency), provide an accessible and well understood record of decisions that are made (Transparency), and the decisions should be made by the same competent staff each time (Accountability).

4.4.2 SNC Management Guidelines, Policies and Procedures

412. This section presents the management guidelines referenced by SNC, those required by NRC regulations, as well as certain SNC procedures. Ultimately, these requirements and guidelines serve to manage the risks in achieving the Project objectives.

413. SNC processes and procedures to manage the quality, schedule, and costs on this Project are generally consistent with industry practices and regulatory requirements.

414. Further, SNC developed additional procedures, such as the CWA and PRT procedures, to manage

[347] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1.

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certain adjustments to the Project execution strategy.

415. In addition, SNC put in place various programs to address and correct emergent issues, such as the productivity improvement initiatives and quality control initiatives. Based on review of various Project documentation, such as performance indicators, these initiatives were not effective in achieving their objectives.

416. The discussion is organized as follows:

- Regulatory Guidelines (INPO, ASME, CFR)
- SNC quality management procedures, including NDQAM, VPEP and VPEP Subplans

4.4.2.1 Institute of Nuclear Power Operations

417. SNC indicated that management of the Project is guided by the following Institute of Nuclear Power Operations (INPO) principles:

> *Successful Project execution is closely linked to the Institute of Nuclear Power Operations' (INPO) Principles for Excellence in Nuclear Project Construction and is best characterized by four primary cornerstones consisting of Safety, Quality, Schedule, and Cost.*[348]

418. INPO in part recommends appropriate controls and continuous improvement practices in quality management.

> *Materials, equipment, and services nuclear suppliers provide meet all applicable requirements for form, fit, and function of the item(s), including the application of appropriate configuration controls and quality assurance program requirements.*[349]
>
> *Managers and workers seek continuous improvement and use effective performance improvement programs such as self-assessment and corrective action to identify and implement change.* [350]

419. Further to the management of quality, INPO recommends a CAP for screening and evaluating emergent issues, that also incorporates lessons learned:

[348] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 5.
[349] Institute of Nuclear Power Operations (INPO), 14-005, October 2014, Principles for Excellence in Nuclear Supplier Performance, Revision 0, page 1.
[350] Institute of Nuclear Power Operations (INPO), 14-005, October 2014, Principles for Excellence in Nuclear Supplier Performance, Revision 0, page 12.

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New problems reported in the corrective action program are screened promptly for their effect on safety, reliability, operability, and reportability.[351]

The nuclear suppliers communicate lessons learned from internal errors or events to appropriate personnel in a timely manner to prevent similar events; human performance errors; or problems resulting from weaknesses in processes, practices, procedures, training, and system or component design. [352]

4.4.2.2 Nuclear Development Quality Assurance Manual

420. The Nuclear Development Quality Assurance Manual is SNC's quality management manual.

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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[353]

421. The NDQAM generally adopts the relevant referenced ASME and Code of Federal Regulations (CFR) guidelines. According to SNC, the NDQAM is the top-level policy document that establishes the way quality is to be achieved and presents SNC's overall philosophy regarding achievement and assurance of quality.[354] The NDQAM describes the methods and establishes quality assurance and administrative control requirements that meet 10 CFR 50, Appendix B and 10 CFR 52. The NDQAM is based on the requirements and recommendations of ASME NQA-1-1994, *"Quality Assurance Requirements for Nuclear Facility Applications,"* Parts I, II, and III as specified in this document.[355]

4.4.2.3 ASME NQA-1-1994, "Quality Assurance Requirements for Nuclear Facility Applications," Parts I, II, and III

422. As noted in Section 4.3.2.2, SNC's NDQAM is based on the requirements and recommendations of ASME NQA-1-1994, "*Quality Assurance Requirements for Nuclear Facility Applications.*"[356]

423. ASME sets out a number of requirements across the EPC functions, which are in part considered below. Generally, these requirements are intended to provide protocols and controls for quality management, including regular, periodic verification of the program's effectiveness and

[351] Institute of Nuclear Power Operations (INPO), 14-005, October 2014, Principles for Excellence in Nuclear Supplier Performance, Revision 0, page 13.
[352] Institute of Nuclear Power Operations (INPO), 14-005, October 2014, Principles for Excellence in Nuclear Supplier Performance, Revision 0, page 15.
[353] June 25, 2018, Southern Nuclear, Quality Assurance Manual, Version No. 19.0, page 6.
[354] June 25, 2018, Southern Nuclear, Quality Assurance Manual, Version No. 19.0, page 6.
[355] June 25, 2018, Southern Nuclear, Quality Assurance Manual, Version No. 19.0, page 6.
[356] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994.

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improvement measures.

424. A documented QA program should be implemented that provides the means (such as tools, controls, and processes) to attain the required quality and for verification of quality.[357]

425. Ultimately, these requirements serve to manage the risks emanating from quality shortfalls.

426. Relevant requirements include timely quality control of design as well as coordination of interfaces.

> *The design shall be defined, controlled, and verified. Applicable design inputs shall be appropriately specified on a timely basis and correctly translated into design documents. Design interfaces shall be identified and controlled.*[358]

427. Appropriate document control, which is particularly important given the ITAAC obligations, is another requirement.

> *The preparation, issue, and change of documents that specify quality requirements or prescribe activities affecting quality shall be controlled to assure that correct documents are being employed. Such documents, including changes thereto, shall be reviewed for adequacy and approved for release by authorized personnel.*[359]

428. Surveillance and inspections are required during the entire installation process; and the purpose is mitigation of risks that may be encountered during the testing phase.

> *A combination of inspection and process monitoring methods, when used, shall be performed in a systematic manner to assure that the specified requirements for control of the process and quality of the item are being achieved throughout the duration of the process.*[360]
>
> ***Installation Checks***
> *Checks shall be performed to verify that mechanical items have been correctly installed and will function properly so that the initial starting of items and preoperational testing can proceed with a minimum amount of problems and delays.*[361]

429. Verification of the compliance and effectiveness of SNC procedures was to be carried out through

[357] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, page 11.
[358] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, page 18.
[359] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, page 25.
[360] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, page 34.
[361] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, pages 127-128.

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the industry recognized methods of a CAP and audits.

> *Corrective Action*
> *Conditions adverse to quality shall be identified promptly and corrected as soon as practical. In the case of a significant condition adverse to quality, the cause of the condition shall be determined and corrective action taken to preclude recurrence. … follow-up action shall be taken to verify implementation of this corrective action.*[362]
>
> *Audits*
> *Planned and scheduled audits shall be performed to verify compliance with all aspects of the quality assurance program and to determine its effectiveness.*[363]
>
> *Objective evidence shall be examined to the depth necessary to determine if these elements are being implemented effectively.*[364]

430. Likewise, ASME required appropriate measures to maintain the integrity of stored materials.

> *Measures shall be established and implemented for the packaging, shipping, receiving, storage, and handling of specified items to be incorporated in the nuclear power plant, and for the inspection, testing, and documentation to verify conformance to specified requirements.*[365]
>
> ***Inspections.*** *Inspections shall be performed and documented on a periodic basis to assure that the integrity of the item and its container, …is being maintained.*[366]

431. ASME further indicated that it is preferred for critical and support systems to be completed prior to conducting the hot functional test.

> *Hot functional tests for PWR plants follow cold function tests and simulate plant operating conditions at elevated temperatures and pressures.* ***All auxiliary and support systems, exclusive of those required for pre-criticality testing must be available for these tests****. If any of these systems is not available, the responsible organization shall specifically authorize exclusion of these systems from testing and document those exceptions.*[367] ***[Emphasis Added]***

[362] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, page 45.
[363] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, page 50.
[364] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, page 51.
[365] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, page 78.
[366] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, page 90.
[367] The American Society of Mechanical Engineers, Quality Assurance Requirements for Nuclear Facility Applications, ASME NQA-1-1994 Edition, Date of Issuance: July 29, 1994, page 130.

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4.4.2.4 10 CFR 50 Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants

432. SNC indicated that the QA program for the Project in part was based on the requirements 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.[368]

433. According to the CFR, "*Quality assurance includes quality control, which comprises those quality assurance actions…which provide a means to control the quality of the material, structure, component, or system to predetermined requirements.*"[369]

434. Like the requirements examined previously, the CFR quality management mandated appropriate and continual checking and verification of the construction installations.

> *The quality assurance functions are those … (2) verifying, such as by checking, auditing, and inspecting, that activities affecting the safety-related functions have been correctly performed.*[370]
>
> *The applicant **shall** regularly review the status and adequacy of the quality assurance program.*[371] ***[Emphasis Added]***

435. Consistent with NRC ITAAC requirements, the CFR also compelled the maintenance of detailed documents that verify the quality of installations.

> *Sufficient records shall be maintained to furnish evidence of activities affecting quality. The records shall include at least the following: Operating logs and the results of reviews, inspections, tests, audits, monitoring of work performance, and materials analyses.* [372]

436. Further, the CFR requires that risk management strategies included effective corrective action programs to timely detect and eliminate further quality shortfalls.

> *Measures **shall** be established to assure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures **shall** assure that the **cause of the condition***

[368] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 24.
[369] August 28, 2007, Appendix B to Part 50, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, page 2.
[370] August 28, 2007, Appendix B to Part 50, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, page 2.
[371] August 28, 2007, Appendix B to Part 50, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, page 3.
[372] August 28, 2007, Appendix B to Part 50, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, page 6.

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> ***is determined and corrective action taken to preclude repetition***. *The identification of the significant condition adverse to quality, the cause of the condition, and the corrective action taken* ***shall*** *be documented and reported to appropriate levels of management.*[373] ***[Emphasis Added]***
>
> *A comprehensive system of planned and periodic audits shall be carried out to verify compliance with all aspects of the quality assurance program and to determine the effectiveness of the program. ... Follow-up action, including reaudit of deficient areas,* ***shall*** *be taken where indicated.*[374]

437. Requirements for the management of quality extended to the preservation of stored procured materials.

> *Measures* ***shall*** *be established to control the handling, storage, shipping, cleaning and preservation of material and equipment in accordance with work and inspection instructions to prevent damage or deterioration.*[375]

4.4.2.5 Plant Vogtle Units 3 and 4 Project Execution Plan

438. SNC's VPEP broadly sets out its goals, strategies and processes that would be employed to achieve the Project objectives.

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> XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[376]

439. Accordingly, SNC's VPEP committed to set up the appropriate level of organization to successfully meet Project objectives.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*
> *XXXXXXXXXXXXXXXXX*[377]

[373] August 28, 2007, Appendix B to Part 50, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, page 6.
[374] August 28, 2007, Appendix B to Part 50, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, page 6.
[375] August 28, 2007, Appendix B to Part 50, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, page 5.
[376] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 4.
[377] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 4.

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4.4.2.5.1 Quality Assurance and Control

440. SNC committed to deploy the required resources and procedures for managing the risks related to quality.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[378]*

441. SNC further indicated that its quality management program was consistent with the NDQAM. By way of example the VPEP indicated that the program was intended to accomplish the following.

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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[379]*
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> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*
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> *XXXXXXXXXXXXXXXXXXX[381]*

Corrective Action Program

442. In accordance with regulatory mandates and industry common practices, SNC's Nuclear Development Corrective Action Program was implemented to satisfy the obligation for SNC's Nuclear Development organization to ensure safety by establishing the necessary measures and governing procedures to promptly identify, control, document, classify, and correct conditions adverse to quality in a timely manner.

443. The overall goal of the program was to ensure that the conditions adverse to quality were promptly reported, reviewed for significance, investigated, and resolved in a timely manner. As mentioned

[378] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 24.
[379] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 24.
[380] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 25.
[381] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 26.

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previously this is one of the nuclear industry's cornerstone procedures for managing the risks related to quality.

4.4.2.5.2 Time Management (Schedule)

444. Consistent with the common obligations of a project manager with overall responsibility, the VPEP assigned overall Project schedule ownership to the SNC Project Controls Scheduling personnel.

445. The key Project control activities related to schedule identified in the VPEP include the following:

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- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

4.4.2.5.3 Risk Management

446. SNC committed that the risk oversight would be the responsibility of the Project Oversight Organization. Further, SNC understood that the purpose of risk management was to mitigate negative impacts to the schedule and costs.

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447. SNC's approach to risk management was broadly described as follows.

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[382] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 11.

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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXX[383]

448. SNC further indicated that a risk register would be updated monthly based on meetings and discussions with the appropriate team members.[384]

4.4.2.5.4 SNC's Risk Management Subplan

449. Consistent with industry protocols, SNC's Risk Management (RM) process recognized that RM XXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[385]

450. The RM process described in this Subplan generally conformed with industry standards. By way of example, it described the following processes.[386]

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- *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*
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383 April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 33.
384 April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 34.
385 February 27, 2019, Southern Nuclear Procedure, Risk Management Program (RMP), ND-PC-VNP-010, Version 2.0, page 9.
386 February 27, 2019, Southern Nuclear Procedure, Risk Management Program (RMP), ND-PC-VNP-010, Version 2.0, page 9.

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451. Further, the process assigned layers of responsibility to manage the program. For instance:[387]

- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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452. SNC's RM process also contemplated change management procedures.

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4.4.2.5.5 Schedule Management

453. In addition to the requirements and procedures indicated in the VPEP, SNC developed a Scheduling Desktop Guide that articulated the standards, practices, and policies regarding the Project schedule. While primarily focused on technical setting and practices, this document also included policies regarding the handling of negative float as well as monthly reporting deliverables.

454. Specifically, the desktop guide indicated that any discrepancies between forecast dates and target dates must either be corrected prior to the close of the reporting period or elevated to Senior Management for help with resolution. The guide further stated that any deviation in Units 3 or 4's respective schedule was required to be removed daily either temporarily or by mitigating the issue. In addition, the guide identified documents and files to be provided to the Company, including reports from Acumen Fuse, earning & percent complete, commodity curves, critical paths, and P6

[387] February 27, 2019, Southern Nuclear Procedure, Risk Management Program (RMP), ND-PC-VNP-010, Version 2.0, pages 6-8.
[388] February 27, 2019, Southern Nuclear Procedure, Risk Management Program (RMP), ND-PC-VNP-010, Version 2.0, page 5.

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native format files.

4.4.3 Industry Standards and Practices

455. This section contains a summarized discussion of relevant industry treatises relating to the processes and tools employed to effectively manage the risks relating to quality, time, and costs. As is demonstrated in this section, SNC's regulatory obligations, management commitments and its procedures generally align with common industry practices promulgated by recognized management treatises.

456. The analysis is organized by the following recognized management treatises:

- Project Management Institute (PMI)
- Association for the Advancement of Cost Engineering International (AACE)
- Construction Management Association of America (CMAA)

4.4.3.1 Project Management Institute – Project Management Body of Knowledge

457. PMI was formed in 1969 as a professional organization to improve the quality of management in the execution of projects. To guide those engaged in project management, PMI developed the Project Management Body of Knowledge (PMBOK), which describes generally accepted practices with respect to project management. PMI indicates that the project management process was focused on meeting the project participants' objectives with respect to scope, quality, schedule, and cost.

458. Importantly, and relevant to the Project, PMI noted that the project management process adjusts to reasonably changing circumstances with the goal of not sacrificing the ultimate expectations. The process was measured by the success achieved in actively managing the interactions of participants and in achieving the project expectations within the overall execution context.

459. PMI defined construction management as follows:

> *The construction management (CM) entity manages the overall functions of the project including design, bidding, purchasing, and construction. The CM can execute the construction on an agency or on an at-risk basis. During construction, the at-risk CM*

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functions much like a general contractor with their subcontractors; whereas, the agency CM manages the work of prime contractors and their subcontractors.[389]

4.4.3.1.1 Management of Quality (QA/QC)

460. According to the PMBOK, Project Quality Management determines the quality policies, objectives and responsibility to assure the project needs will be met. It includes the following processes.

> *Plan Quality Management: The process of identifying quality requirements and/or standards for the project and its deliverables and documenting how the project will demonstrate compliance with quality requirements and/or standards.*
>
> *Manage Quality: The process of translating the quality management plan into executing quality activities that incorporate the organization's quality policies into the project.*
>
> *Control Quality: The process of monitoring and recording the results of executing the quality management activities to assess performance and ensure the project outputs are complete, correct, and meet customer expectations.*[390]

461. The PMBOK indicates that while Quality Management applies to all projects, the quality measures and techniques are specific to each project, primarily based on the scope and deliverables. Failure to meet the quality requirements can have various negative consequences, such as increased costs or delay to completion. Every project requires a Quality Management Plan that is monitored by the Project Team including maintenance of documentation to prove compliance with the agreed plan.

462. The PMBOK also defines the difference between Quality Assurance and Quality Control as follows:

> *Manage Quality is sometimes called quality assurance, although Manage Quality has a broader definition than quality assurance as it is used in non project work. In project management, the focus of quality assurance is on the processes used in the project. Quality assurance is about using project processes effectively. It involves following and meeting standards to assure stakeholders that the final product will meet their needs, expectations, and requirements. Manage Quality includes all the quality assurance activities and is also concerned with product design aspects and process improvements. Manage Quality work will fall under the conformance work category in the cost of quality framework.*[391] *Quality Control is the process of monitoring and recording the results of executing quality management activities, as defined in the Quality Management Plan, and it is intended to assess performance and ensure the*

[389] Construction Extension to The PMBOK Guide, Third Edition, Second Edition, 2008**,** PMI Project Management Institute, page 107.
[390] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition, 2017, Project Management Institute, page 271.
[391] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition, 2017, Project Management Institute, page 289.

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project outputs are complete, correct, and meet customer expectations. The key benefit of this process is verifying that project deliverables and work meet the requirements specified by key stakeholders for final acceptance. The Control Quality process determines if the project outputs do what they were intended to do. Those outputs need to comply with all applicable standards, requirements, regulations, and specifications. This process is performed throughout the project. [392]

4.4.3.1.2 Management of Time (Schedule)

463. Project Time Management is defined by PMI as the processes required to ensure timely completion of the Project.[393] These processes typically include the following:[394]

- Schedule Plan Management
- Activity Definition
- Activity Sequencing
- Activity Resource Estimating
- Activity Duration Estimating
- Schedule Development
- Schedule Control

464. The PMBOK-recognized process for time management starts with the Plan for Schedule Management, which establishes the policies, procedures and documentation required for the life of the project schedule from planning through controlling.[395]

465. PMBOK recognizes that, following the development of a reasonable and adequate project schedule, the contractor must exercise adequate control over that schedule and generate updates when necessary for the schedule to be effectively utilized as a project management tool. Naturally, the plan and control tools (schedules, etc.) must align with and meet the contractual requirements, including achievement of the mandated milestone completions, providing the required level of detail, and monitoring, controlling, and reporting as contractually required with respect to

[392] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition, 2017, Project Management Institute, page 298.
[393] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition, 2017, Project Management Institute, page 173.
[394] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition, 2017, Project Management Institute, page 173.
[395] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition, 2017, Project Management Institute, page 179.

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frequency and level of detail.

466. Consistent with the SNC obligations, PMBOK indicates that Schedule Control entails the following:

- Determining the status of the project schedule
- Influencing the factors that create schedule changes by conducting retrospective reviews and adjusting the schedule process as required
- Conducting retrospective reviews and adjusting the schedule process as required
- Reprioritizing remaining work to address backlogs
- Determining work productivities on a regular basis
- Determining that the project schedule has changed
- Managing the actual changes as they occur

467. During the control phase, unplanned situations occur, the potential impacts of which must be an added input to the schedule control system. To accomplish this task, the project manager must integrate information pertaining to performance and change requests into the project's baseline schedule. The project manager accomplishes the integration of this information through the schedule change control system and the measurement of performance.

4.4.3.2 Management of Risk

468. Risk Management is defined within PMBOK as follows:

> *Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation and monitoring of risk on a project. The objectives of Project Risk Management are to increase the probability and/or impact of positive risks, and decrease the probability and/or impact of negative risks, in order to optimize the chance of project success.*[396]

469. According to the PMBOK:

> *Risk is an uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives.*[397]

470. The PMBOK stresses the proactive approach to managing risk.

[396] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition, 2017, Project Management Institute, page 395.
[397] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition, 2017, Project Management Institute, page 397.

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> *High-variability environments, by definition, incur more uncertainty and risk. To address this, projects managed using adaptive approaches make use of frequent reviews of incremental work products and cross-functional project teams to accelerate knowledge sharing and ensure that risk is understood and managed. Risk is considered when selecting the content of each iteration, and risks will also be identified, analyzed, and managed during each iteration.* [398]

471. PMBOK identifies the output of the risks process as being a Risk Register containing both a list of identified risks and a list of potential responses. The Risk Register should be regularly updated and, in part, entail ranking of risks, and causes of risks or project areas that require particular attention, including responses.

472. The updating process includes, but is not limited to, outcomes of risk reassessments, risk audits, and periodic risk reviews. Additionally, appropriate updates to the project management plan are made and touch multiple elements of management including quality, schedule, cost, and procurement.

4.4.3.3 Association for the Advancement of Cost Engineering International

473. AACE is a recognized source for recommended practices in engineering and construction. AACE's mission is to enhance skills and knowledge and to improve the predictability of cost and schedule performance across the entire life cycle of assets, programs, and projects by providing technical guidance, educational products, events and professional certifications. Examples of relevant published Standard of Performance guides/articles, referred to as "Recommended Practice" (RP), include the following:

- 36R-08 Development of Cost Estimate Plans – as applied in EPC for the Process Industries.[399]
- 39R-06 Project Planning – As Applied in Engineering and Construction for Capital Projects[400]
- 60R-10 Developing the Project Controls Plan[401]
- 83R-13 Organizational Breakdown Structure and Responsibility Assignment Matrix[402]

[398] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition, 2017, Project Management Institute, page 400.
[399] AACE International Recommended Practice, 36R-08, Development of Cost Estimate Plans – As Applied in Engineering, Procurement, and Construction for the Process, Rev. October 10, 2019.
[400] AACE International Recommended Practice, 39R-06, Project Planning – As Applied in Engineering and Construction for Capital Projects, Rev. December 8, 2011.
[401] AACE International Recommended Practice, 60R-10, Developing the Project Controls Plans, Rev. December 21, 2011.
[402] AACE International Recommended Practice, 83R-13, Organizational Breakdown Structure and Responsibility Assignment Matrix, Rev. May 1, 2014.

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4.4.3.3.1 Management of Quality

474. AACE indicates that QA/QC involves inspections and verifications of the effectiveness of the quality control procedures.

> *QA includes practices focused on providing confidence that requirements will be fulfilled while QC includes practices focused on fulfilling the requirements. QA is generally focused on measuring and assessing conformance of the quality management system and processes with its requirements. As such QA does not ensure quality assets or products, but provides confidence that nothing stands in the way of quality being achieved (e.g., Do you have a quality management process? Is it being followed?). QC focuses on measuring and assessing the conformance of products with their requirements (e.g., Is the product in accordance with specification?).*[403]

4.4.3.4 Management of Time

475. AACE provides several RPs related to Project Schedule (Time) Management concepts, such as, project planning, baseline scheduling design and updates, and analysis of delay based on project schedules, among others.[404] Several of these RPs are specific to the EPC delivery method.

476. AACE RP 60R-10 Developing the Project Controls Plan, defines the requirements for proper schedule controls.

> *The project controls plan will address the integration of the schedule development, basis of schedule and schedule validation process.* [405]

477. AACE RP 39R-06 notes that EPC contractors have a broader responsibility for planning due to early involvement in the project.[406] AACE RP 39R-06 identifies typical planning shortcomings that can lead to failure during the execution of the plan, such as.

> *Failure or poor execution by the project team in developing and implementing a comprehensive plan.*

[403] Total Cost Management Framework, An Integrated Approach to Portfolio, Program, and Project Management, First Edition, Edited by John K. Hollmann, PE CCE, 2006, page 249.
[404] AACE International Recommended Practice, 60R-10, Developing the Project Controls Plans, Rev. December 21, 2011; AACE International Recommended Practice, 39R-06, Project Planning – As Applied in Engineering and Construction for Capital Projects, Rev. December 8, 2011; AACE International Recommended Practice, 53R-06, Schedule Update Review – As Applied in Engineering, Procurement, and Construction, Rev. August 14, 2008.
[405] AACE International Recommended Practice, 60R-10, Developing the Project Controls Plans, Rev. December 21, 2011, page 9.
[406] AACE International Recommended Practice, 39R-06, Project Planning – As Applied in Engineering and Construction for Capital Projects, Rev. December 8, 2011.

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> *Failure by the project team to revise the plan when major changes have been identified and incorporated into the scope of work.* [407]

478. According to AACE RP 53R-06, the schedule update reflects the Contractor's *intent to reach project completion*.[408] AACE RP 53R-06 further indicates that late or inaccurate updates can negatively impact the overall performance of the contract.

> ***Failure to arrive at a quick, accurate, and timely agreement of project status can cause confusion, uncertainty, and potential loss of time and/or money on many projects.*** *A lack of timely agreement on the project schedule status could result in contractor acceleration, cost overruns, late project delivery, and disputes that frequently last well past project completion.*
>
> *Assessment of the impacts of trends, deviations, changes, etc. on project schedules usually cannot be made without agreement on schedule status. If the participants agree that the schedule update submittal meets the specified standards and represents the current status and forecast using logic for the project as of the status date for the schedule update, it is understood that both the contractor and owner are in agreement on approval of the schedule submittal.* [409] ***[Emphasis Added]***

479. AACE RP 53R-06 adds that it is of paramount importance to the project that the schedule be updated, submitted, and reviewed per the contractual requirements.

> *For the owner to receive full value of the schedule submittal, it should be delivered within the specified time.*
>
> *Failure to comment on a schedule submittal in a timely manner may result in disruption and hinder the efficient prioritization of scheduled construction. Because failure to comment generally implies acceptance of the schedule, it is in the owner's interest to review and formally comment and/or accept the submitted schedule update.* [410]

480. AACE also indicates that accurate recording of actual data is critical to the usefulness of the update's output.[411]

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[407] AACE International Recommended Practice, 39R-06, Project Planning – As Applied in Engineering and Construction for Capital Projects, Rev. December 8, 2011, page 12.
[408] AACE International Recommended Practice, 53R-06, Schedule Update Review – As Applied in Engineering, Procurement, and Construction, Rev. August 14, 2008, page 1.
[409] AACE International Recommended Practice, 53R-06, Schedule Update Review – As Applied in Engineering, Procurement, and Construction, Rev. August 14, 2008, page 2.
[410] AACE International Recommended Practice, 53R-06, Schedule Update Review – As Applied in Engineering, Procurement, and Construction, Rev. August 14, 2008, page 4.
[411] AACE International Recommended Practice, 53R-06, Schedule Update Review – As Applied in Engineering, Procurement, and Construction, Rev. August 14, 2008, pages 8-9.

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AACE further stresses the importance of notifying the Owner of all changes in the schedule so that the change may be accepted or mitigated.[412]

Further, the Contractor is responsible for the accuracy and viability of the submitted update.[413]

4.4.3.4.1 Construction Management Association of America

481. SNC represents that its role on the Project was that of a project manager as agent of the Company, SNC, on behalf of all the Vogtle Owners, including management of overall execution and direction of day-to-day Project activities.[414] As such, common industry practices in construction management are applicable.

482. CMAA was formed in 1982 to establish standards for managing construction projects. CMAA's mission is to promote the profession of construction management and the use of qualified construction managers on projects and programs.

483. CMAA publishes the Construction Management Standards of Practice, which is intended to establish industry standards of service and to serve as a guide to the range of services that constitute professional construction management. In that publication, the CMAA discussed the role of a construction manager as follows.

Construction management is a management approach that focuses on the delivery of professional services. There are several different forms and variations of the construction management practice. Each has its own definition, characteristics, and menu of services. All variations can be placed in both the "agency" or "at-risk" forms of construction management. [415]

4.4.3.4.2 Management of Quality

484. According to CMAA, QA/QC involves a continuous review and inspection of workmanship and systematic verifications to verify the effectiveness of the quality control procedures.

485. Accordingly, the CMAA definitions are as follows:

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[412] AACE International Recommended Practice, 53R-06, Schedule Update Review – As Applied in Engineering, Procurement, and Construction, Rev. August 14, 2008, page 11.
[413] AACE International Recommended Practice, 53R-06, Schedule Update Review – As Applied in Engineering, Procurement, and Construction, Rev. August 14, 2008, page 17.
[414] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 10.
[415] CMAA: Construction Management Association of America, Construction Management Standards of Practice, 2015 Edition, page 5.

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Quality Control (QC)

The continuous review, certification, inspection, and testing of project components, including persons, systems, materials, documents, techniques, and workmanship to determine whether or no such components conform to the plans, specifications, applicable standards, and project requirements.[416]

Quality Assurance (QA)

The application of planned and systematic examinations or verifications, which demonstrate that quality control procedures are being effectively implemented.[417]

486. The excerpt from CMAA above highlights the importance of SNC ensuring (through various methods such as surveillance and inspections) that the work is compliant with contractual specifications.

487. In administering the contractor's QC program, the project manager's role is one of quality assurance and is fairly and impartially implementing the requirements stipulated in the contract documents.

4.4.3.5 Management of Risk

488. In its publication titled "Construction Management Standards of Practice", the CMAA states that in the context of design and construction:

… risk management is the process to methodically address risk and work to lessen the impact of the occurrence of risk events on a project or program in all phases of development.[418]

489. According to the same publication, the objective of risk management for construction projects and programs is to provide a process for the early identification of risks and opportunities to allow them to be tracked and managed throughout the project.

490. CMAA indicates that often the larger or more complex the project, the more severe the risk consequences can be, adding the following.

The best method for dealing with these uncertainties and the associated risk consequences is to develop and implement a risk management process as part of the construction management process. A structured risk management methodology is one of the key management processes integrated with the project management

[416] CMAA: Construction Management Association of America, Construction Management Standards of Practice, 2015 Edition, pages 51-52.
[417] CMAA: Construction Management Association of America, Construction Management Standards of Practice, 2015 Edition, page 52.
[418] CMAA: Construction Management Association of America, Construction Management Standards of Practice, 2015 Edition, page 127.

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> *applications, receiving the same level of attention as budget control and scheduling, decision-making, and claims avoidance.* ***Controlling risks is not an arbitrary function that is separate or apart from other project management applications****. Risk management is expected to be a continuous process on projects and be integrated into the project management processes.* [419] ***[Emphasis Added]***

491. The CMAA presents four essential components of the risk management process:

- Communication and Reporting: The construction manager holds project team meetings to communicate the risks and opportunities, collect feedback, updates and any relevant information. Reports are then produced and communicated to internal project personnel based on who should be informed and be in the best position to act or mitigate the risks or achieve the opportunity.
- Tracking: After updates from the project risk meetings, the risks and opportunities are tracked and adjusted, based on input from the project team, including additions to the list when new risks or opportunities become known. Tracking must be updated and communicated consistently to maintain a focus on the priorities of the project team.
- Mitigation: According to CMAA, mitigation is possibly the most important part of the risk management process. The CMAA recommends that a member of the project team is given the primary responsibility for the risk as the risks are identified.

492. The CMAA stresses that as many risks outside of the control of the project team have the potential to cause impacts if not continually monitored, "*The project owner should have an ongoing integrated process for risk management based on sound fundamental principles. As conditions change, the CM, on behalf of the owner, should have a process in place for implementing new mitigation strategies and options as project conditions change*."[420]

493. In conclusion, CMAA indicates that a continuous integrated risk management process will help reduce the potential for unidentified negative impacts, improve the CM's continuous efforts of obtaining consensus, continue coalition building, and maintain a steady focus on the project's constraints and objectives.

[419] CMAA: Construction Management Association of America, Construction Management Standards of Practice, 2015 Edition, page 128.
[420] CMAA: Construction Management Association of America, Construction Management Standards of Practice, 2015 Edition, page 136.

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4.5 SNC's Management of Key Processes

494. This section analyzes SNC's management of its obligations, including how known, foreseeable, and emergent risks were managed. In order to achieve the Project primary objectives, risks must be managed effectively.

495. The analysis is segregated into the following major management categories:

- Management of Risk
- Management of Quality
- Management of Time
- Management of Cost

4.5.1 Management of Risk

496. Management of risk entails using foresight to deal with known and emerging issues that pose risks to achieving the project objectives. SNC's VPEP indicates that risk is an inherent part of the project that would need to be identified and managed to mitigate potential impacts. There are various tools that are employed in the industry for managing risks in order to achieve the project objectives relating to quality, time, cost, and safety.

497. Broadly, the objective of risk management is to provide a process for the early identification of risks to allow them to be tracked and managed throughout the project execution period. Likewise, SNC indicates that the purpose of its risk procedures is to facilitate effective and efficient XXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXX*[421] The ultimate objective XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXX*[422]

498. The risk management process employs a structured approach to managing risks, which involves the compilation of all risks in a centralized manner to facilitate efficient evaluation and timely treatment strategies, as well as effective reporting to management and to accountable parties. Information

[421] April 2018, Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 33.
[422] A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition, 2017, Project Management Institute, page 395.

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from project activities is routinely collected as the project progresses such as schedule performance, quality performance, and costs incurred/productivity performance. The relevant data includes related trend reports and KPIs, such as productivity factors, schedule performance index, and cost variance through earned value management and cost performance index. Naturally, timely and accurate updating of the performance metrics is a vital requirement. See Section 3, Section 5, and Section 6 of this Report for additional analysis of schedule and cost metrics.

499. SNC's Risk Management Program established procedures for the risk management process flow which includes identification, qualitative risk analysis, risk response planning, monitoring and control, and reviews and approvals. Generally, the Risk Management Program was reasonably aligned with requirements and common industry practice. [423]

500. Further, the information generated by the other key management control processes (quality, time and cost) was contemporaneously generating information about the health of the project and relevant trends and metrics. In addition, periodic audits were conducted to evaluate the implementation and effectiveness of the key management processes (quality, time and cost) and identify areas that posed risks and needed improvement.

501. Although the underlying processes supporting risk management were providing timely information relating to unfavorable Project trends, and audits identified areas that needed improvements, effective mitigation strategies were not implemented. In fact, even though historical data, such as labor productivity factors, habitually displayed unfavorable performance metrics, management nevertheless continued in the same manner that had produced the unfavorable trends. This approach to risk management conflicts with SNC's obligations and commitments, as well as common industry practices; and it deprives the Project of the benefits from risk management.

502. As an example, SNC proceeded with the PRT program until completion of Unit 3, under severely degraded productivity factors. So, instead of managing the known VCM 17 risks relating to productivity, SNC directed changes in Bechtel's construction plan which amplified the known risks. When Project performance metrics informed about the unfavorable trends, SNC nevertheless proceeded absent any effective mitigation measures. In recognition of the PRT impacts, SNC apparently somewhat changed its strategy for Unit 4 as bulk construction was substantially

[423] February 27, 2019, Southern Nuclear Procedure, Risk Management Program (RMP), ND-PC-VNP-010, Version 2.0.

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completed before the transition to systems testing. See Section 3.3 of this Report for additional analysis relating to the PRT process.

503. The following evaluation focuses on certain aspects of the SNC's management of the risk processes, and it is organized by the following topics:

- Risk Registers
- Known Risks
- External Audits

4.5.1.1 Risk Registers

504. The risk register typically serves as the centralized repository of risks on a project. The risk register is regularly updated to reflect the current known risks, including ranking of impact severity, probability of occurrence, and mitigation strategies.

505. Management developed and maintained a risk register that was provided to the Commission and included in the Project's monthly status reports. Additionally, high value risk register line items as well as newly identified risks were reviewed monthly through Risk Management Working Group (RMWG) meetings.

506. Although there were RMWG Meeting Agendas or Presentations which span from January 2019 through September 2022, there are no meeting minutes from these meetings. Therefore, there is no information regarding any potential mitigation measures for treating the identified risks. Given the acknowledged importance of risk management and the scale and complexity of the Project, the lack of minutes conflicts with management's obligations and commitments, as well as with common industry practices.

507. While these risk registers were developed and there were consistent RMWG meetings, it does not appear that there were meaningful steps taken to address the underlying causes to reduce the risk levels. As examined in Section 3 of this Report and in this section various risk drivers persisted for extended periods of time, resulting in detrimental impacts to the Project.

Risk Register Example – Construction Productivity

508. One example of ineffective risk mitigation relates to the issue of craft productivity. Achieving budgeted productivity was identified as a risk in VCM 17. The excerpt below from the August 2018,

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Risk Register includes three identified risks related to craft productivity and resulting schedule delays.[424]

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509. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[425] XXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*

510. As time went on, the risk amount was updated monthly to reflect Project performance. XXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXX*[426] The detailed risk analysis included within this document does not reference any mitigation measures, only updates to the cost impacts.

511. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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[424] Vogtle Project Risk Register. J22080649-0000026899_August 2018 Update to TS Attachment STF-142-4 Vogtle Project Risk Register - DD 8-24-2018_2.xlsx, 'Risk Register' tab.

[425] J22080649-0000026899_August 2018 Update to TS Attachment STF-142-4 Vogtle Project Risk Register - DD 8-24-2018_2.xlsx,August 2018, Project Risk Register 'Risk Register' tab

[426] November 30, 2021, November Risk Management Working Group (RMWG) Meeting, page 7. "*"High / Very High" is defined as those risk events that score 15 or higher on our Project Risk Scorecard –matrix of probability versus consequence.*" Page 10 includes details for Risk Event 181-3.

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XXXXXXX	*XXX*	*XXX*
XXXXXX	*XXX*	*XXX*
XXXXXXX	*XXX*	*XXX*
XXXXXXXXXXXX	*XXX*	*XXX* [427]

512. This Forecasted CPI To Go of 4.32 is significantly higher than the forecasted CPI of 1.46 as of VCM 17.[428] As previously indicated, the Project consistently failed to achieve planned performance targets and project management was ineffective in undertaking meaningful steps to remediate the negative trends, and ultimately forecasted that performance would improve despite observed trends pointing to a continued decline. See Section 3.3 of this Report for further analysis of CPI rates.

513. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[429]

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[427] Vogtle Project Risk Register. J22080649-0000026775_TS Attachment STF-142-4 Vogtle Project Risk Register - DD 2022-05-23.xlsx, "Risk Event ID Catenate" for 181-3 and column "Basis of Estimate".
[428] August 29, 2017, VCM 17 Exhibit 7, Plant Vogtle Units 3 & 4 Quantitative Risk Assessment, page 14 states, "*The estimate assumes a performance range from 1.2 to 3.0 with 1.46 as the most likely performance factor*."
[429] Vogtle Project Risk Register. J22080649-0000026775_TS Attachment STF-142-4 Vogtle Project Risk Register - DD 2022-05-23.xlsx, "Risk Event ID Catenate" for 181-3 and column "Activity Log".

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514. The above excerpt further indicates that SNC was just simply updating the risk event log monthly that was reflective of deteriorating performance. The above indicates that the persistent underlying cause, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX was not addressed and/or risk event consequences were not effectively remediated. Further to this point, a series of motion studies conducted through 2019, by SNC's independent consultant, Vitale, determined that a lack of XXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX. See Section 4.5.1.2 of this Report for further examination of the Vitale studies.

515. Management's decisions during March and August 2019 to reduce and subsequently maintain the risk probability at 25% represented an ambitious, albeit unrealistic target given Unit 3 historical performance.

516. SNC's unrealistic approach to mitigating risk was further supported in the VCM testimony of Don Grace. In VCM 22 Grace testified that SNC's productivity risk analyses were not reflective of historical trends on the Project. Unrealistic forecasted production rates had been a continued issue on the Project ever since VCM 17. For example, Grace stated:

> *Here, the CPIs that are assumed in SNC's latest risk analyses are based on much lower numbers than recent experience would indicate, and this therefore represents an example of unrealistic inputs to SNC's risk analysis process.*[430]

517. By VCM 26, Grace stated that the Risk Management Process has been a failure by SNC.

[430] June 5, 2020, Direct Testimony of Donald N. Grace P.E., page 32.

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> *The next issue is* ***the Risk Management Process*** *(up to just recently)* ***has continued to underestimate risks which has then led to not taking adequate risk mitigation measures****.* [431] ***[Emphasis Added]***

4.5.1.2 Known Risks

518. Under VCM 17 SNC identified the known and/or anticipated risks that it was obligated to manage. This section examines the management of a number of those known risks as of VCM 17, that can be segregated into the following topics:

- First of a Kind Risk – ITAAC
- Productivity (Vitale Reports and Bechtel Reports)

First of a Kind Risk – ITAAC

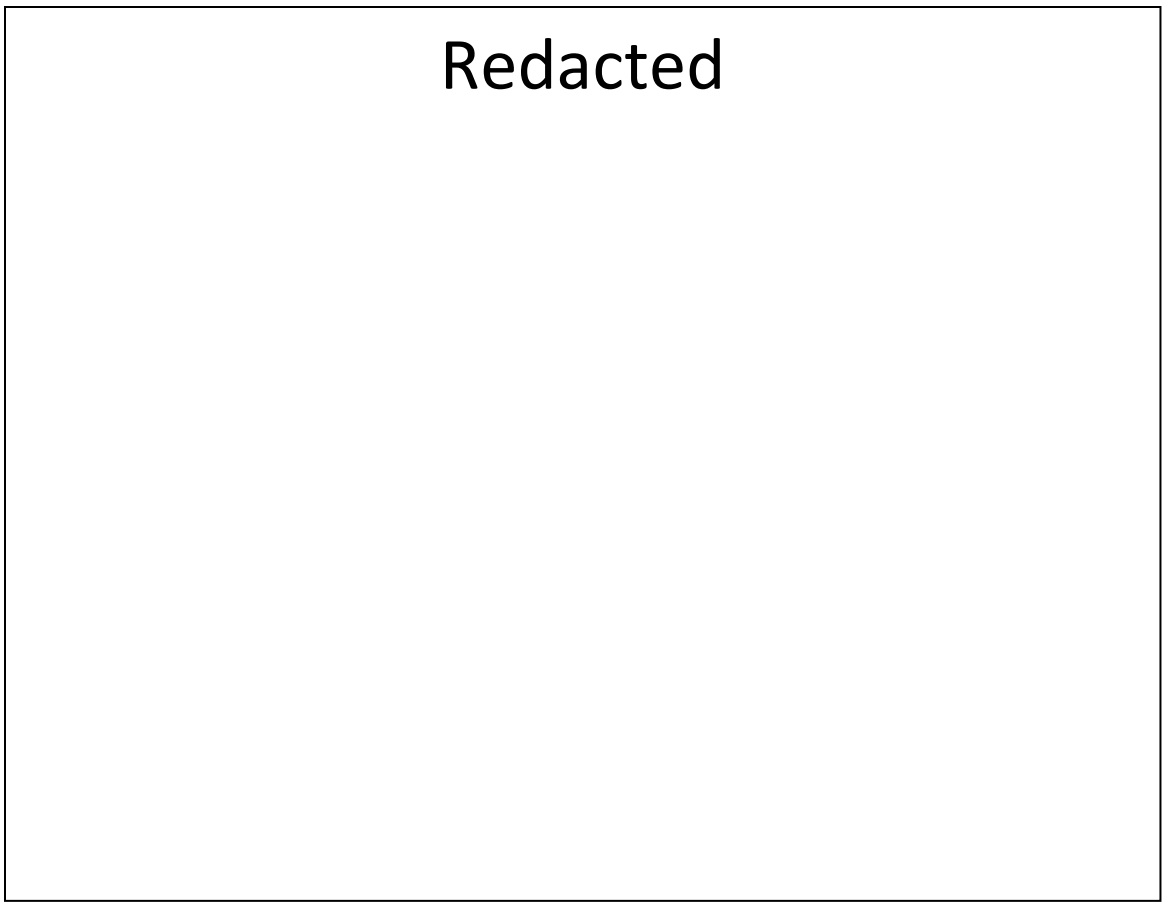
519. In VCM 17 ITAAC was labeled as a unique risk to this Project:

> *One FOAK risk unique to this Project is the possibility of a delay to fuel load as a result of ITAAC closure, licensing challenges, or* ***inadequate quality assurance documentation****.* ***One possible source of a delay is challenges in closing one or more ITAAC to enable fuel load.*** [432] ***[Emphasis Added]***

520. Given this known risk, SNC was obligated to manage the ITAAC process to eliminate and/or reduce impacts from ITAAC closure. SNC did not effectively manage this risk, resulting in a significant backlog of incomplete and/or missing inspection records (IR) that took considerable time and effort to resolve in an expedited manner. Moreover, completion of these IRs delayed the Project. The excerpt below depicts that there was a backlog of 25,000 IRs, as of November 2021,[433] which was four (4) months after achieving HFT for Unit 3. This is another example of deficient risk management by SNC.

[431] June 17, 2022, Direct Testimony of Donal N. Grace P.E., page 15.
[432] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, page 94.
[433] November 18, 2021, GPC-SNC Monthly Project Review Meeting Presentation.

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Productivity (Vitale Reports and Bechtel Reports)

521. **Figure 4.5-1** below depicts several impactful issues that caused disruption, delay and cost growth on the Project. The blue bars represent contemporaneous alerts by Bechtel regarding impacts to their construction. These in part included:

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- XXXXXXXXXXXXXXXXXXXX
- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

522. The black bars in **Figure 4.5-1 XXXXXXXXXXXXXXXXX**, represent periods when motion studies were conducted by SNC's independent consultant, Vitale. Vitale's reports generally observed the following:

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- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXX

Figure 4.5-1 XXXXXXXXXXXXXX

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523. Corresponding KPIs, such as PF factors, CPI and SPI, further corroborated the unfavorable conditions on the Project. Therefore, SNC was aware of the risks to productivity based on contemporaneous information provided by KPIs, independent experts and Bechtel.

524. Further, Bechtel contemporaneously and repeatedly raised concerns that the PRT execution strategy was difficult to manage and coordinate and it was causing labor inefficiency and Project delays. These impacts represented the materialization of known risks as of VCM 17. Section 3 of this Report contains additional analysis of the PRT issue.

525. SNC proceeded with the PRT program until completion of Unit 3, under severely degraded productivity factors. So, instead of managing the known VCM 17 risks, SNC directed changes in Bechtel's construction plan which amplified the known risks. When Project performance metrics informed about the unfavorable trends, SNC nevertheless proceeded absent any meaningful mitigation measures. In recognition of the PRT impacts, SNC apparently changed its strategy for Unit

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4, bulk construction was substantially completed before transition to systems testing. Sections 3.3.5, 3.3.6 and 3.3.7 of this Report contain additional analysis of these issues.

4.5.1.3 External Audits

526. Audits are a risk management tool commonly employed on construction projects to provide an objective evaluation of the project, verify the effectiveness of implemented processes and procedures, and serve as a risk mitigation tool by providing recommended process improvements. Consistent with its obligations and common industry practices, the Company retained a third-party firm (KPMG) to conduct such audits.

527. By July 2018, KPMG was engaged by the Company[434] to assess the processes and controls. KPMG stated their scope was to:

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- *XXXXXXXXXXXXXXXXX*
- *XXXXXXXXXXXXXX*
- *XXXXXXXXXXXXXXXX*[435]

528. In February 2019, KPMG provided their findings, which included a benchmark of SNC's Risk Management strategy compared to other energy industries.

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[434] February 8, 2019, KPMG, Vogtle Project Controls Maturity Assessment, Georgia Power Company (GPC), Southern Nuclear Company (SNC), Oglethorpe Power Corporation, Municipal Electric Authority of Georgia, Inc., and Dalton Utilities, Georgia (collectively, Co-Owners), page 4.
[435] February 8, 2019, KPMG, Vogtle Project Controls Maturity Assessment, page 4.

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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXX[436]

530. KPMG provided several recommendations to the Company/SNC with respect to Policies and Procedures, Roles and Responsibilities, Bechtel Risk Alignment, Risk Identification and Assessment, Mitigation, and Reporting. These recommendations included the following:

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531. In summary, SNC's management of Project risks was deficient and ineffective, driven by unreasonable decisions that were schedule driven at the expense of cost growth. See Section 3 of this Report for additional analysis of this topic.

4.5.2 Management of Quality

532. As demonstrated previously in Section 4.4 of this Report, SNC understood the significance of quality management, and it adopted common practices and regulatory requirements designed to achieve the quality objectives of the Project.

533. Although SNC developed and implemented several quality management procedures and tools, the management of quality was ineffective, resulting in unfavorable impacts to costs (such as disruption and rework) and schedule.

[436] February 8, 2019, KPMG, Vogtle Project Controls Maturity Assessment, page 21.
[437] February 8, 2019, KPMG, Vogtle Project Controls Maturity Assessment, pages 47-48.

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534. The Project files document a variety of lapses in quality management and missed opportunities in risk mitigation. By way of example:

- The systemic increase of IEEE 384 related cable separation violations appeared to be first documented in the CRs in Unit 3 in July 2020, in CR 50055012.[438] Additional cable separation violations and the subsequent CRs were issued in October and November 2020. This suggests ineffective and/or delayed mitigation of a known risk.
- In March 2021, the RCD Report for the cable separation found *Inadequate enforcement of construction standards and behaviors related to electrical installations.* [439] In addition, "*The sample of work packages reviewed by the root cause team did not include any documented examples of in-process surveilling and monitoring activities on the inspection reports, as defined in N1204*." [440]
- Likewise, "*The NRC inspectors found that Southern Nuclear did not adequately separate safety and nonsafety-related cables for reactor coolant pumps and equipment designed to safely shut down the reactor."* They also found *"instances where the company did not identify and report construction quality issues related to the safety-related electrical raceway system and enter them into its corrective action program."*[441]
- The NRC also highlighted the results from SNC's root cause determination and noted that the cable separation issues were missed by QC inspections as far back as November 2019, nearly seven months before the first issue was identified in Unit 3 and a full year before most cable separation issues were identified by Bechtel and SNC.
- CRs seem to agree with NRCs observations. The cable separation issues were first identified on the overall Project, in January 2015 and assigned to the manager "ENGSUPRTMGR", suggesting that the initial origin of the cable separation issues may be engineering related.[442]
- Aggregate trend reports show that the cable separation work was identified as an "Adverse Trend" by SNC during the fourth quarter of 2020. One year later, a review of the Q4 2021 Aggregate Trend Report includes "Electrical Installation Quality/Bechtel "Separation Violation"" as an Adverse trend that has still not been resolved.

[438] July 4, 2020, CR Audit Report.
[439] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, Version 9.0, page 4.
[440] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, Version 9.0, pages 5-6.
[441] August 27, 2021, United States Nuclear Regulatory Commission, NRC News, Office of Public Affairs, Region II, No. II-21-021.
[442] EPC Trade Secret Information Subject to Restricted Procedures, TS Attachment STF-93-3-a.

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535. As such, although there were multiple occasions of risks to quality, they were not effectively elevated to the appropriate level of risk management, such as in CAP, which would timely develop and direct appropriate mitigation strategies.

536. Evaluation of the management of quality is found below, and it is organized by the following topics:

- Audits
- Trends
- VCM Testimony and NRC Determinations

4.5.2.1 Audits

537. As previously mentioned, audits are intended to provide an objective evaluation of the effectiveness of implemented processes and procedures as well as recommend process improvements, as necessary. Consistent with its obligations and common industry practices SNC conducted internal audits of its processes.

Internal Audits

538. SNC performed internal audits of the Project, separate from the CAP audits, on an annual basis XXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXX*,[443] which are defined on an annual basis in the SNC VPEP.

539. Internal audits found several persistent non-conforming practices with the quality of SNC's schedule management, which are summarized below.

- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[444]
- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[445]
- XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

[443] September 25, 2012, Budget and Cost Management Assessment, Report No. GPC2012-13, page 1.
[444] July 31, 2018, SNC memo from Deb Key to Steve Owen, Re: Vogtle 3&4 Scheduling Assessment, Report No. GPC2018-08, Schedule Management, As of August 14, 2018, page 1.
[445] September 21, 2022, Internal Audit Report from Southern Company, Re: Vogtle 3&$ Initial Testing Program (ITP) Schedule Audit, page 3.

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Nuclear Development Corrective Action Program

540. The CAP was audited annually from 2009 through 2023.

541. Of the 110 audits reviewed, only two audits noted findings that required resolution. Further, each audit concluded that the CAP was being effectively implemented. Additionally, since the 2016 audit, there has been an average of under 1.5 Deficiencies per audit with no items which rose to the level of an AFR.

542. It appears that following VCM 17, there were six (6) total revisions of the CAP procedure – versions 27 through 32. Apart from minor exceptions there were no significant changes to the procedures. This was indicative of the ineffective implementation of this critical procedure, when considering the observed construction disruptions, quality issues and resultant rework.

4.5.2.2 Trends

Aggregate (CAP) Trend Reports

543. SNC, Bechtel, and Stone & Webster created quarterly trend reports referred to as the "*Vogtle 3 & 4 Aggregate Trend Report*" (Trend Report). The purpose of these reports is as follows:[446]

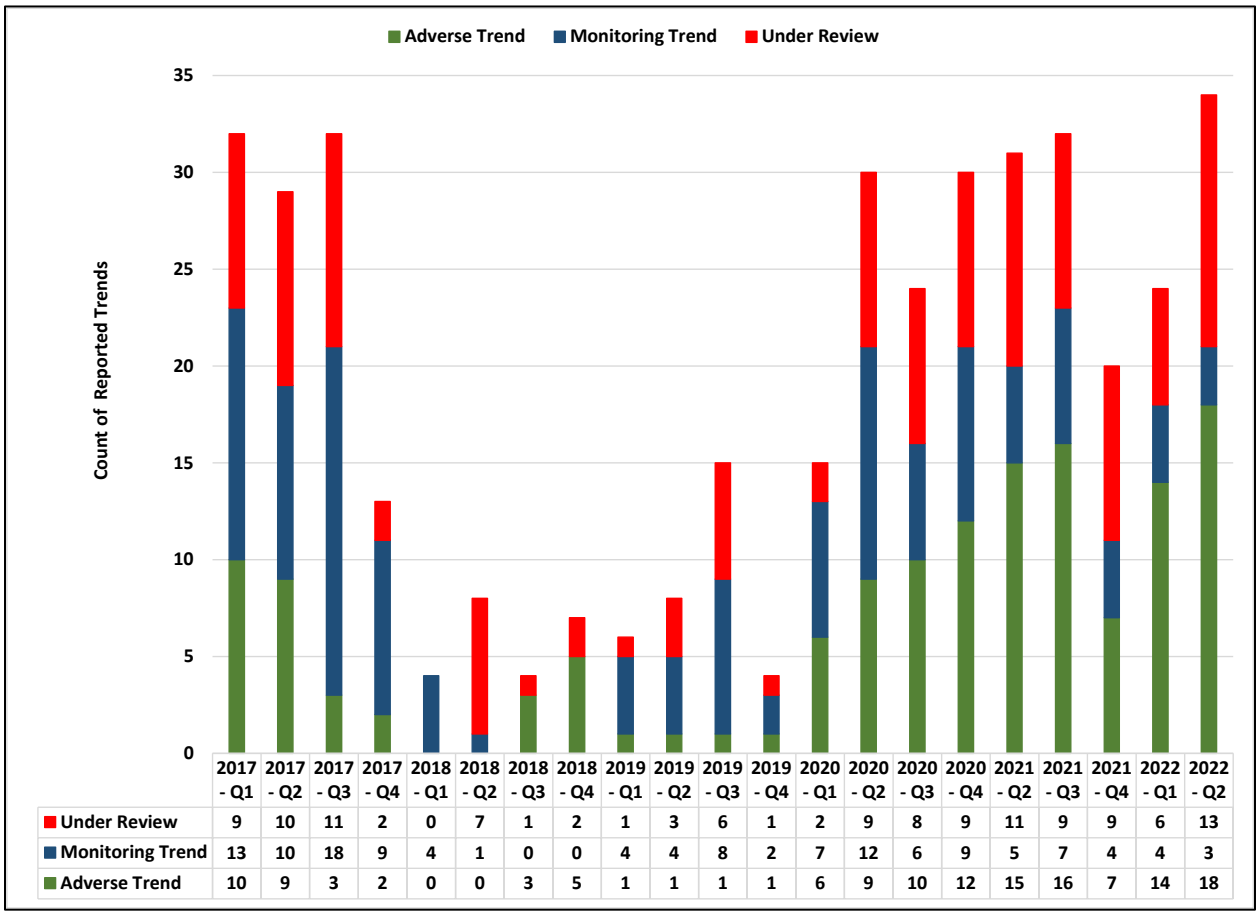
> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*

544. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[447] XXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

545. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

[446] April 2022 – June 2022 Second Quarter 2022, Vogtle 3 & 4 Aggregate Trend Report, SNC, Bechtel and Stone & Webster, page 1.
[447] April 2022 – June 2022 Second Quarter 2022, Vogtle 3 & 4 Aggregate Trend Report, SNC, Bechtel and Stone & Webster, page 3.

Figure 4.5-2 Quarterly Trend Report Added Trends



	2017 - Q1	2017 - Q2	2017 - Q3	2017 - Q4	2018 - Q1	2018 - Q2	2018 - Q3	2018 - Q4	2019 - Q1	2019 - Q2	2019 - Q3	2019 - Q4	2020 - Q1	2020 - Q2	2020 - Q3	2020 - Q4	2021 - Q2	2021 - Q3	2021 - Q4	2022 - Q1	2022 - Q2
Under Review	9	10	11	2	0	7	1	2	1	3	6	1	2	9	8	9	11	9	9	6	13
Monitoring Trend	13	10	18	9	4	1	0	0	4	4	8	2	7	12	6	9	5	7	4	4	3
Adverse Trend	10	9	3	2	0	0	3	5	1	1	1	1	6	9	10	12	15	16	7	14	18

546. As shown in **Figure 4.5-2 Quarterly Trend Report Added Trends**, the number of trends identified on the Project increased over time. The number of Adverse Trends was increasing from 2019 through 2022 and was at its highest in Q2 2022.[448] While the Project team was utilizing the Trend Report to monitor quality on the Project, it does not appear there were meaningful steps taken to mitigate these issues over time.

4.5.2.3 VCM Testimony and NRC Determinations

547. VCM testimony and NRC determinations further corroborate ineffective quality management.

548. For instance, the testimony of Steven D. Roetger and William R. Jacobs, Jr., Ph.D. on June 7, 2021, in VCM 24 referenced a conflicting report regarding cable separation issues that identified failure in the Corrective Action Program:

[448] Quarter 2, 2022, was the latest Aggregate Trend Report utilized for review.

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> *An Extent of Condition ("EOC") was performed by SNC in January, 2021. Its findings were that there was a failure of the SNC QAP and therefore it's Corrective Action Program ("CAP"); there was inadequate enforcement of construction standards and behaviors; and that electrical production was placed above safety by Bechtel, the Construction Contractor.* [449]

549. The SNC root cause determination report determined that the cable separation issue (also referred to as IEEE 384) was caused by inadequate and/or ineffective quality management:

> *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXX*[450]

550. Likewise, NRC observed deficiencies in SNC's quality management. By way of example:

> *The inspectors noted that there were several cable separation nonconformances identified in the RCD that **had not been previously entered into the CAP, which was a missed opportunity to identify the adverse trends sooner.*** [451]

551. The NRC also highlighted the results from SNC's RCD and noted that the cable separation issues were missed by QC inspections as far back as November 2019, nearly seven (7) months before the first issue was identified in Unit 3 and a full year before most cable separation issues were identified by Bechtel and SNC.

> *The licensee concluded that "**the root cause lay in a culture across the construction organization where standards were not being followed or enforced and leadership did not consistently correct improper worker behaviors in the area of electrical installations. This culture allowed electrical commodities to be installed, and in some cases, inspected and turned over while not meeting all applicable quality requirements.**" Based on the work packages that the NRC inspectors reviewed during the SI, some examples of cable installation issues missed during QC inspections occurred in November and December 2019, as well as from August through December 2020.* [452] ***[Emphasis Added]***

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[449] June 7, 2021, Direct Testimony and Exhibits of Steven D. Roetger, William R. Jacobs, Jr. PhD., page 33.
[450] April 15, 2021, Root Cause Determination Report, ND-AD-006-F04, Version 9.0, page 4.
[451] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 - NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and - Preliminary White and Greater than Green Findings for Unit 3, page 11.
[452] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 - NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and - Preliminary White and Greater than Green Findings for Unit 3, pages 5-6.

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> *The inspectors noted that there* ***were several cable separation nonconformances identified in the RCD that had not been previously entered into the CAP, which was a missed opportunity to identify the adverse trends sooner.*** [453] ***[Emphasis Added]***

552. Further, SNC failed to effectively implement the lessons learned protocols. According to the NRC, similar issues were identified in the USA in the 1980's and at a nuclear construction site in Japan from 2015.

> *In addition to missing related generic communications, such as Information Notice 85-11, "Licensee Programs for Inspection of Electrical Raceway and Cable Installations," which described several examples of cable separation nonconformances that occurred in the 1980s in U.S. nuclear plants under construction, the inspectors noted the licensee also missed a related electrical separation issue stemming from original construction activities discovered in 2015 at the Kashiwazaki Kariwa site in Japan.* [454]

553. In conclusion, although SNC put in place the obligatory procedures, they had limited effectiveness and resulted in some significant quality defects. See Section 3.3.8 of this Report for an expanded review of quality issues.

4.5.3 Management of Time

554. The management of time is crucial in handling the risks associated with disruption (inefficiency) and delay. As examined in Section 4.3 of this Report, SNC's obligations and commitments relating to time management were comprehensive and robust, with the intent of providing meaningful processes and tools for planning, monitoring and controlling the execution of the Project scope. Further, SNC's procedures were generally consistent with common industry practices.

555. After SNC assumed control of the IPS and the Project at large, SNC inaccurately portrayed actual progress and forecasted progress, which resulted in mis-informed management decisions and exacerbated known problems that contributed to additional delays, avoidable cost growth, and quality deficiencies.

556. As is further described below, and in more detail in Section 3.3 and Section 5 of this Report, despite committing to implementing the procedures in conformance with its obligations, SNC failed to do

[453] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 - NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and - Preliminary White and Greater than Green Findings for Unit 3, page 11.
[454] August 26, 2021, letter EA-21-109, from USNRC to Southern Nuclear, Subject: Vogtle Electric Generating Plant, Units 3 and 4 - NRC Special Inspection Reports 05200025/2021010, 05200026/2021010 and - Preliminary White and Greater than Green Findings for Unit 3, page 14.

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so in an appropriate and effective manner. As a result of SNC's inadequate and ineffective time management the actual Project status and forecasted plans were inaccurate and unreliable; thereby pre-empting and impairing SNC's and Bechtel's ability to appropriately control the Project and implement meaningful mitigation measures. Ultimately, the Project experienced extensive delays and avoidable cost growth. See Section 5 of this Report for an analysis of Project delays.

557. SNC's inadequate practices included the following:

- SNC was managing the Project to an unrealistic IPS as demonstrated by SNC using unachievable unit production rates, mis-reporting progress, inadequate resource loading, missing logic, incorrect logic, inappropriate use of milestones and hard constraints, and the inappropriate use of start as opposed to finish constraints and milestones to report and credit progress.
- Despite the continual failure to achieve productivity, SNC did not adjust the production planned in the IPS to accurately reflect actual performance, and thereby reported inaccurate planned durations in the IPS forecasts rendering them unrealistic.
- Despite a growing gap between earned and spent manhours (PF degradation) the planned progress for certain areas was revised to give the erroneous impression that the Project was not delayed.

558. As further described in Section 3.3 and Section 5 of this Report, SNC's inadequate schedule reporting practices led to misinformed management decisions exacerbating problems that contributed to avoidable cost growth and quality deficiencies.

559. Evaluation of SNC's time management is found below, and it is organized by the following topics:

- Unrealistic Integrated Project Schedule
- Systems Completion/Turnover

Unrealistic Integrated Project Schedule

560. AACE indicates that inaccurate and delayed assessment of project status can cause confusion, uncertainty, and potential loss of time and/or money on construction projects.[455]

561. As demonstrated in Section 3.3.2 and in Section 5 of this Report, SNC's management of time was

[455] AACE International Recommended Practice, 53R-06, Schedule Update Review – As Applied in Engineering, Procurement, and Construction, Rev. August 14, 2008, page 1.

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marked by several deficiencies that resulted in delays and cost growth. Generally, those deficiencies related to the maintenance of the IPS as well as changes to the execution strategy that caused disruption and delay.

562. The IPS displayed several deficiencies that impaired its use as an effective tool for managing time. By way of example:

- SNC failed to balance the objectives and emphasized adherence to the schedule milestones to the detriment of the cost and quality of the Project.
- SNC credited progress when an activity started, thereby over-reporting progress in the schedule and mis-reporting actual progress achieved.
- SNC also compressed activities, and shortened durations, despite the loss of productivity experienced and the demonstrated delay in progress curves. As a result of compressed and constrained activities the IPS became unreliable and lost its value as a project management tool.
- SNC implemented non-progress changes to the IPS to mask the delays to progress.
- The utilization of unachievable production rates, inadequate resource loading, missing, logic, as well as inappropriate use of milestones as markers to progress the project. As examined in Section 3 and Section 5 of this Report, the PF factors used to develop the go-forward plan were unachievable based on historical performance.
- Internal audits in part found repeated lapses in schedule adherence reporting, and poor sequencing of work between SNC and Bechtel. See Section 3.3.8.2 of this Report for further analysis of this issue.

563. These types of scheduling practices conflict with SNC's obligations, VPEP and procedures, as well as common industry practices. As important, the inaccurate scheduling impairs the risk management process, that relies on this information to identify risks and develop appropriate mitigation strategies. Further, the masking of actual progress hampers evaluation of the effectiveness of mitigation strategies.

Systems Completion/TO

564. When Bechtel joined the Project in 2017, it expected and planned that leading into ITP, the transition to system turnover would occur after completion of the bulk installation and each plant system would be tested and turned over from construction to operations in a complete, or near complete state. This was reflected in the Project schedule.

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565. SNC transitioned the Project from the bulk installation of construction commodities to an approach that focused on system testing that was inconsistent with Bechtel's plan and common industry practice. The result was a significant increase in work activities and subsystem milestones within the IPS. The decision to switch to the systems testing approach forced Bechtel to reprioritize work based on the turnover milestones.

566. Bechtel contemporaneously noted that work that did not "align with system turnover priorities" was being deferred until some later date. This included work that was previously critical path and preempted logic that was built into the schedules. Deferring work also led to the growth in utilizing both the PRT and the CWA processes.

567. The deferred incomplete bulk work was performed later in the Project and during the system testing period, which was inherently less efficient. This led to unanticipated coordination issues, demands for labor resources, and increases in the use of PRT and CWA, and procedures within the turnover process.

568. As illustrated below, over 5,000 work packages that had been deferred remained incomplete after achieving HFT. Given the congested nature of the AP1000 design that was well understood by SNC, SNC knew or should have known that this condition can lead to disruption and delay in completing the construction. As demonstrated above, Bechtel contemporaneously reported on disruptive events stemming from this "premature" transition to testing. [456]

[456] October 20, 2021, GPC-SNC Monthly Project Review Meeting Presentation.

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Redacted

569. When there is such a significant change in execution strategy, as on this Project, common industry practices dictate a structured evaluation (such as cost-benefit analysis) of the change in strategy. This not only validates the approach, but also identifies risks and provides a structured approach to monitor the plan. There is no indication of such an analysis. Given the lack of a structured evaluation and Bechtel's persistent concerns relating to schedule and cost impacts, it was not reasonable for SNC to continue with its change in execution strategy. See Section 3.3.4, Section 3.3.5, and Section 5 of this Report, for additional analysis of the Systems turnover issue.

4.5.4 Management of Cost

570. Regulatory requirements, industry standards and SNC's own policies and procedures emphasized the importance of providing robust systems for monitoring, controlling and reporting of costs. SNC was obligated to deploy integrated systems that provided an accurate assessment of incurred costs against an established baseline, reported to management and the Commission, and adjusted as appropriate, utilizing a formal change management process.

571. Despite developing procedures to meet its obligations, the information generated by these

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procedures was not effectively employed by SNC to manage risks related to cost growth. These systems provided KPIs that were fundamental to monitoring and controlling costs and they generated leading indicators of unfavorable trends, such as worsening CPI rates.

572. Although the underlying processes supporting risk management were providing timely information relating to unfavorable trends in costs, it appears that management did not implement effective mitigation measures. Instead, management proceeded in the same manner that had produced the unfavorable trends. The Project consistently failed to achieve planned CPI rates, but project management repeatedly forecasted that performance would improve despite observed trends pointing to a sustained decline. The monthly VPMB progress presentations indicated that productivity was below expectations and CPI was worsening month-over-month. Nevertheless, management continued to forecast an improvement in CPI in each of the months to come.

573. In summary, the metrics of Project performance were collected but not effectively and properly used to manage the risk related to costs and budget. This approach to managing risks conflicts with SNC's obligations and commitments, as well as common industry practices, and it deprived the Project of the benefits of proactive risk mitigation.

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5 Delay and Disruption Analysis

5.1 Introduction

574. J.S. Held's forensic schedule delay and disruption analysis assessed overall Project performance to quantify and apportion the impact of delays and loss of productivity associated with completing construction and startup scope for achieving the Fuel Load milestones and thereby COD of Units 3 and 4 and determined the following which is summarized in Table 5.4-18 below.

- The start of Fuel Load for both units was impacted by significant delays. Unit 3 experienced a total delay of 2,661 days (7.3 years) and Unit 4 experienced a total delay of 2,603 days (7.1 years).[457]
- During the post-VCM 17 period, since October 2017, the Project experienced delay of 734 days (24.1 months) to Unit 3 and 670 days (22.0 months) to Unit 4.[458]
- Of the post-VCM 17 delays, the unforeseen event of COVID-19 caused 266 days (8.7 months) to Unit 3 and 211 days (6.9 months) to Unit 4.
- While the Project struggled with loss of productivity throughout the performance period, the unforeseen event of COVID-19 resulted in a combined total of XXXXXXXXX inefficient direct labor hours for Unit 3 and Unit 4. The observed indirect-to-direct labor hour ratio was applied to the total inefficient direct labor hours to calculate a total of XXXXXXX inefficient indirect labor hours caused by COVID-19.

575. The balance of Project delay and disruption, experienced post-VCM 17 of 468 days (15.4 months) to Unit 3 and 459 days (15.1 months) to Unit 4, which is summarized in Table 5.4-18, and the associated inefficient direct and indirect labor hours was driven by:

- The realization of known or foreseen risks events and issues that SNC accepted and identified in VCM 17, and which would have been covered by contingency, such as:[459]
  - That WEC will not meet its obligations (Engineering) under the new Services Agreement
  - That the labor force and craft will be unable to realize productivity improvements

[457] For the forensic schedule analysis, J.S. Held measured delay to the Fuel Load Start milestone.
[458] Fuel Load started for Units 3 and 4 started on October 13, 2022, and August 17, 2023, respectively.
[459]August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, pages 93-99.

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- That the Project will be unable to continue to meet FOAK challenges
- Procurement
- Unidentified scope risk
- Testing/Startup Risk

- Issues that were the responsibility of actions, inactions, and management decisions after VCM 17 that created different circumstances or exacerbated risks, included:
  - SNC's focus on schedule at the expense of quality and costs
  - Managing the Project to an unrealistic IPS and EAC
  - Lack of planning for and an early transition from bulk construction to system testing
  - Ineffective management of the PRT and ITP programs
  - Incomplete engineering and inadequate engineering management
  - Deficient procurement and management of materials and modules
  - Deficient quality management
  - Deficient resource management

5.2 Methodology

576. J.S. Held examined the contemporaneous Project documentation to assess the suitability of available schedules for use in a forensic schedule analysis. This included periodic VPMB presentations containing progress to date, predicted completion dates, and summary critical paths. These presentations assisted in identifying changes in the Project critical path and enhanced understanding of contemporaneous construction progress. Key as-built dates were obtained from the progress reported in the contemporaneous Project schedules and VPMBs.

577. Based on the availability of the contemporaneous schedules, J.S. Held determined an appropriate method to analyze delay in Units 3 and 4. J.S. Held performed a retrospective forensic schedule delay analysis using an industry recognized observational, dynamic, contemporaneous technique (commonly referred to as a Window Analysis method) to quantify and apportion causation for delay to the Project.[460] J.S. Held selected this method for two reasons: (a) when applied appropriately, the Windows Analysis method can provide a detailed, comprehensive, and understandable explanation of the quantum, and timing for the delays; and (b) the other primary methods are unsuitable due to deficiencies in the Project's schedule updates. Specifically, the numerous logic revisions and added

[460] J.S. Held considered applicable protocols of AACE International Recommended Practice 29R-03, Forensic Schedule Analysis, MIP 3.3. [See Attachment 3]

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activities make certain methods (such as Bifurcated Contemporaneous Period Analysis and Retrospective Time Impact Analysis) infeasible.

578. The Window Analysis is a Critical Path Method (CPM) schedule analysis technique that divides a project into specific consecutive time periods (or windows) to analyze critical delays to the project.[461] The windows are discrete time periods that are defined and bound by major schedule changes or events determined by the contemporaneous "as-is" project schedule updates and project documentation. The analysis method uses the actual project schedules developed, updated, and used on a project, in conjunction with as-built facts, to analyze the actual "*then current critical path*" from update to update; identify specific time periods of delay; identify the delayed activities; and quantify impacts to the project critical path.[462]

579. A Window Analysis begins with identifying the as-planned baseline schedule and proceeds chronologically through the project, comparing the contemporaneous schedule update to a prior update, and assessing the progress and impacts along the critical and near-critical paths.[463] Beginning with the baseline schedule, each window starts with a contemporaneous plan for the future work and ends when there are substantial changes to the plan (i.e., the critical path changes) in a schedule update and/or events warranting a break to facilitate the analysis occur.[464] The window

[461] CPM schedule is a standard project control tool (typically shown as a graphical network) used on construction projects to plan and control the work in a manner that ensures completion of the work by a stipulated date defined in a contract. CPM schedules identify and describe the activities to be performed and the time it will take to complete them. The schedule serves as a plan to indicate the date on which specific work must commence, the duration of the work, the sequence of the work, and the date by which specific work must be completed to ensure timely project completion. CPM schedules are also used to monitor, measure, and evaluate actual progress of work completed against the baseline schedule or contemporaneous schedule update.

[462] The critical path is the longest path of logically connected activities that equals the overall duration of the project. By definition, if a critical path activity is delayed, it delays the entire project by the exact same number of days. Typically, activities with the lowest total float are on the critical path.

[463] Near-critical paths are paths that have a reasonably small number of days of float relative to the total float (negative or positive) of the most-critical path and which can become critical because of delays. The delays to non-critical path activities are analyzed when the delays cause the non-critical activities to become critical. By analyzing critical and near-critical paths, the delays and concurrency can be assessed, and the responsible party can be more accurately determined.

[464] Typically, changes to the CPM schedule plan in an update arise from impacts that have occurred to critical path activities, or from delays that have consumed the total float available to non-critical activities and pushed them onto the critical path. Revised schedules also arise from non-progress schedule modifications (i.e., add or remove activities, alter the planned logic and/or durations of remaining work, change calendars) to more accurately reflect the remaining work scope or work plan, improve the schedule, mitigate delay, or reflect change orders.

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is defined as the calendar period between these schedules, with the prior update becoming the baseline for the analysis during the analysis period.

580. Within each window, J.S. Held identified the critical path activities to Fuel Load for each unit that were scheduled to start, finish, or be worked on during the period, then identified and measured impacts to the critical activities. To determine the critical path of activities driving the IPS schedules, J.S. Held first identified the critical (or longest) path as computed by the executable native Primavera schedule files. J.S. Held then assessed the relative total float (to the Fuel Load milestone) values for activities to confirm the activities with the lowest total float value were driving the critical path.

581. The analysis compared actual as-built progress to as-planned start dates, finish dates, and durations of specific activities or milestones along the critical path during the window to identify and quantify the net delay.[465] The analysis also identified shifts in the critical path caused by actual progress and changes to schedule logic between analysis periods. As impacts and delays were identified, J.S. Held used Project documentation, records, and data to explain the causes for the quantified delay.

5.2.1.1 As-Planned v. As-Built

582. The following sections reflect the windows analysis for Units 3 and 4. J.S. Held evaluated delays from a technical standpoint based upon its prior experience with nuclear power units and using an industry-accepted method for the development of comprehensive forensic delay analyses.

583. When developing this analysis, J.S. Held identified the relevant "As-Planned" schedules, divided the As-Planned schedules into windows, calculated the delay incurred in each window, and assessed the causes of delay. The resulting analysis provides a detailed understanding of the delays and their respective causes.

5.3 Delay and Disruption Analysis

5.3.1 Analysis of Progress & Productivity Curves / Data

584. J.S. Held also analyzed the Project progress, quantity, manhour and productivity data that was contemporaneously reported and observed that the Project failed to achieve the planned progress and productivity in each major work area and commodity. **Attachment 2** contains the compiled labor progress and productivity curves for the major areas of work and for major trade disciplines and

[465] For consistency, unless otherwise noted, all delays or gains were measured in calendar days.

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commodities on the Project by the identified Window time frames.

585. The figures in **Attachment 2** show the failure to achieve the planned progress and productivity on the Project, and that the cumulative level of progress and productivity was worse than planned for every work area and discipline, and continually decreased over time.

586. The discrete progress and productivity for major work areas and disciplines that were driving (and delayed) progress on the Project critical path during the post VCM 17 period will be discussed in more detail in the specific window periods that follow.

5.4 Detailed Analysis by Window Period

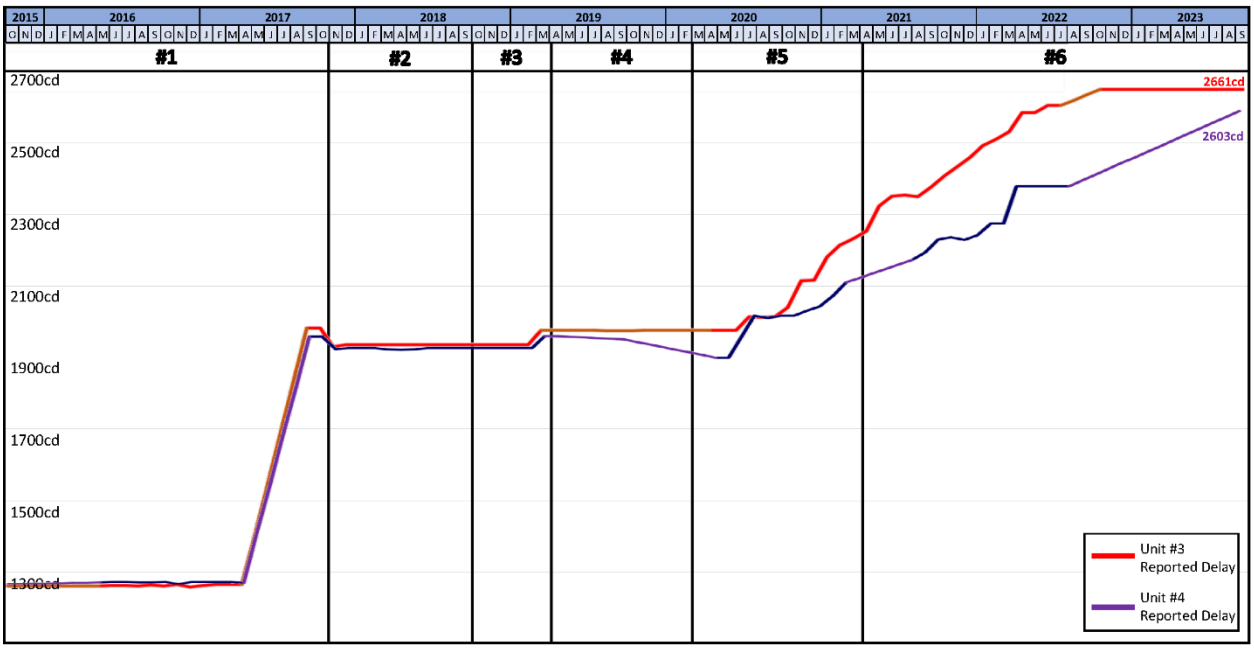
587. J.S. Held divided Units 3 and 4 schedules into six (6) windows to enhance the accuracy of the analysis.

- Window #1, from April 8, 2008, to October 29, 2017, encompassed the period during which WEC was the EPC Contractor up until VCM 17.
- Window #2, from October 30, 2017, until October 26, 2018, represented the start of the post-VCM 17 period, where SNC assumed responsibility for project management and Bechtel assumed the role as contractor.
- Window #3, from October 27, 2018, until March 29, 2019, represented the start of the transition from bulk construction to a system testing approach to managing the Project.
- Window #4, from March 30, 2019, until March 27, 2020, represented the revised IPS from the Earned Value April 2019 Re-Baseline.
- Window #5, from March 28, 2020, to April 23, 2021, covered the COVID-19 period of impacts through the cutoff date of the Bechtel Claim for the COVID-19 impact evaluation submitted on April 20, 2021 (Bechtel COVID-19 Claim).
- Window #6, from April 24, 2021, to August 17, 2023, which encompasses the post-COVID-19 impact period through the actual start of Fuel Load for Unit 4 on August 17, 2023.

588. The figure below presents a summary of the six windows along with the projected delay for Unit 3 and Unit 4 Fuel Load date in calendar days (CD) as forecasted by the contemporaneous schedule updates. The figure primarily shows the post-VCM 17 period assessed in Windows #2 through #6.

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Figure 5.4-1 Schedule Windows Summary



589. J.S. Held performed its analysis by comparing the dates projected at the start of each window and comparing them against the actual achieved dates, observing the causes of measured delay, and evaluating changes and adjustments in the schedules.

5.4.1 Window #1 – April 2008 through October 2017

Window #1 covered the period from April 8, 2008, to October 29, 2017, during which WEC was the EPC contractor up until VCM 17.

5.4.1.1 Window Overview

590. J.S. Held observed in Window #1 that the critical path started along the application, review of, and issuance of the Design Certification Document (DCD), which allows the issuance of the COL.[466] With the issuance of the COL, the Project's critical path transitioned to civil construction of the Unit 3 nuclear island beginning with rebar installation and followed by placement of what is termed first nuclear concrete (FNC).[467] Once concrete was sufficiently progressed, the critical path again transitions to fabrication, delivery, site assembly, and setting of structural modules in the Unit 3

[466] December 7, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 2, page 8
[467] May 30, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 6, page 8.

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nuclear island.[468] Subsequently, a co-critical path emerged regarding inside containment at Unit 3 including setting of remaining structural modules, concrete placement, and setting of major reactor components.[469] This path would later overtake the exterior building construction as the critical path and remain the critical path for the remainder through the balance of the Window #1 period.[470]

591. As a result of the impacts experienced in Window #1 both Units 3 and 4 were forecasted to achieve their respective COD milestones 63 months later than set in the EPC Agreement.[471] This can be seen in **Figure 5.4-2 Window #1 Project As-Planned v. As-Built** and **Table 5.4 1 Window #1 Analysis Summary** below.

Figure 5.4-2 Window #1 Project As-Planned v. As-Built

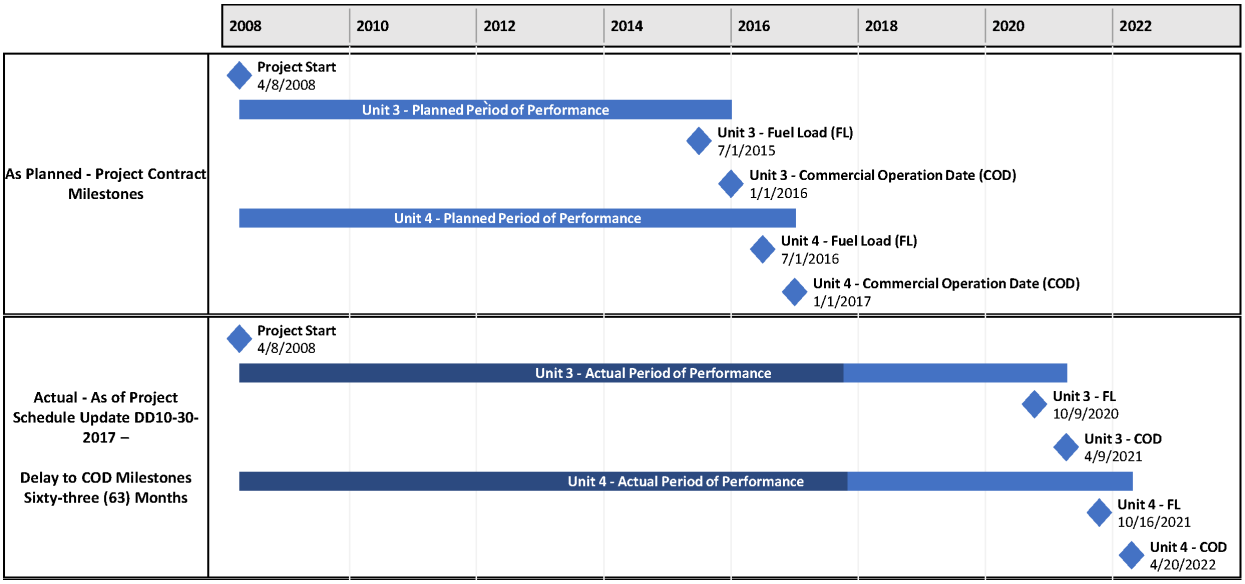


Table 5.4-1 Window #1 Analysis Summary			
Milestone	**Start of Window #1 EPC Agreement Date**	**End of Window #1 Forecasted Date**	**Delay**
Unit 3 Fuel Load	7/1/2015	10/9/2020	63 Months

[468] December 7, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 7, page 16.; August 8, 2013, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 8, page 12.; June 20, 2014, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 9 / 10, page 20.; November 21, 2014, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 11, page 20.

[469] June 10, 2015, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 12, page 21.

[470] June 17, 2016, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 14, page 17.; Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 15, page 15.; June 8, 2017, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 16, page 14.

[471] Engineering, Procurement, and Construction (EPC) Agreement, page. 9.

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Table 5.4-1 Window #1 Analysis Summary			
Milestone	**Start of Window #1 EPC Agreement Date**	**End of Window #1 Forecasted Date**	**Delay**
Unit 3 Comm. Oper.	1/1/2016	4/9/2021	63 Months
Unit 4 Fuel Load	7/1/2016	10/16/2021	63 Months
Unit 4 Comm. Oper.	1/1/2017	4/20/2022	63 Months

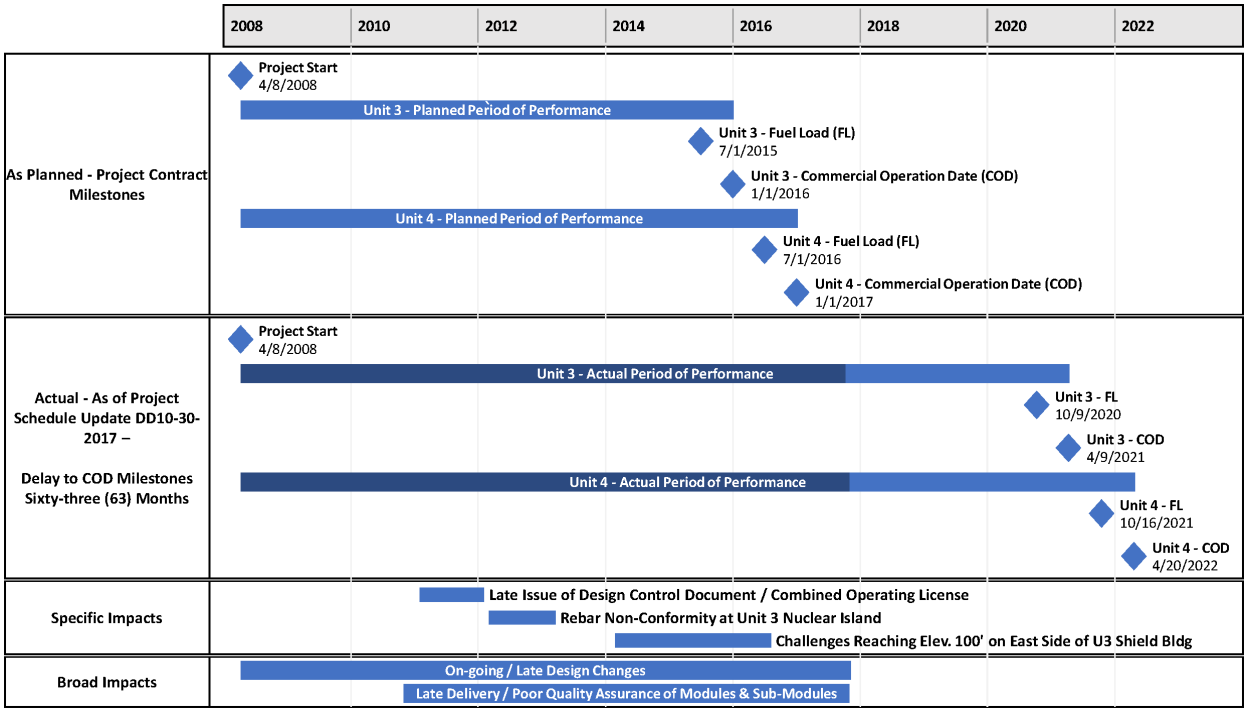
592. For Window #1, the native schedule (*.xer) files were not available from the start of the Project through a data date of June 27, 2016, as SNC did not receive them from WEC. Although provided with native schedule files beginning in June 2016, this was at a period where the Project schedule fidelity had been lost and was acknowledged as unusable by the contractor.[472] As a result, the critical path observations within Window #1 are based on a combination of static Level 1 / Level 2 schedule printouts along with testimony provided in conjunction with the VCM reports.

593. J.S. Held observed that the major causes of delay to the critical path within Window #1 included both specific and broad impacts. Specific impacts included late issuance of the DCD / COL, rebar non-conformance at Unit 3 nuclear island, and delays in reaching Elev. 100’ at the east side of the Unit 3 shield building. Broad impacts included on-going and late design changes as well as late delivery / poor quality assurance of sub-modules. These impacts and their timing on the Project are illustrated in the figure below.

[472] June 8, 2017, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 16, page 23.

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Figure 5.4-3 As-Planned v. As-Built Project Impacts



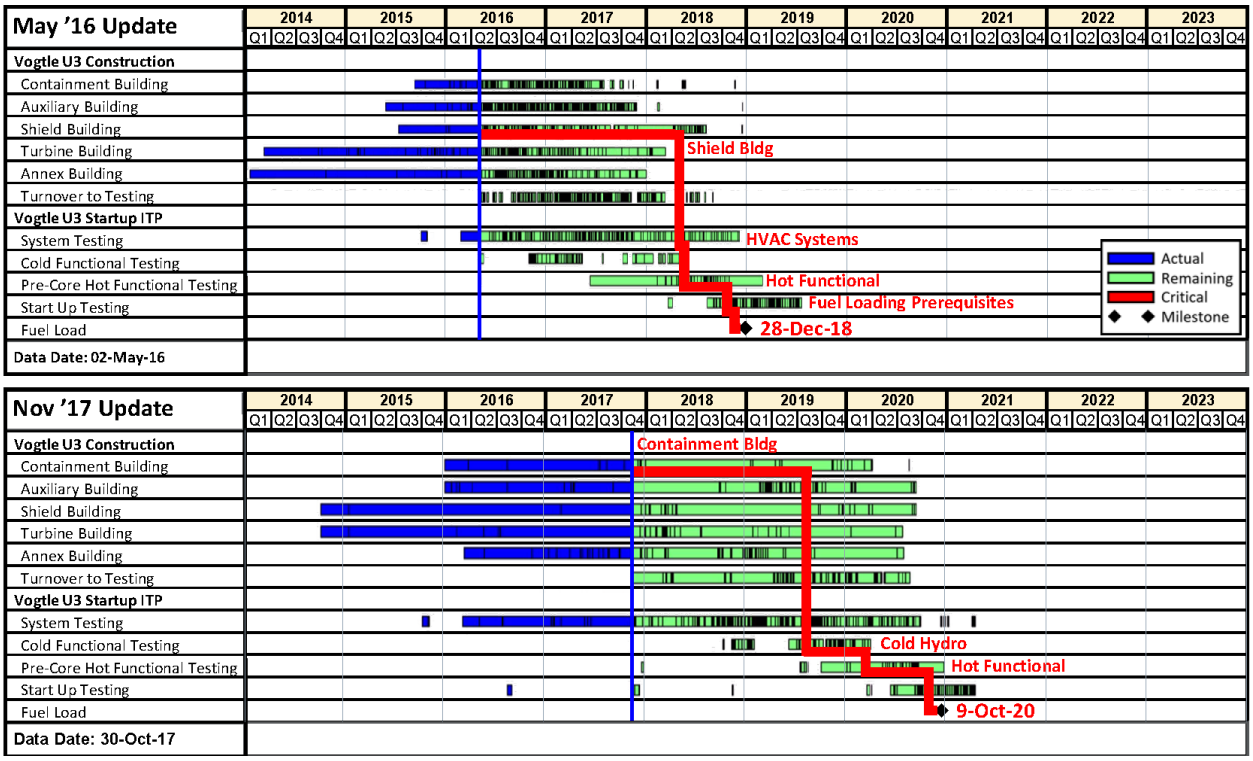
5.4.1.2 Critical Path As-Planned v. As-Built – Window #1

594. The schedules analyzed for Window #1 encompass the period from the start of the Project through the end of the period where WEC was the EPC contractor and goes from April 2008 to October 30, 2017. As noted previously, J.S. Held did not have access to any schedules issued prior to May 2016. The window critical path for Unit 3, starting in May 2016, is summarized in the figure below.[473]

[473] Vogtle Monthly Progress P6 Schedule Data - 16-May.

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Figure 5.4-4 Unit 3 Window #1 As-Planned v. As-Built



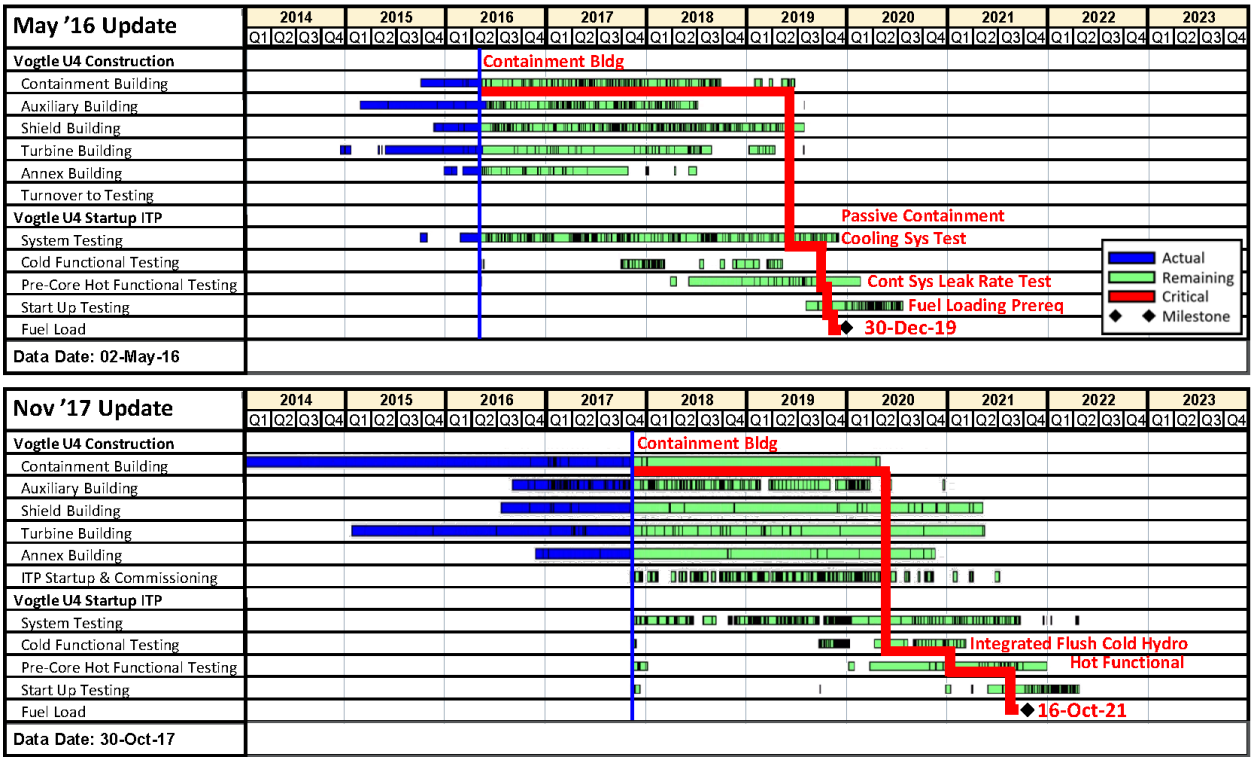
595. The critical path in the schedule update with a data date of May 2, 2016, went through construction work at the shield building, then shifted to system testing for heating/ventilation/and air conditioning (HVAC), HFT, finally reaching the Fuel Load date on December 27, 2018. The critical path at the end of the window went through containment building construction activities, CHT, and HFT.[474] The projected Fuel Load date slipped 652 days to October 9, 2020, primarily due to delays in the construction of the containment and shield buildings. The other plant buildings, including the turbine, annex and auxiliary buildings experienced similar delays.

596. The window critical path for Unit 4, starting in May 2016, is summarized in the figure below.[475]

[474] October 2017 Plant Vogtle Units 3&4 Senior Management Update presentation, page 3.
[475] Vogtle Monthly Progress P6 Schedule Data - 16-May.

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Figure 5.4-5 Unit 4 Window #1 As-Planned v. As-Built



597. The Unit 4 critical path in the schedule update with a data date of May 2, 2016, went through construction of the containment building, then shifted to passive containment cooling system, containment system leak rate testing, finally reaching the Fuel Load date on December 30, 2019. The critical path at the end of the window went through containment building construction activities, IF, CHT, and HFT. [476] The projected Fuel Load date slipped 655 days to October 16, 2021, primarily due to delays in the construction of the containment building. The other plant buildings, including the turbine, annex and auxiliary buildings experienced similar delays.

5.4.1.3 Cause of Delay – Window #1

Specific Impacts

598. During Window #1, the Project experienced impacts to the schedule which were specifically identified and discussed within the testimony provided during in support of the semi-annual VCM reports. In conjunction with the Level 1 and Level 2 schedules these provide contemporaneous documentation of emerging and on-going issues, including (1) late approval of the DCD and issuance

[476] October 2017 Plant Vogtle Units 3&4 Senior Management Update presentation, page 3.

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of the COL, (2) rebar non-conformity at Unit 3 nuclear island, and (3) reaching Elev. 100' at the east side of Unit 3 shield building.

Late Issue of Design Control Document / Combined Operating License

599. While site operations began in August of 2009 under the Limited Work Authorization (LWA) and Early Site Permit (ESP), this work was limited to non-safety related site work including clearing, certain cooling water intakes, demolition of existing structures, and excavation of the power block area.[477] Nuclear safety related construction could not begin until the DCD was approved by the NRC and the COL issued. The Project originally expected the DCD approval and COL issuance to be provided in February 2011.[478] However, this approval would not be received until February 2012.[479]

Rebar Non-Conformity at Unit 3 Nuclear Island

600. Once the COL was issued the contractor was able to proceed with work leading to the placement of concrete at the nuclear island foundation for Unit 3.[480] The FNC required the installation of rebar, piping, and other elements. As this work progressed, inspectors for the NRC identified a non-conformity related to installed rebar at the Unit 3 nuclear island. This rebar was not in agreement with neither the DCD design nor the appropriate code of the American Concrete Institute.

601. Ultimately this conflict was resolved by the contractor agreeing to install rebar as depicted in the DCD design – requiring the partial removal / modification of previously installed reinforcing steel.[481] The correction of this non-conformity would extend from March 2012, when the conflict with the rebar design under the DCD was first detected to March 2013, when the base mat of the Unit 3 Nuclear Island was placed.[482]

Reaching Elev. 100' on East Side of Unit 3 Shield Building

602. Following the placement of FNC, the critical path proceeded through setting of structural modules and concrete placement to grade level (approximately Elev. 100') reaching this elevation allowed

[477] December 2, 2009, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 1, page 17.
[478] June 9, 2011, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 4, page 9.
[479] May 30, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 6, page 6.
[480] May 30, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 6, page 8.
[481] May 30, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 6, page 9.; December 7, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 7, page 14.; August 8, 2013, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 8, page 6.
[482] Direct Testimony of Kyle C. Leach & David L. McKinney, VCM 9/10, page 12.

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the construction of the shield building within the nuclear island.[483] Based on progress through May 2013, the contractor was expected to achieve concrete placement and readiness to set initial building panels on the east side of the Unit 3 shield building in February 2014.[484] Over the intervening two years, this milestone would continue to slip, initially to December 2014, then to January 2015, then to July 2015, and finally to August 2016.[485] The factors associated with this continued slip were discussed in the testimony of Steven D. Roetger and William R. Jacobs in VCM 13.

> *Q. CAN YOU IDENTIFY THE FACTORS THAT LEAD TO THE PLACEMENT OF ONLY SEVENTEEN FEET SIX INCHES OF CONCRETE ON THE EAST SIDE OF THE SHIELD BUILDING IN TWENTY THREE MONTH BASED ON THE CURRENT FORECAST FOR THE PLACEMENT?*
>
> *A. Yes. The following factors contributed to the slow placement:*
>
> *1. Complex rebar design;*
>
> *2. High re-work rate resulting in poor rebar installation productivity;*
>
> *3. The decision to divide one concrete pour into three concrete pours which required procurement of re-designed rebar;*
>
> *4. Issues with rebar clearances and rebar congestion had to be resolved;*
>
> *5. Lack of Quality Control resources to support rebar installation;*
>
> *6. Installation of cross-tie hook lengths not being installed per an Engineering & Design Coordination (or condition) Report;*
>
> *7. E&DCR changes in Certified for Construction drawings.* [486]

Broad Impacts

603. In addition to the specific impacts, there were several issues experienced on the Project during the Window #1 period which were discussed more broadly within the associated VCM testimony of Steven D. Roetger and William R. Jacobs. These issues include both on-going / late design changes, as well as late delivery / poor quality assurance of modules and sub-modules.

[483] June 20, 2014, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 9/10, page 19.
[484] November 21, 2014, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 11, page 27.
[485] November 21, 2014, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 11, page 27.; June 10, 2015, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 12, page 23; November 20, 2015, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 13, page 22.; June 17, 2016, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 14, page 21.
[486] November 20, 2015, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 13, page 27.

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On-Going / Late Design Changes

604. Throughout the duration of the Project the design was consistently experiencing changes. As early as 2009, design changes were discussed relating to the shield buildings for both units.[487] This continued to be identified as a significant challenge, particularly as it related to prefabricated modules and sub-modules, through subsequent VCM testimony.[488] The finalization of design continued to be a concern in issuing Certified for Construction (CFC) packages well in advance of expected construction and maintaining compliance with the DCD and COL.[489]

> *Even more important than the timely issuance of the CFC packages is the requirements for CFC packages to conform to the licensing basis that the NRC approved in issuing the DCD. Lack of conformance to the licensing basis was identified as an issue when the NRC discovered that the nuclear island rebar installation did not agree with the design shown in the DCD. Recognizing that failure of the design to conform to the licensing basis was a significant issue, the Consortium, in conjunction with the Southern Nuclear Company, undertook a review of all documents related to the first year of construction and documents in the site data center. This review was called the Construction to Licensing Basis ("C2LB") review. Over 30,000 documents were reviewed, resulting in identification of 92 required design changes, 109 issues that did not require license amendments and 22 issues that require license amendments to resolve. Conformance of the plant design to the licensing basis is critical to safe plant operation and to licensability of the Project. The Consortium's failure to ensure that the plant design conforms to the licensing basis is a significant performance failure by the Consortium. In spite of the C2LB review, additional issues with the rebar design have been identified and have further delayed FNC.* [490]

605. Additionally, as construction progressed, late changes were incorporated into the work to maintain agreement between the design, the licensing basis, as well as technical / industry standards.[491]

Late Delivery / Poor Quality Assurance of Modules and Sub-Modules

[487] December 2, 2009, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 1, page 19.
[488] June 18, 2010, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 2, page 8.; December 10, 2010, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 3, page 6.; June 9, 2011, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 4, page 6.; December 2, 2011, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 5, page 6.; December 7, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 7, page 15.
[489] December 10, 2010, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 3, page 14. May 30, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 6, pages 19-20; December 7, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 7, page 17.
[490] December 7, 2012, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 7, pages 18-19.
[491] June 20, 2014, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 9/10, page 19.; June 10, 2015, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 12, page 24.; November 20, 2015, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 13, page 32.

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606. The AP1000 design used modules and sub-modules which were fabricated off-site and transported to the Project site. Once at the site, these modules were then assembled and incorporated into the work. The fabrication of these modules and sub-modules began in the latter half of 2009 at the Shaw Modular Solution (SMS) facility in Lake Charles, Louisiana.[492] Almost immediately the delivery of modules and sub-modules was noted to be behind schedule and of poor quality requiring corrective work at the Project Vogtle site prior to assembly and placement.

> *Q. PLEASE PROVIDE AN UPDATE TO THE COMMISSION ON THE ISSUE RELATED TO QUALITY ASSURANCE, DESIGN AND FABRICATION OF MODULES AND SUBMODULES AT THE SHAW MODULAR SOLUTIONS FACILTIY.*
>
> *A. As described in my testimony in the Third Semi-annual VCM proceeding, the AP1000 design uses modular construction techniques to reduce the amount of work that must be done on site. The modules and sub-modules will be fabricated at the Shaw Modular Solutions ("SMS") facility in Lake Charles, Louisiana. Fabrication of the modules has experienced repeated delays due to quality assurance, design, material and fabrication problems. The ability of SMS to provide complete high quality modules to meet the Project schedule remains a significant concern. [493]*

607. This issue continued to persist despite targeted efforts by all parties to ensure the on-time delivery of conforming modules and sub-modules. Issues related to quality were not resolved until late 2014 at which point acceptable modules were consistently received from SMS.[494] However, the repair work associated with legacy modules remained impactful to the schedule.

> *Q. WHAT IS THE CURRENT QUALITY STATUS OF THE CONSORTIUM'S VENDORS FABRICATING THE SUB-MODULES FOR UNITS THREE AND FOUR?*
>
> *A. Newport New Industries ("NNI"), the fabricator of the Shield Building panels, continues to supply the Project with quality and compliant panels. Quality of sub-modules from the Lake Charles facility has improved significantly and Lake Charlies is now providing quality sub-modules with complete documentation packages. However, required repair work on older so-called legacy modules from Lake Charles continued to impact the Project schedule during the 12th VCM period. The Contractor had added suppliers of modules with varying degrees of success. Oregon Iron Works is providing quality sub-modules for Unit 4 CA20. Toshiba and IHI are supplying quality sub-modules for Unit 4 CA01. The primary*

[492] Direct Testimony of Jeffery A. Burleson & Brian L. (Pete) Ivey Testimony, VCM 2, page 5.
[493] December 10, 2010, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 3, pages 13-14; June 9, 2011, Direct Testimony of William R. Jacobs, Jr. PhD., VCM 4, page 13.
[494] June 10, 2015, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 12, page 14.

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concern for each of the vendors is its ability to maintain quality while producing sub-modules to meet construction need dates. [495]

5.4.1.4 Window Summary

608. As discussed above, the Fuel Load milestones for both Unit 3 and Unit 4 on the Project were impacted by events that transpired during the Window #1 period from April 2008 to December 2017. During this period the Fuel Load milestone for both Unit 3 and Unit 4 were forecasted to occur 63 months later than the dates in the baseline schedule.

609. J.S. Held identified that this delay was primarily caused by both specific and broad events.

610. The specific events included:

- Late approval of the DCD and issuance of the COL
- Rebar non-conformity at Unit 3 nuclear island
- Challenges in reaching elev. 100' at the east side of Unit 3 shield building

611. The broad events included:

- On-going / late design changes
- Late delivery / poor quality assurance of modules and sub-modules

612. The tables below summarize the delays in Window #1.

Table 5.4-2 Summary of Unit 3 Window #1 Fuel Load Delay

Window	Window Start	Window Finish	Forecast Fuel Load (Window Start)	Forecast Fuel Load (Window Finish)	Fuel Load Delay (days)
Window #1	April 2008	October 2017	27-Dec-18	9-Oct-20	1927

Table 5.4-3 Summary of Unit 4 Window #1 Fuel Load Delay

Window	Window Start	Window Finish	Forecast Fuel Load (Window Start)	Forecast Fuel Load (Window Finish)	Fuel Load Delay (days)
Window #1	April 2008	October 2017	31-Dec-19	16-Oct-21	1933

[495] June 10, 2015, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 12, page 14.

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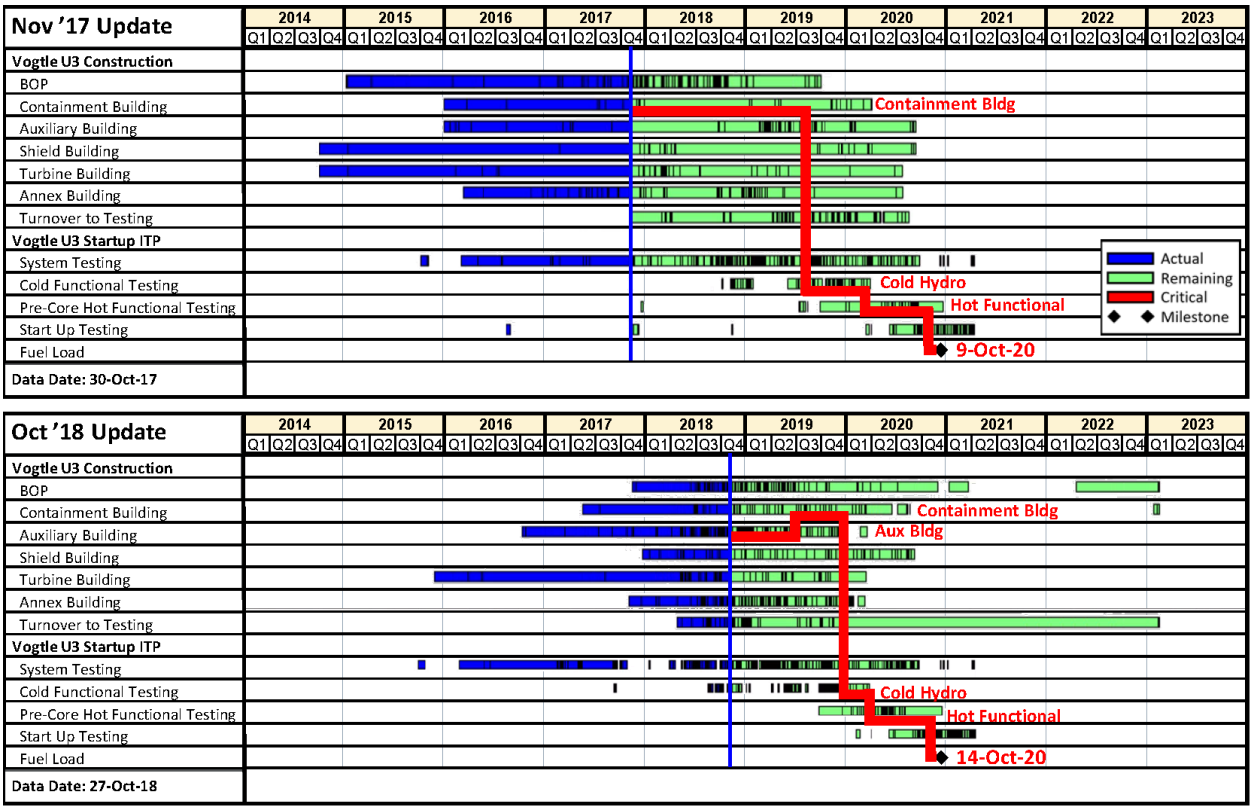
5.4.2 Window #2 – October 2017 through October 2018

613. Window #2 covered the period from October 30, 2017, until October 26, 2018, and represented the start of the post-VCM 17 period, where SNC assumed responsibility for project management and Bechtel assumed the role as contractor.

5.4.2.1 Critical Path As-Planned v. As-Built – Window #2

614. The critical paths at the start and end of the window for Unit 3 are summarized in the figure below.

Figure 5.4-6 Unit 3 Window #2 As-Planned v. As-Built



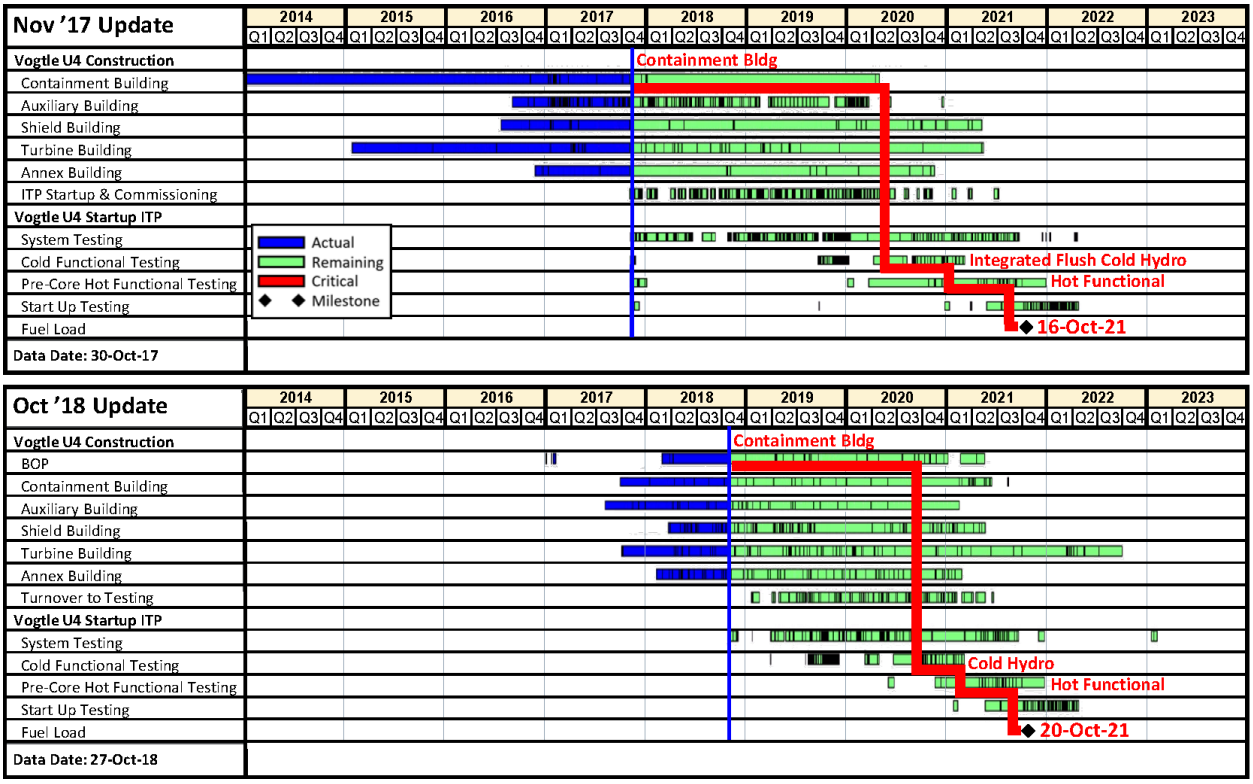
615. As shown above, the critical path at the beginning of Window #2 went through construction work at the containment building, then to CHT, HFT, finally reaching the projected Fuel Load date on October 9, 2020. [496] The critical path at the end of the window remained roughly the same going through the auxiliary and containment building construction activities, CHT, and HFT. [497] During this window the projected Unit 3 Fuel Load date slipped five (5) days to October 14, 2020.

[496] October 2017 Plant Vogtle Units 3&4 Senior Management Update presentation, page 3.
[497] November 26, 2018 Plant Vogtle Units 3&4 Schedule Review Package presentation, page 8.

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616. The critical paths at the start and end of the window for Unit 4 are summarized in the figure below.

Figure 5.4-7 Unit 4 Window #2 As-Planned v. As-Built



617. The Unit 4 critical path at the beginning of Window #2 went through construction work at the containment building, then to CHT, HFT, finally reaching the projected Fuel Load date on October 16, 2021.[498] The critical path at the end of the window similarly went through containment building construction activities, CHT, and HFT. [499] During this window the projected Unit 4 Fuel Load date slipped four (4) days to October 20, 2020.

5.4.2.2 Causes of Delay – Window #2

618. The projected start date for Fuel Load in Unit 3 slipped only five days during the Window #2 period. However, contemporaneous Project records showed that, right at the onset, Bechtel faced challenges in locating and sourcing the craft labor required to support the Project schedule.[500] At the time, Commission Staff's VCM 18 testimony explicitly identified SNC's ability to increase

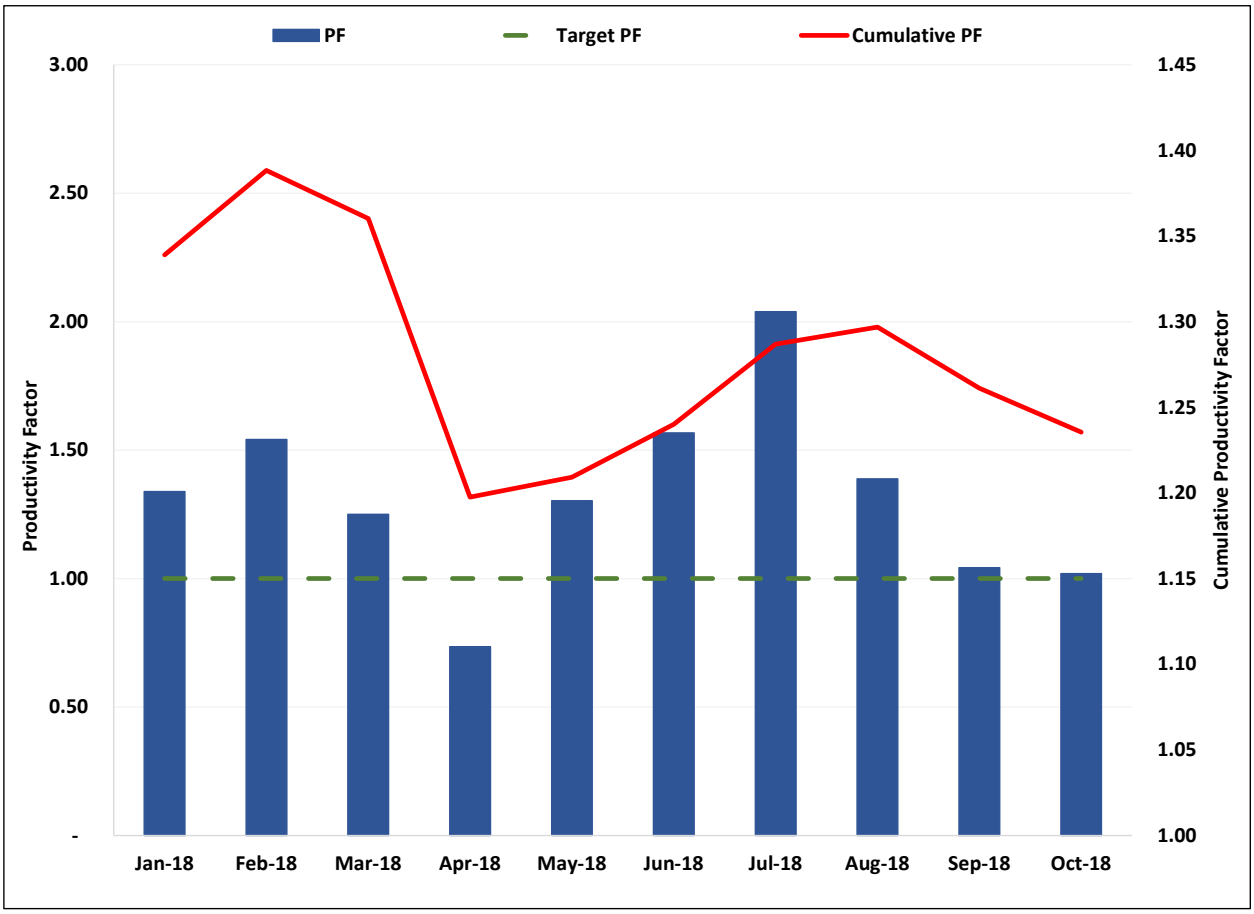
[498] December 2017, Senior Management Update December 2017, Supplemental to STR-86 Senior Management Update, page 12.
[499] November 26, 2018 Plant Vogtle Units 3&4 Schedule Review Package presentation, page 18.
[500] Direct Testimony of Stephen Kuczynski and Aaron Abramovitz, VCM 19, page 6.

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construction production to required levels as the "*greatest concern*" and "*most significant risk to the project schedule*."[501] Although the impact of this particular issue did not appear to have led to significant delays in Window #2, the inability to source craft labor became one of the primary drivers of delay in subsequent windows as discussed in the sections below.

619. The progress and labor productivity curves for the critical path Unit 3 containment building from **Attachment 2** are shown below. This includes the bulk commodity discipline for small bore piping. The Window #2 period is highlighted on the charts below which show the Project failed to achieve the planned progress during the Window #2 period in the containment building for the target PF and earned hours.[502]

Figure 5.4-8 Unit 3 Containment Building Adj. PF (Window #2)



[501] June 6, 2018, Direct Testimony of Steven D. Roetger & William R. Jacobs, Jr. PhD., VCM 18, page 15.
[502] PF is defined as Actual Hours / Earned Hours.

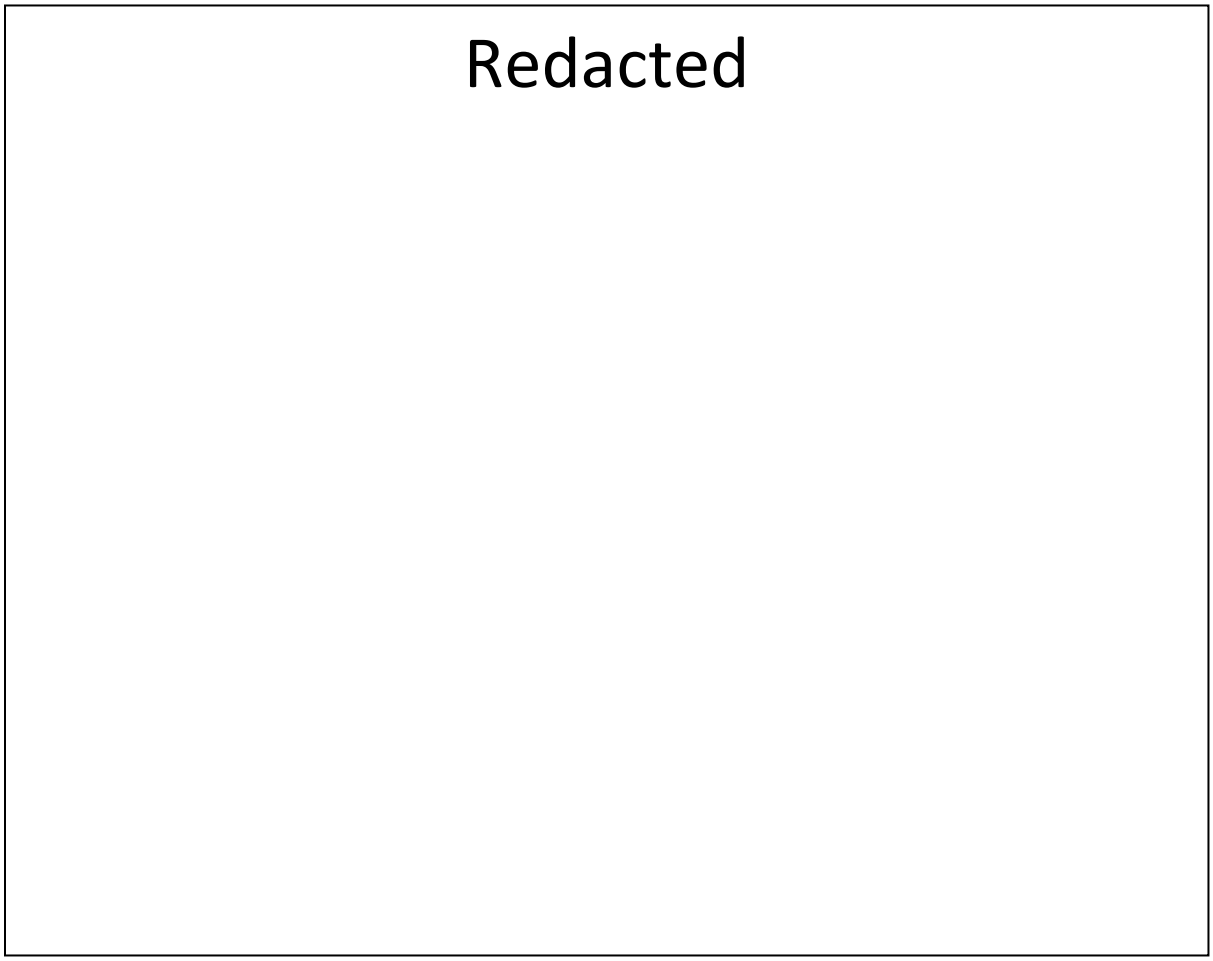
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Figure 5.4-10 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



620. While the progress curves during Window #2 reflect the failure to achieve the planned progress resulting in a delay of approximately one to two months to Unit 3, the progress update at the end of the window reflected a delay of five days, confirming that SNC masked the actual progress delays to the Project and misrepresented the forecast.

5.4.2.3 Window Summary

621. Window #2 saw the projected Fuel Load date for Unit 3 slip by five days and Unit 4 by four days. This window was also the period in which the issue of locating and attracting craft labor was originally identified. The tables below summarize the Unit 3 and 4 delays during this period as depicted in the contemporaneous update. However, as previously discussed the schedule updates did not depict accurately the level of progress and productivity experienced during construction execution which indicated a range of delay of 1 to 2 months as reflected in the Project data contained in **Attachment**

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2.

Table 5.4-4 Summary of Unit 3 Window #2 Fuel Load Delay					
Window	**Window Start**	**Window Finish**	**Forecast Fuel Load (Window Start)**	**Forecast Fuel Load (Window Finish)**	**Fuel Load Delay (days)**
Window #2	October 2017	October 2018	9-Oct-20	14-Oct-20	5

Table 5.4-5 Summary of Unit 4 Window #2 Fuel Load Delay					
Window	**Window Start**	**Window Finish**	**Forecast Fuel Load (Window Start)**	**Forecast Fuel Load (Window Finish)**	**Fuel Load Delay (days)**
Window #2	October 2017	October 2018	16-Oct-21	20-Oct-21	4

5.4.3 Window #3 – October 2018 through April 2019

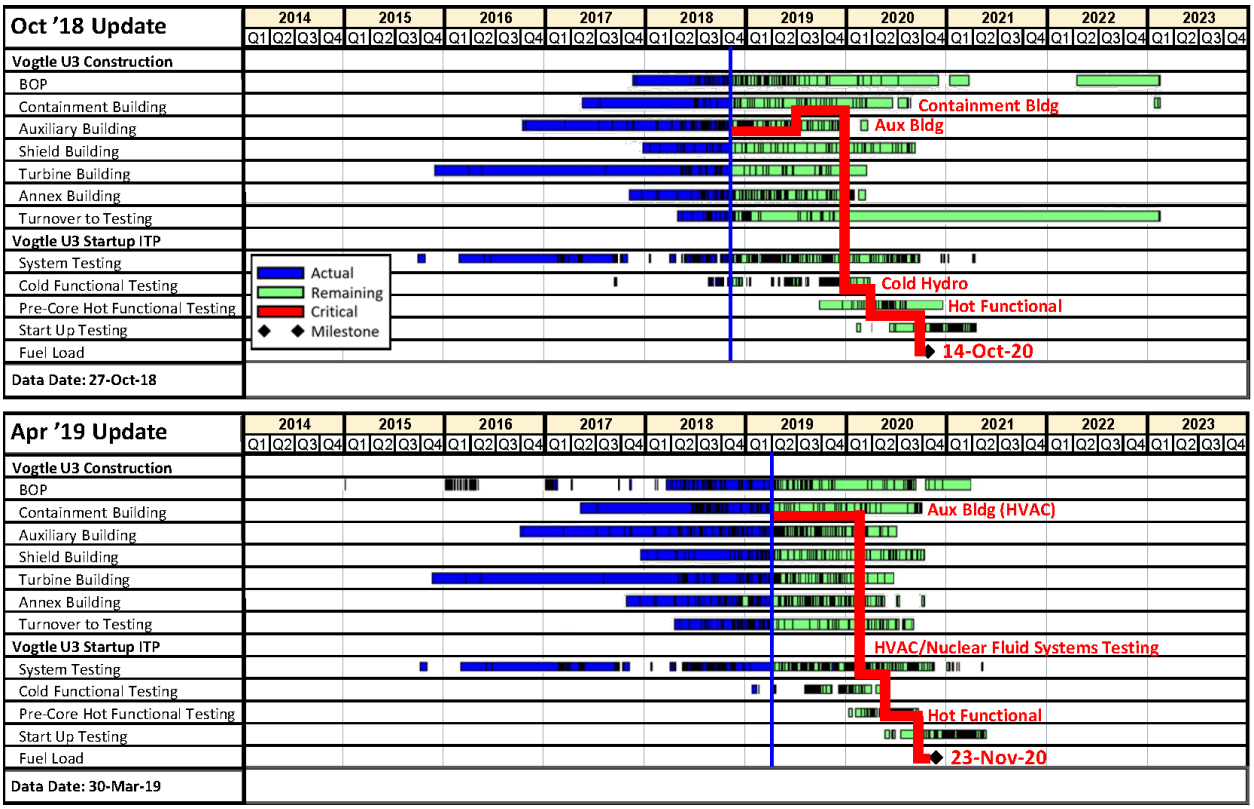
622. Window #3 spanned from October 27, 2018, until March 29, 2019, and represented the start of the transition from bulk construction to a system testing approach to managing the Project.

5.4.3.1 Critical Path As-Planned v. As-Built – Window #3

623. The Window #3 critical paths for Units 3 and 4 are summarized in the figures below.

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Figure 5.4-11 Unit 3 Window #3 As-Planned v. As-Built



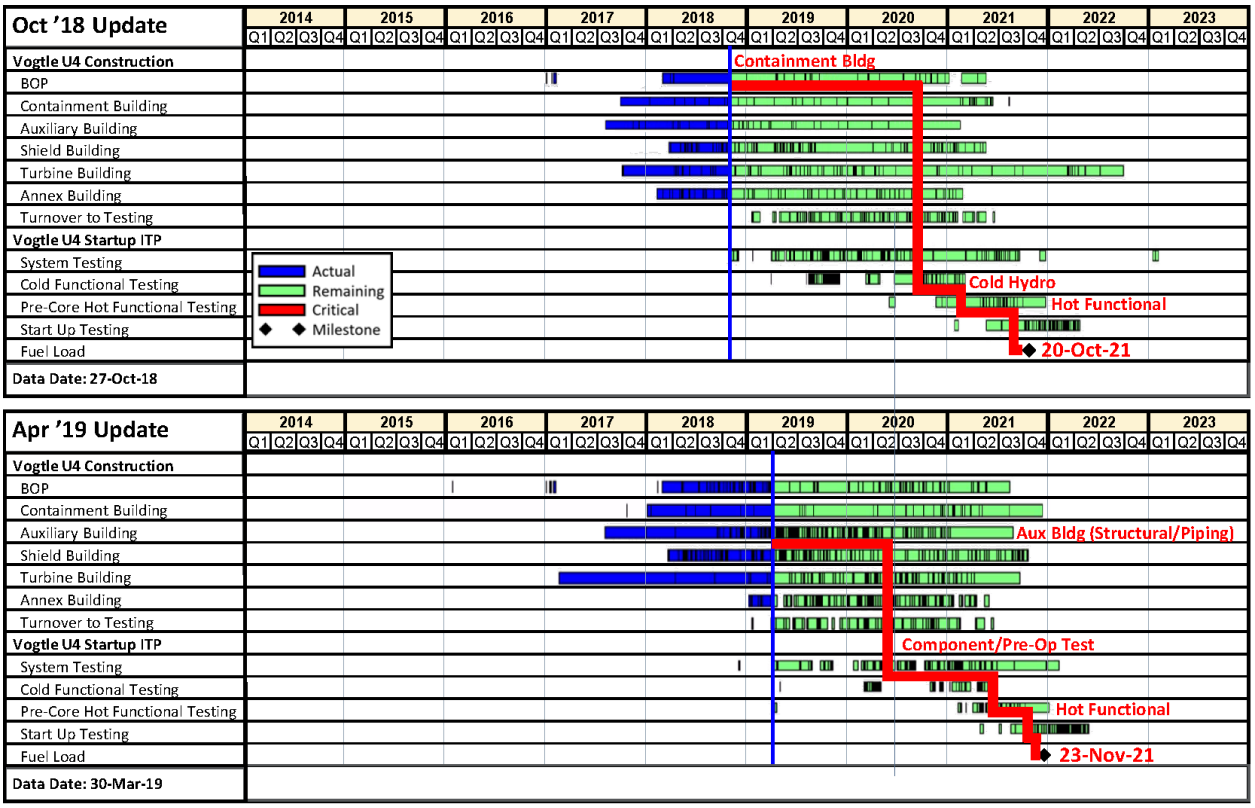
624. The critical path at the beginning of Window #3went through construction work at the auxiliary and containment buildings, then shifted to CHT, HFT, and finally reached the projected Fuel Load date on October 14, 2020. [503] The critical path at the end of the window continued through the HVAC activities at the auxiliary building, HVAC and nuclear fluid systems testing, and HFT. [504] Within this window the projected Unit 3 Fuel Load date slipped 40 days to November 23, 2020.

625. The critical paths at the start and end of Window #3 for Unit 4 are summarized in the figure below.

[503] November 26, 2018 Plant Vogtle Units 3&4 Schedule Review Package presentation, page 8.
[504] Vogtle Monthly Progress P6 Schedule Data - 19-Apr.

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Figure 5.4-12 Unit 4 Window #3 As-Planned v. As-Built



626. The critical path at the beginning of Window #3 went through containment building construction activities, CHT, and HFT. [505] Fuel load was projected to start on October 20, 2021, at the start of the window. The critical path at the end of the window shifted to auxiliary building structural and piping activities, component testing, pre-operational testing, and HFT. [506] The projected Unit 4 Fuel Load date slipped 34 days to November 23, 2021.

5.4.3.2 Causes of Delay – Window #3

627. Three primary causes of delay were identified during this period. They were: [507]

- The turnover of systems from construction to ITP
- An insufficient backlog of workable construction packages for electricians and pipefitters to be able to work ("Ready/Ready work")

[505] November 26, 2018, Plant Vogtle Units 3&4 Schedule Review Package presentation, page 18.
[506] Vogtle Monthly Progress P6 Schedule Data - 19-Apr.
[507] November 30, 2018, Direct Testimony of Don Grace, VCM 19, page 12.

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- The completion of "*specialty sub-contractors*" work (fire protection, and HVAC work) in conjunction with other remaining work

628. The lack of planning for the early transition from bulk construction to system testing is covered in detail in Section 3.3.4 of this Report. In summary, the management decision in October 2018 had an immediate negative impact on the execution of the Project both in terms of progress and productivity.

629. In 2018, Bechtel started reporting that incomplete engineering and inadequate management of engineering documents were impacting Project execution. Section 3.3.6 of this Report details the issues including, the lack of complete design, the steady stream of engineering design documents, design conflicts, engineering holds, the processing of an extensive number of ESRs and E&DCRs, and the slow processing of engineering documents that contributed to Project delays and labor inefficiency.

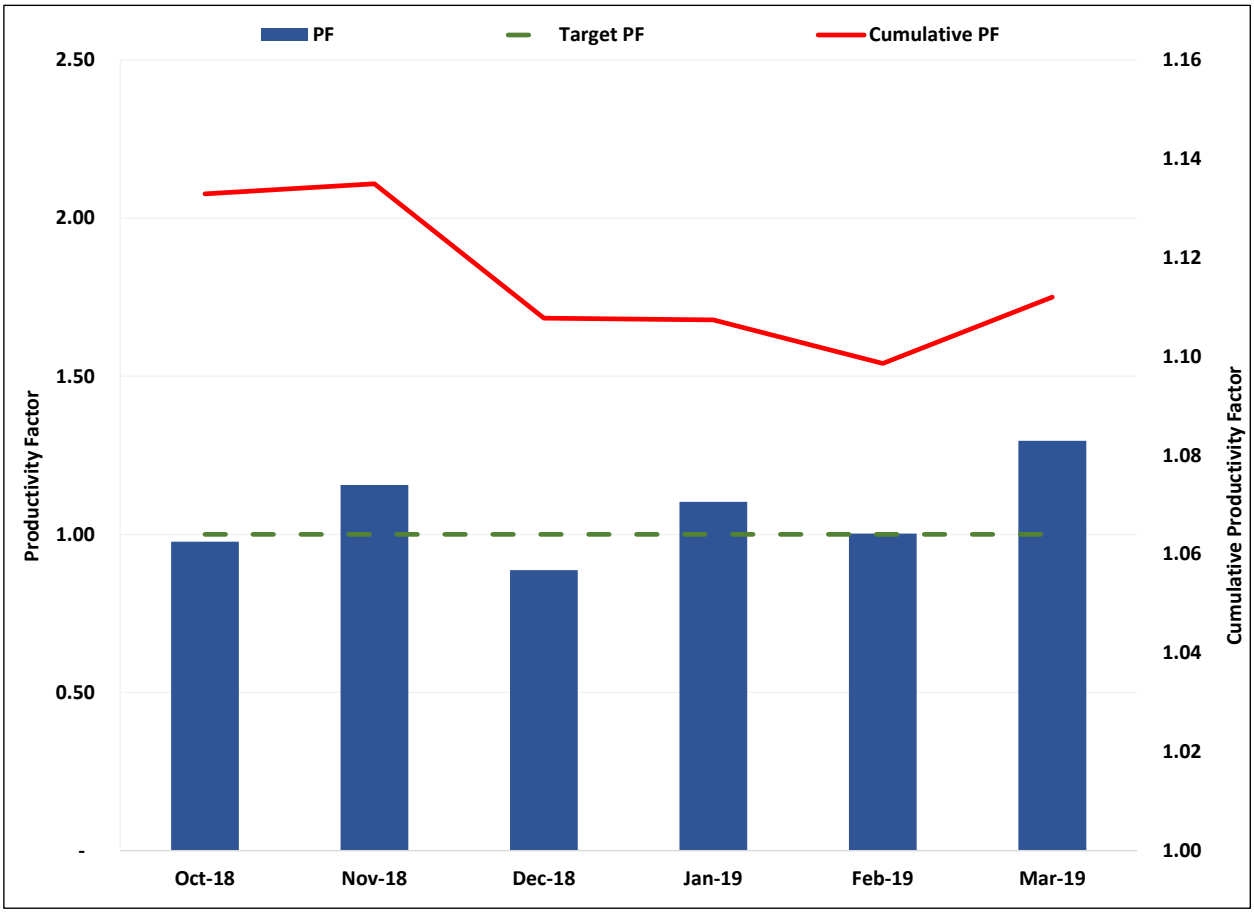
630. Procurement deficiencies and materials/module management impacted the Project and is covered in detail in Section 3.3.7 of this Report. Starting in 2018 and continuing into 2019, the work was impacted by equipment and material defects, material shortages, manufacturing defects, delays in long lead time equipment delivery, and unplanned on-site fabrication due to changes and delays which contributed to Project delays and labor inefficiency.

631. Ineffective resource management and inability to maintain or improve productivity on the Project is covered in detail in Section 3.3.9 of this Report. Despite efforts to improve craft labor management and productivity, the Project suffered from idle time, inadequate staffing, and little success improving construction performance which contribute to schedule delays and labor inefficiency.

632. The progress and labor productivity curves for the critical path Unit 3 containment and auxiliary buildings from **Attachment 2** are shown below. This includes the bulk commodity discipline for large bore piping. The Window #3 period is highlighted on the charts below which show the Project failed to achieve the planned progress during the Window #3 period in the auxiliary and containment buildings for the PF, earned hours, and the piping large bore trade. The failure to meet the planned earned hours was an ongoing issue as experienced during Window #2.

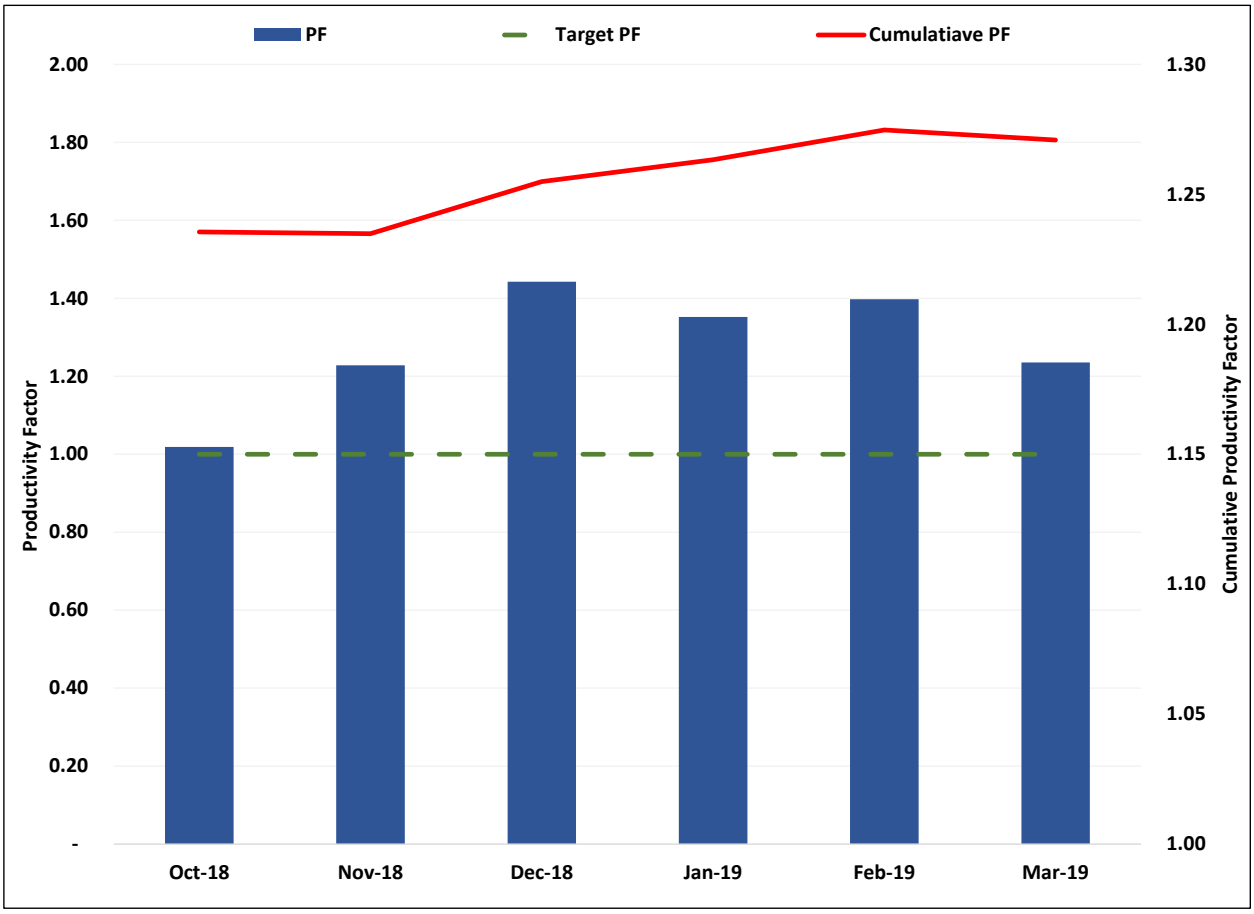
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Figure 5.4-13 Unit 3 Auxiliary Building Adj. PF (Window #3)



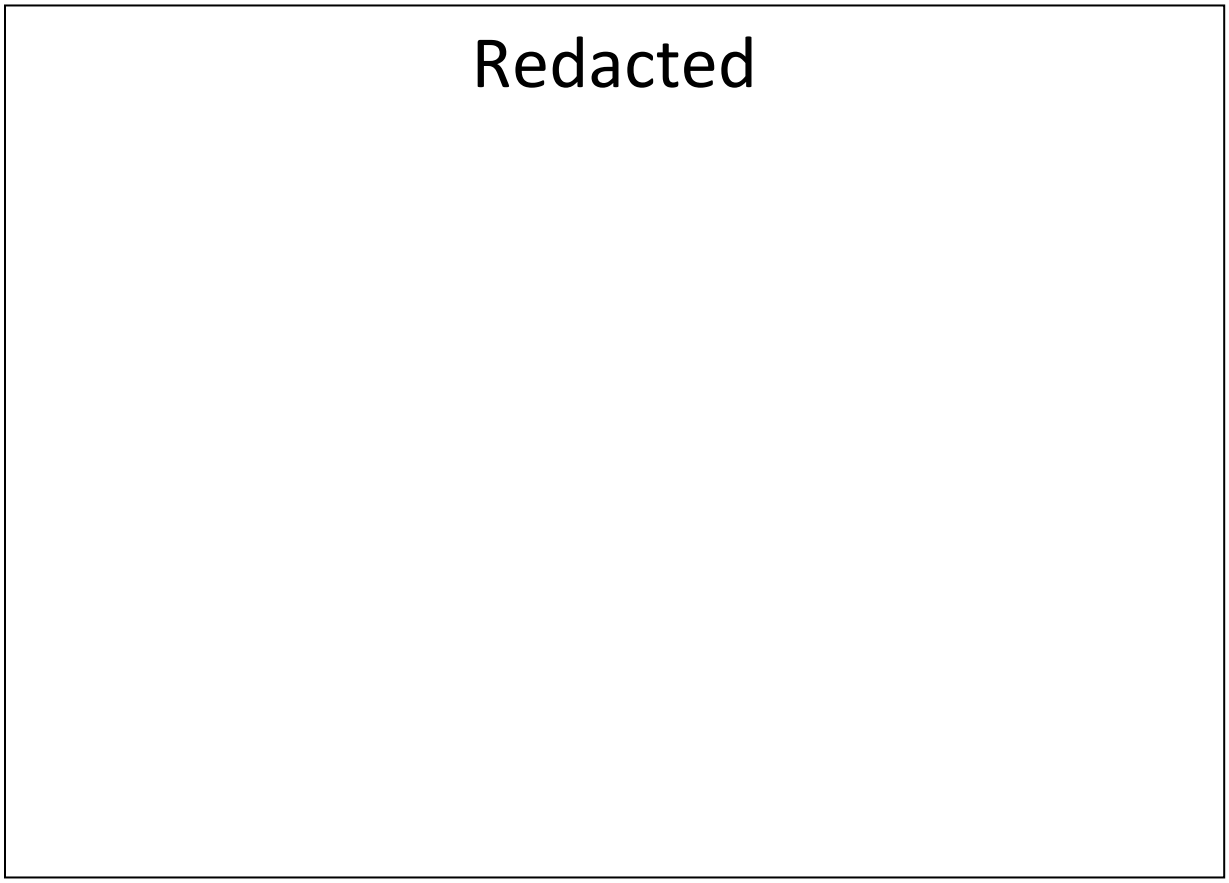
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Figure 5.4-14 Unit 3 Containment Building Adj. PF (Window #3)



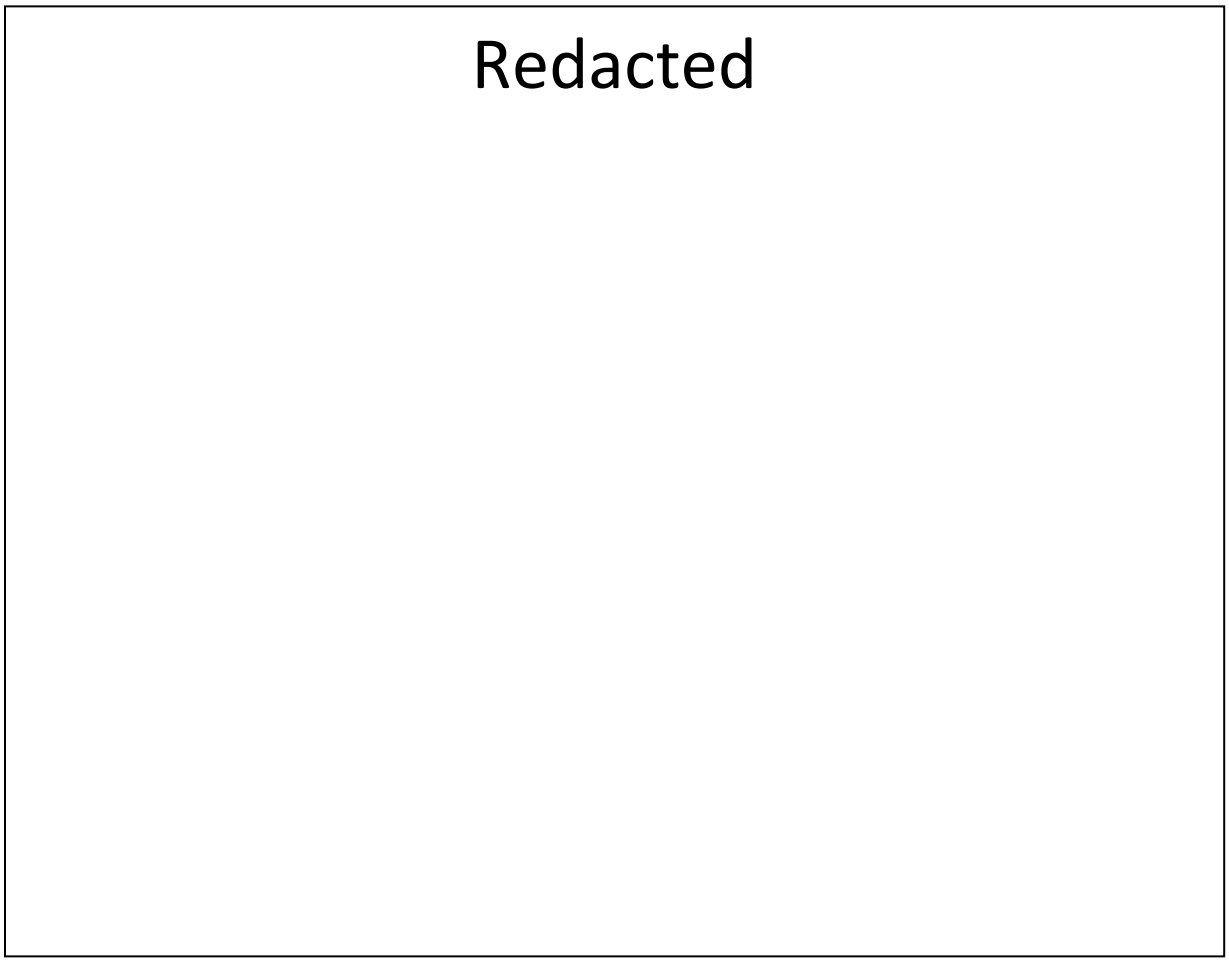
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Figure 5.4-16 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



633. While the progress and PF curves during Window #3 reflect the failure to achieve the planned progress resulting in a delay of approximately three to four months to Unit 3, the progress update at the end of the window reflected a delay of 40 days, confirming that SNC masked the actual progress delays to the Project and misrepresented the actual recovery in the April 2019 Re-baseline forecast.

5.4.3.3 Window Summary

634. Window #3 saw the start of the mismanagement of the transition from construction activities to system testing which led to a projected delay of 40 days in the Unit 3 Fuel Load start date and a delay of 34 days to Unit 4. The tables below summarize the delays during the window. However, as previously discussed the schedule updates did not depict accurately the level of progress and productivity experienced during construction execution which indicated a range of delay of three to

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four months as reflected in the Project data contained in **Attachment 2**. The tables below summarize the result of the analysis for Window #3.

Table 5.4-6 Summary of Unit 3 Window #3 Fuel Load Delay					
Window	**Window Start**	**Window Finish**	**Forecast Fuel Load (Window Start)**	**Forecast Fuel Load (Window Finish)**	**Fuel Load Delay (days)**
Window #3	October 2018	March 2019	14-Oct-20	23-Nov-20	40

Table 5.4-7 Summary of Unit 4 Window #3 Fuel Load Delay					
Window	**Window Start**	**Window Finish**	**Forecast Fuel Load (Window Start)**	**Forecast Fuel Load (Window Finish)**	**Fuel Load Delay (days)**
Window #3	October 2018	March 2019	20-Oct-21	23-Nov-21	34

5.4.4 Window #4 – April 2019 through March 2020

635. Window #4 analyzed the period from March 30, 2019, until March 27, 2020, and represented the revised IPS from the Earned Value April 2019, Re-Baseline through the start of the COVID-19 pandemic.

5.4.4.1 April 2019 Re-Baseline

636. The analysis of the timeline of events leading to the April 2019 re-baseline and a summary of the primary implemented changes is presented below.

637. In VCM 17, the Commission approved the in-service dates of November 2021 and November 2022 for Unit 3 and Unit 4, respectively.

638. As of VCM 19, issued on August 31, 2018, SNC was conducting a routine, expected, and customary verification of Project quantities, staffing, and productivity (referred to as the "re-baseline effort") and was to file a report no later than May 15, 2019.

639. Toward the end of 2018, it was deemed necessary to perform a re-baseline to calibrate the schedule and cost, incorporating the most current information available based on construction progress since

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VCM 19. SNC reported the re-baseline effort as part of the Project's ongoing review of costs and schedule.

640. On May 1, 2019, SNC provided its report on the results of the schedule re-baseline for the construction of Vogtle Units 3 and 4.

641. In summary, SNC reported that, their re-baseline process:

- Affirmed the regulatory-approved schedule with the expected in-service dates of November 2021 and November 2022 for Units 3 and 4.
- Adjusted the site working schedule for the Project to account for recent performance and refining projected future performance on the Project.
- Incorporated current information regarding productivity, commodity installation, system turnover, and the ability to attract and retain craft labor.
- Utilized an iterative, phased approach to develop schedule scenarios that considered resource constraints, logic and sequence, and milestone dates. The scenarios were also evaluated by functional groups across the site both independently and collectively and engaged leadership from Bechtel, SNC, the Company, and the other Vogtle Co-owners.
- Affirmed the capital forecast as presented in VCM 19. The cost associated with the adjustment to the working schedule was consistent with the cost estimates included in the VCM 19 capital cost forecast; therefore, no changes to the total Project capital cost forecast were necessary.

642. SNC reported the re-baseline process was a complex and coordinated effort among personnel from all organizations on the Project, including the construction, subcontracts, SNC ITP, engineering, and procurement organizations.

- Each organization was tasked with validation of its schedule scope, while performing specific actions and reviews relevant to the organization's function.
- The construction organization was responsible for quantity verification of all commodities for the updated site working schedule to reflect a current and accurate assessment of quantities remaining to install. Construction was additionally responsible for the identification of current resource constraints and to assess the potential to ramp up those resources when necessary to support Project needs.

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- The subcontracts organization was responsible for supporting the integration of the subcontracted scope in the updated site working schedule.
- Engineering was responsible for evaluation of design constraints and a review of logistics in the updated site working schedule.
- The procurement organization coordinated services and material availability with other functional organizations to support their need date.
- Each organization was responsible for identifying potential construction impacts and, when necessary, developing mitigation plans to support the schedule.
- After analyzing the initial data and, where applicable, mitigating potential impacts, the construction schedules were resource loaded and levelized. Bechtel and the SNC ITP organizations also reviewed the schedule logic connecting construction system completion to system testing.
- The ITP organization then built a detailed, resource-loaded testing schedule for Unit 3 to support testing and system turnover milestones up to Fuel Load. The updated working schedule for Unit 4 includes a twelve-month lag to the Unit 3 schedule.

643. The re-baseline revised the completion schedule to May 2021 and May 2022. The shift to May 2021 and May 2022 from the previous site working dates of April 2021 and April 2022 was driven by the Project's lower than projected performance in 2018 against the June 2018 schedule.

644. The following table tracks the changes to Project Milestones for the updated site working plan. [508]

Table 5.4-8 Site Working Plan Project Milestones

Major Milestone	Unit 3			Unit 4		
	June 2018 Baseline	April 2019 Baseline	Delta (day)	June 2018 Baseline	April 2019 Baseline	Delta (days)
Initial Energization (IE)	7-May-19	7-May-19	0	24-Oct-19	7-May-20	-196
Integrated Flush (IF) – Start	23-Jul-19	7-Aug-19	-15	22-Jul-20	7-Aug-20	-16
Main Control Room (MCR) Ready for Testing	9-Nov-19	25-Nov-19	-16	9-Nov-20	25-Nov-20	-16
Cold Hydro Test (CHT) – Start	9-Feb-20	16-Apr-20	-67	26-Feb-21	16-Apr-21	-49

[508] Vogtle Monthly Progress P6 Schedule Data – 18-Jun, 19-Apr.

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Table 5.4-8 Site Working Plan Project Milestones						
Major Milestone	**Unit 3**			**Unit 4**		
	June 2018 Baseline	**April 2019 Baseline**	**Delta (day)**	**June 2018 Baseline**	**April 2019 Baseline**	**Delta (days)**
Hot Functional Test (HFT) – Start	26-Apr-20	13-Jun-20	-48	26-Apr-21	13-Jun-21	-48
Fuel Load	14-Oct-20	23-Nov-20	-40	14-Oct-21	23-Nov-21	-40
Declare Project Substantial Completion	14-Apr-21	23-May-21	-39	25-Apr-22	23-May-22	-28

- The changes were driven primarily by construction performance and challenges in attracting necessary craft labor.
- The experience gained in managing the Project since VCM 17 informed the assumptions that were considered in the development of the updated site working schedule.
- The re-baseline was built on existing schedule logic to improve construction sequencing activities for room and area completion to best support turnover to testing milestones.

645. Critical Paths in the April 2019 Re-baseline.

- Unit 3 – was driven through completion of IF to start OVT, then CHT, followed by HFT, and ultimately leading to Fuel Load forecasted on November 23, 2020. The key drivers to these critical path milestones were fit-up and welding of the containment vessel (CV) top head, testing and completion of the polar crane, and the reactor coolant system (RCS-1) system turnover.
- Unit 4 – was driven through the shield building. Fuel Load was being driven by the RC-04B/07B concrete placement, RC-10 concrete placement, and ultimately shield building vertical construction completion, which included the assembly and testing of the passive containment cooling water storage tank.

646. The re-baseline saw a net reduction of approximately 540,000 direct hours for commodity installation, which is largely attributable to reductions in electrical and piping quantities:

- Electrical quantity reduction resulted from lessons learned from Chinese projects.
- Increase in civil quantities due to changes in rebar and embedded plate density.
- On-site fabrication budgets increased based on shift from procurement budgets to allow for more expedient execution for near-term construction needs.

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- Goal of 160,000 hours of productive work per week during peak construction period of August 2019 to March 2020. It was estimated that an additional 500 to 1,000 craft (comprised of electricians, pipefitters, and civil trades) above the current level of 4,600 workers would be needed to meet revised earnings targets.

647. To meet the new earnings plan, the Project had identified several near-term focus areas.

- Increase the number of, and continue to improve the effectiveness of, leadership across the site to improve the current level of productivity,
- Increasing night shift earnings while evaluating other opportunities to make valuable shift adjustments, and
- Added craft employees to the Project in a phased approach to reduce potential impact on performance.

648. Variances to direct hours scopes for commodity installation hours were adjusted through a trend program. The net reduction of 540,000 was partially offset by reallocation of 470,000 hours for fabrication to the construction budget. This did not change the total quantities to be installed but allowed for items to be fabricated on-site as opposed to an offsite vendor. The following table summarizes the variances in labor hours for the commodities in the April 2019 Re-baseline. [509]

Table 5.4-9: Labor Hour Variances in the April 2019 Re-baseline

(in hours)	June 2018 Baseline	April 2019 Baseline	
	Total Scope	Total Scope	Total Scope DELTA
Excavation & Backfill	632,179	604,609	(27,570)
Formwork	1,070,352	1,320,315	249,963
Rebar	984,406	1,274,083	289,677
Embeds	745,642	869,131	123,489
Concrete	1,595,352	1,012,785	(582,567)
Structural Steel	876,126	1,099,549	223,423
Architectural	36,738	62,710	25,972
Conduit	1,109,485	1,927,972	818,487
Conduit Supports	2,148,610	485,586	(1,663,024)
Cable Tray	260,909	226,841	(34,068)
Cable Tray Supports	911,853	839,471	(72,382)
Cable	695,303	710,523	15,220

[509] Vogtle Monthly Progress P6 Schedule Data – 18-Jun, 19-Apr.

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Table 5.4-9: Labor Hour Variances in the April 2019 Re-baseline			
(in hours)	**June 2018 Baseline**	**April 2019 Baseline**	
	Total Scope	**Total Scope**	**Total Scope DELTA**
Terminations	332,882	240,012	(92,870)
Instrumentation	381,474	539,336	157,862
Equipment, Tanks & Pumps	1,220,505	1,180,239	(40,266)
Electrical Equipment	480,367	720,043	239,676
U/G Pipe	477,382	378,079	(99,303)
A/G Large Bore Pipe	1,400,761	1,396,285	(4,476)
A/G Large Bore Pipe Supports	1,606,191	1,765,811	159,620
A/G Small Pipe	634,380	581,020	(53,360)
A/G Small Pipe Supports	705,717	619,502	(86,215)
Modules Set & Post Set	744,032	662,927	(81,105)
Module Assembly	96,865	93,628	(3,237)
Total	**19,147,511**	**18,610,457**	**(537,054)**
Fabrication	182,913	651,752	468,839
Total Including Fabrication	**19,330,424**	**19,262,209**	**(68,215)**

649. Project leadership acknowledged that the updated site working schedule remained aggressive but believed it was a reasonable strategy to provide schedule margin to the regulatory approved in-service dates. They stated that the Project would work diligently to attract the necessary craft labor, enhance site leadership, and drive productivity improvements.

650. Project risks that were recognized and which could impact Project contingency included:

- The ability to attract and retain additional craft labor
- Increasing labor rates due to a strong labor market in Georgia and the southeastern United States
- Additional subcontract scope
- The inability of construction to improve performance, increased Project support resources required beyond current estimates
- Additional materials and/or labor required for testing and start-up of the Project

651. In addition, documents would be filed separately with the Commission that included further details about the new site working schedule's target earnings plans, craft staffing curves, and commodity curves, as well as updated assumptions, risk register items, and detailed schedule files.

652. Also noted was the fact that the direct construction work did not include certain subcontracted

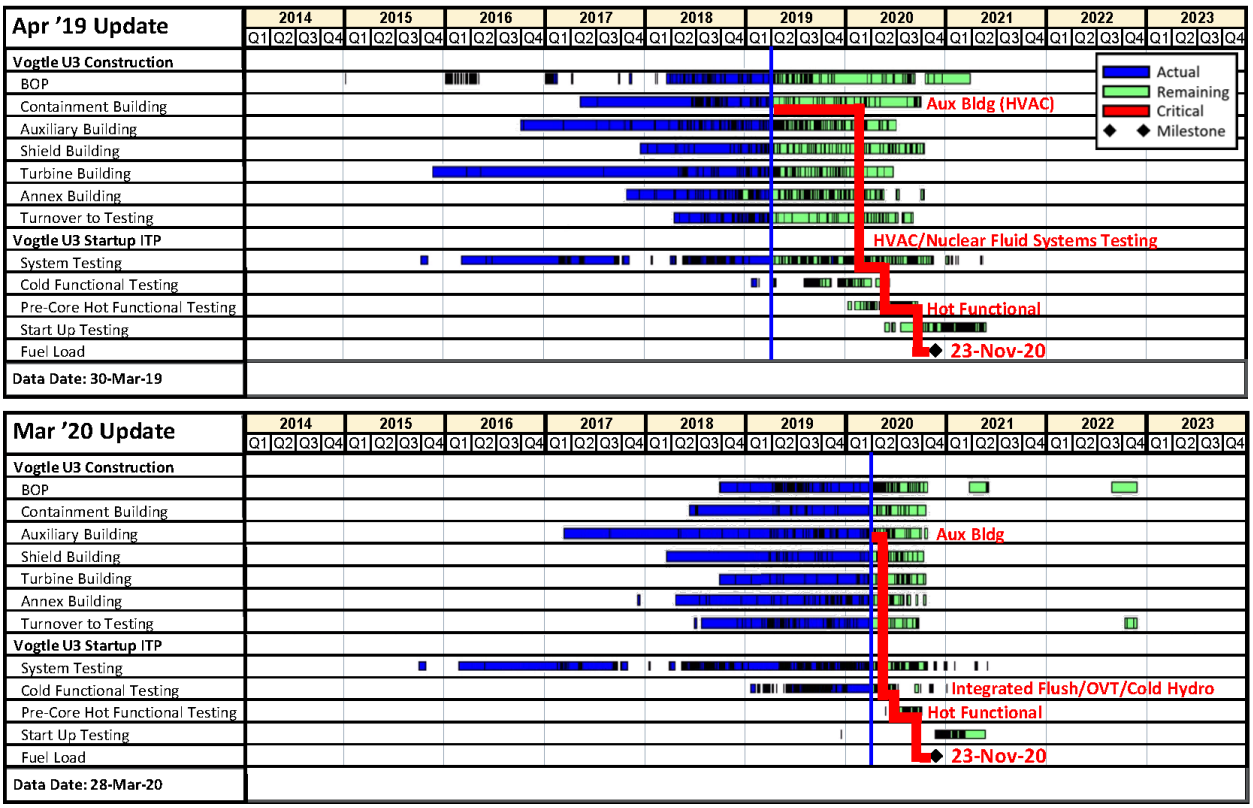
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scopes of work (e.g., Units 3 and 4 cooling towers, river water intake structure, and permanent buildings) or the indirect labor necessary to support construction (e.g., labor to construct temporary construction facilities, scaffolding, material handling, housekeeping, warehousing support, and training).

5.4.4.2 Critical Path As-Planned v. As-Built – Window #4

653. Window #4 encompasses the period from March 30, 2019, to March 28, 2020. The critical paths at the start and end of the window for Unit 3 are summarized in the figure below.

Figure 5.4-17 Unit 3, Window #4 As-Planned v. As-Built



654. The critical path for Unit 3 at the beginning of Window #4 went through the HVAC activities in the containment building, HVAC and nuclear fluid systems testing, and HFT, finally reaching the projected Fuel Load date on November 23, 2020. [510] The critical path at the end of the window remained roughly the same going through the auxiliary building construction activities, CHT, and HFT.[511] The projected Fuel Load date stayed at November 23, 2020. The critical activities in the

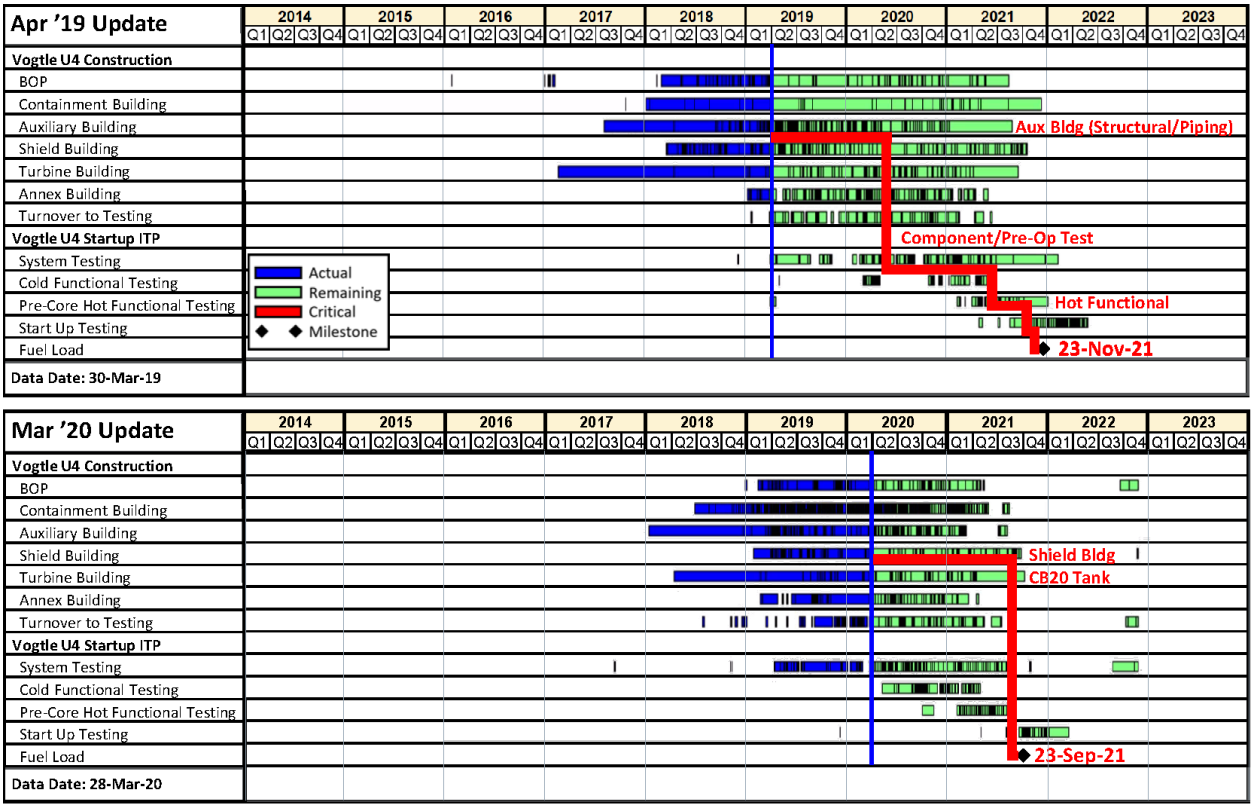
[510] Vogtle Monthly Progress P6 Schedule Data - 19-Apr.
[511] Vogtle Monthly Progress P6 Schedule Data - 20-Apr.

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containment building slipped into 2020, however these delays appear to have been mitigated by conducting the critical cold and HFT activities concurrently with construction work on the containment building.

655. The critical paths at the start and end of the window for Unit 4 are summarized in the figure below.

Figure 5.4-18 Unit 4 Window #4 As-Planned v. As-Built



656. The critical path at the beginning of Window #4 went through to the auxiliary building structural and piping activities, component testing, pre-operational testing, and HFT.[512] Fuel Load was projected to start on November 23, 2021, at the start of the window. The critical path at the end of the window shifted to shield building CB20 tank activities. [513] The projected Fuel Load date was projected to start on September 23, 2021, 61 days earlier than at the beginning of the window.

5.4.4.3 Causes of Delay – Window #4

657. The lack of planning for the transition from bulk construction to system testing continued during

[512] Vogtle Monthly Progress P6 Schedule Data - 19-Apr.
[513] Vogtle Monthly Progress P6 Schedule Data - 20-Apr.

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this window, this issue is covered in detail in Section 3.3.4 of this Report.

658. Incomplete engineering and inadequate management of engineering documents continued impacting Project execution. Section 3.3.6 of this Report details the ongoing issues including, the lack of complete design, the steady stream of engineering design documents, design conflicts, engineering holds, the processing of an extensive number of ESRs and E&DCRs, and the slow processing of engineering documents that contributed to Project delays and labor inefficiency.

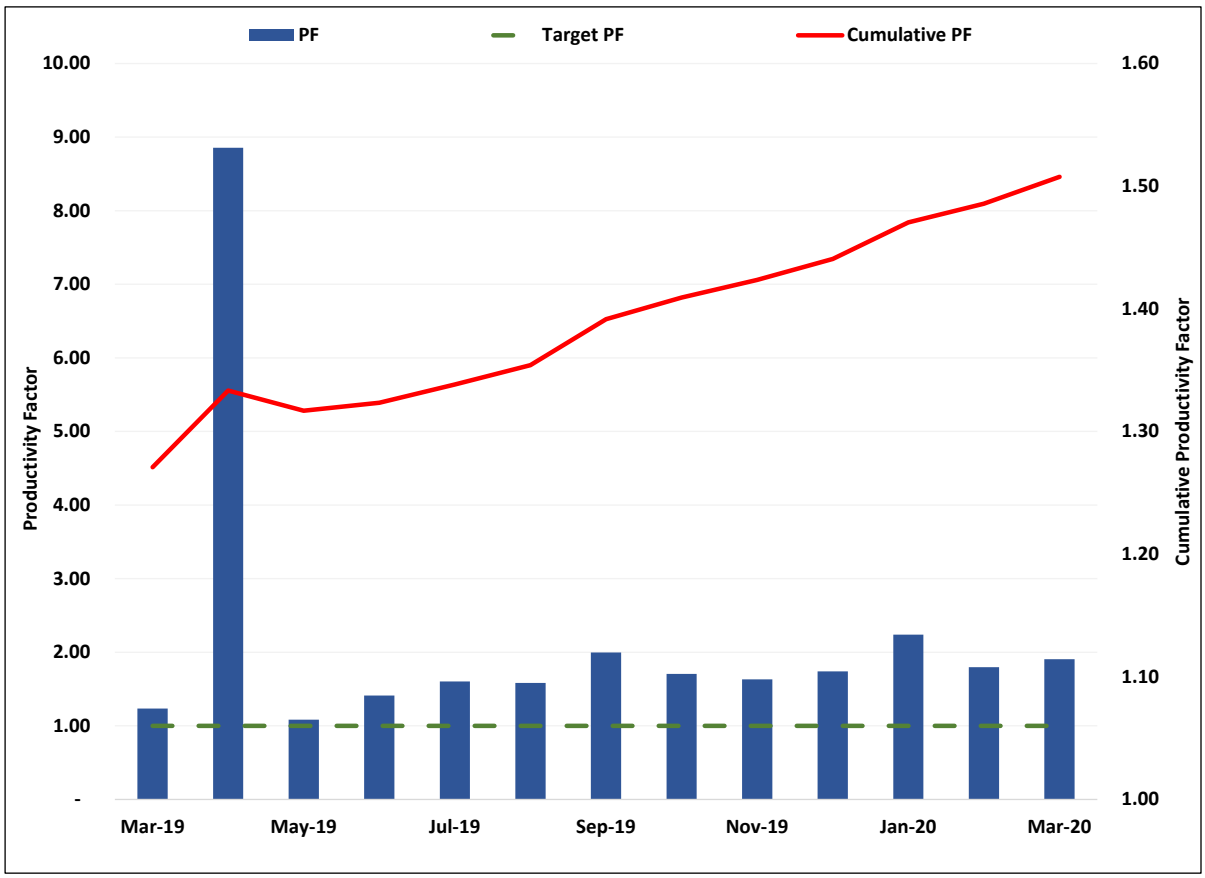
659. Procurement deficiencies and materials/module management impacted the Project and is covered in detail in Section 3.3.7 of this Report. Continuing through this window, the work was impacted by equipment and material defects, material shortages, manufacturing defects, delays in long lead time equipment delivery, and unplanned on-site fabrication due to changes and delays which contributed to Project delays and labor inefficiency.

660. Ineffective resource management and inability to maintain or improve productivity on the Project is covered in detail in Section 3.3.9 of this Report. Despite ongoing efforts to improve craft labor management and productivity, the Project suffered from idle time, inadequate staffing, and little success improving construction performance which contribute to schedule delays and labor inefficiency.

661. The progress and labor productivity curves for the critical path Unit 3 Containment and auxiliary building from **Attachment 2** are shown in the figures below. This includes the driving bulk commodity discipline for electrical. The Window #4 period is highlighted on the charts below which show the Project failed to achieve the planned progress during the Window #4 period in the containment building for the PF, earned hours, and the large and small-bore piping and supports.

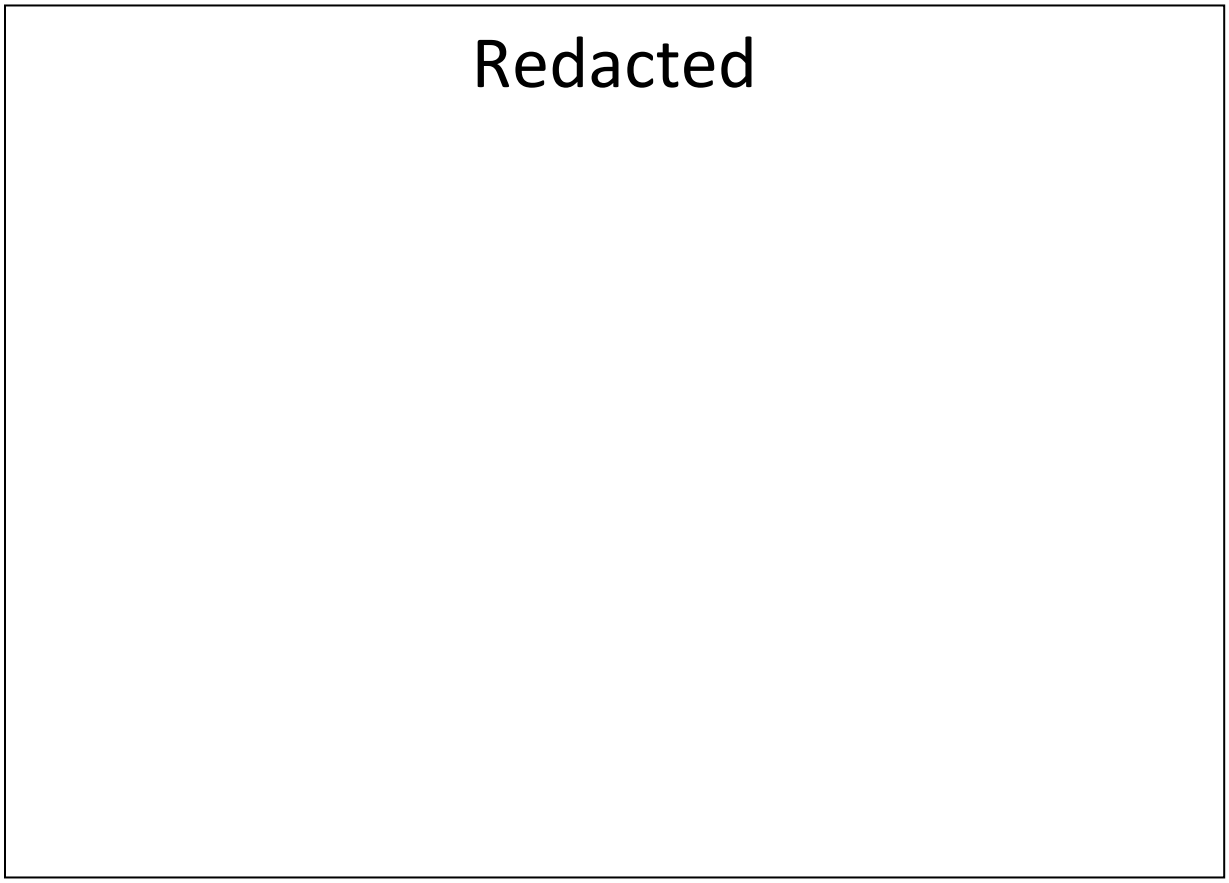
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Figure 5.4-19 Unit 3 Containment Building Adj. PF (Window #4)



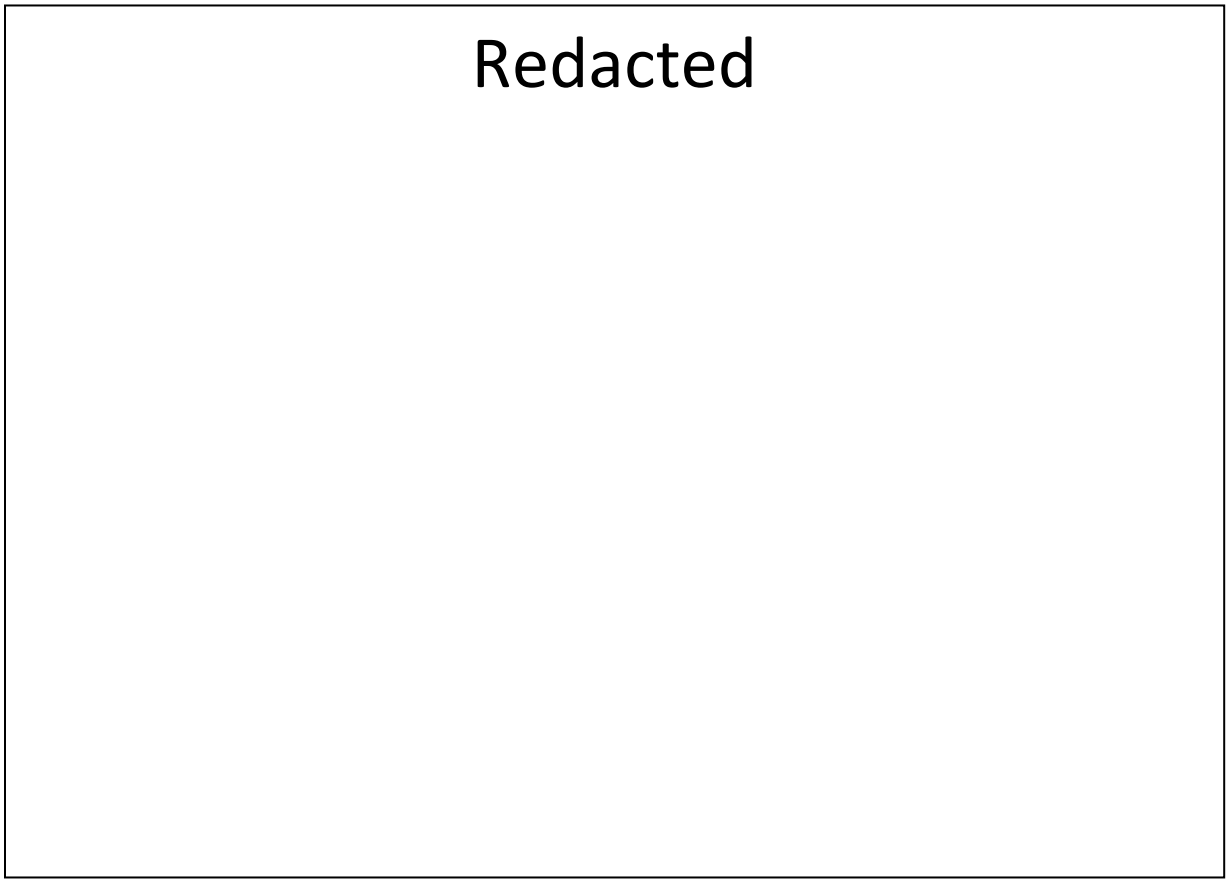
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Figure 5.4-20 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



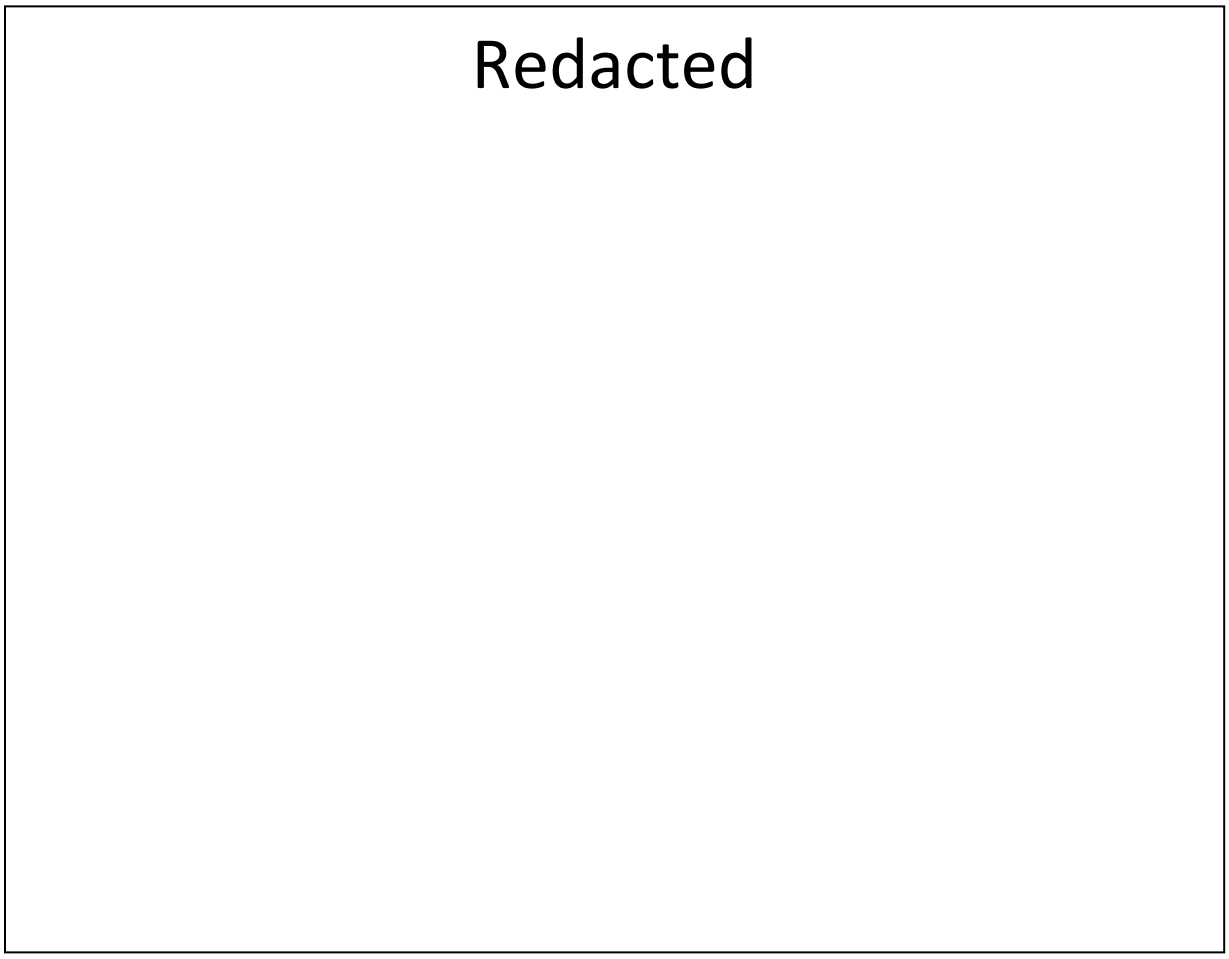
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Figure 5.4-21 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



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Figure 5.4-22 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



662. While the progress curves during Window #4 reflect the failure to achieve the planned progress resulting in a delay of approximately of four months to Unit 3, the progress update at the end of the window reflected a delay of zero days, indicating that SNC masked the actual progress delays to the Project and misrepresented the actual recovery in the April 2019 Re-baseline forecast. The curves show SNC failed to achieve the planned progress immediately after the re-baseline forecast was issued.

5.4.4.4 Window Summary

663. Window #4 saw the ongoing mismanagement of the transition from construction activities to system testing plus impacts from incomplete engineering and inadequate management of engineering documents, procurement deficiencies and material management, ineffective resource management, and the inability to maintain or improve productivity. However, as previously

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discussed, the schedule updates did not depict accurately the level of progress and productivity experienced during construction execution which indicated a range of delay of three to four months as reflected in the Project data contained in **Attachment 2**. The tables below summarize the result of the analysis for Window #4.

Table 5.4-10 Summary of Unit 3 Window #4 Fuel Load Delay					
Window	**Window Start**	**Window Finish**	**Forecast Fuel Load (Window Start)**	**Forecast Fuel Load (Window Finish)**	**Fuel Load Delay (days)**
Window #4	March 2019	March 2020	23-Nov-20	23-Nov-20	0

Table 5.4-11 Summary of Unit 4 Window #4 Fuel Load Delay					
Window	**Window Start**	**Window Finish**	**Forecast Fuel Load (Window Start)**	**Forecast Fuel Load (Window Finish)**	**Fuel Load Delay (days)**
Window #4	March 2019	March 2020	23-Nov-21	23-Sep-21	-61

5.4.5 Window #5 – March 2020 through April 2021

664. Window #5 analyzed the period from March 28, 2020, to April 23, 2021, and covered the COVID-19 period of impacts through the submittal of Bechtel's claim for the COVID-19 impact evaluation submitted on April 20, 2021.

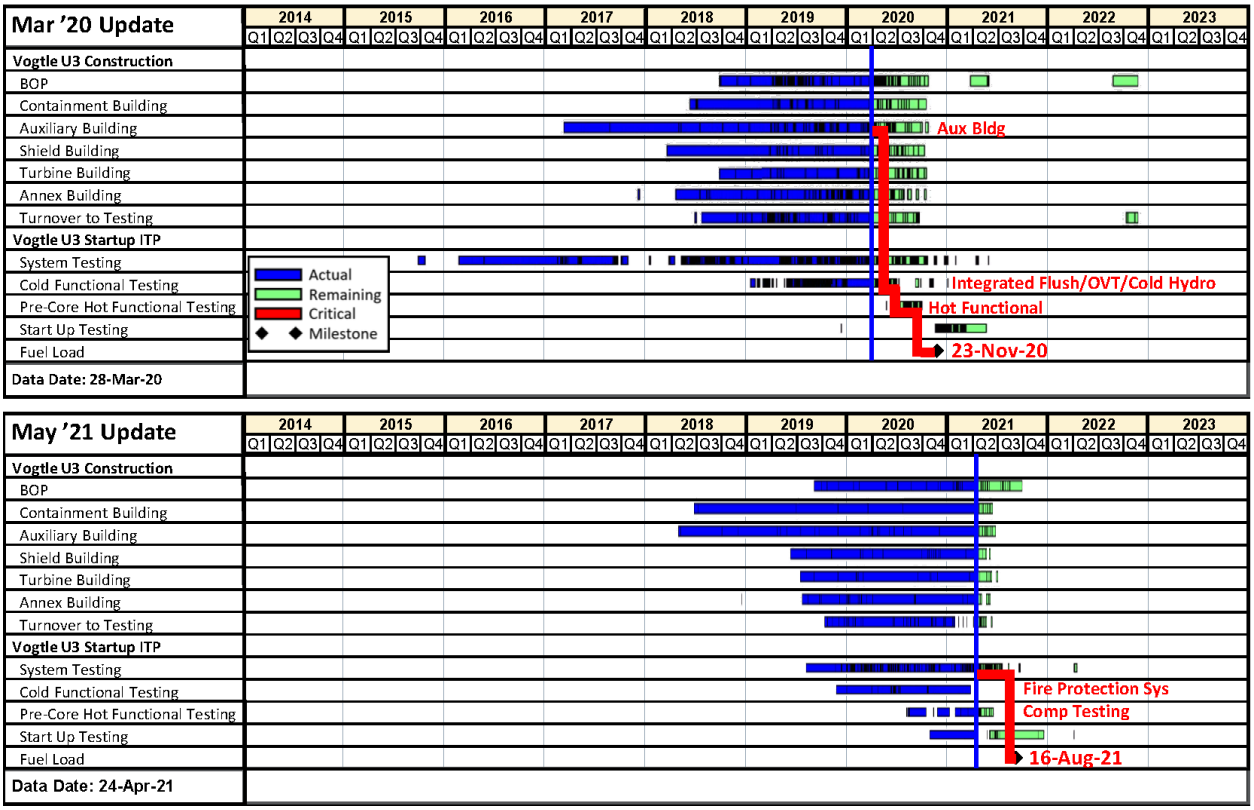
5.4.5.1 Critical Path As-Planned v. As-Built – Window #5

665. Window #5 extends from the start of the COVID-19 pandemic to the cutoff date of the Bechtel COVID-19 claim. This time frame also coincides with the start of the COVID-19 pandemic and corresponding impacts resulting therefrom.

666. The figure below summarizes the Unit 3 critical paths at the beginning and end of the window.

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Figure 5.4-23 Window #5 As Planned v. As-Built



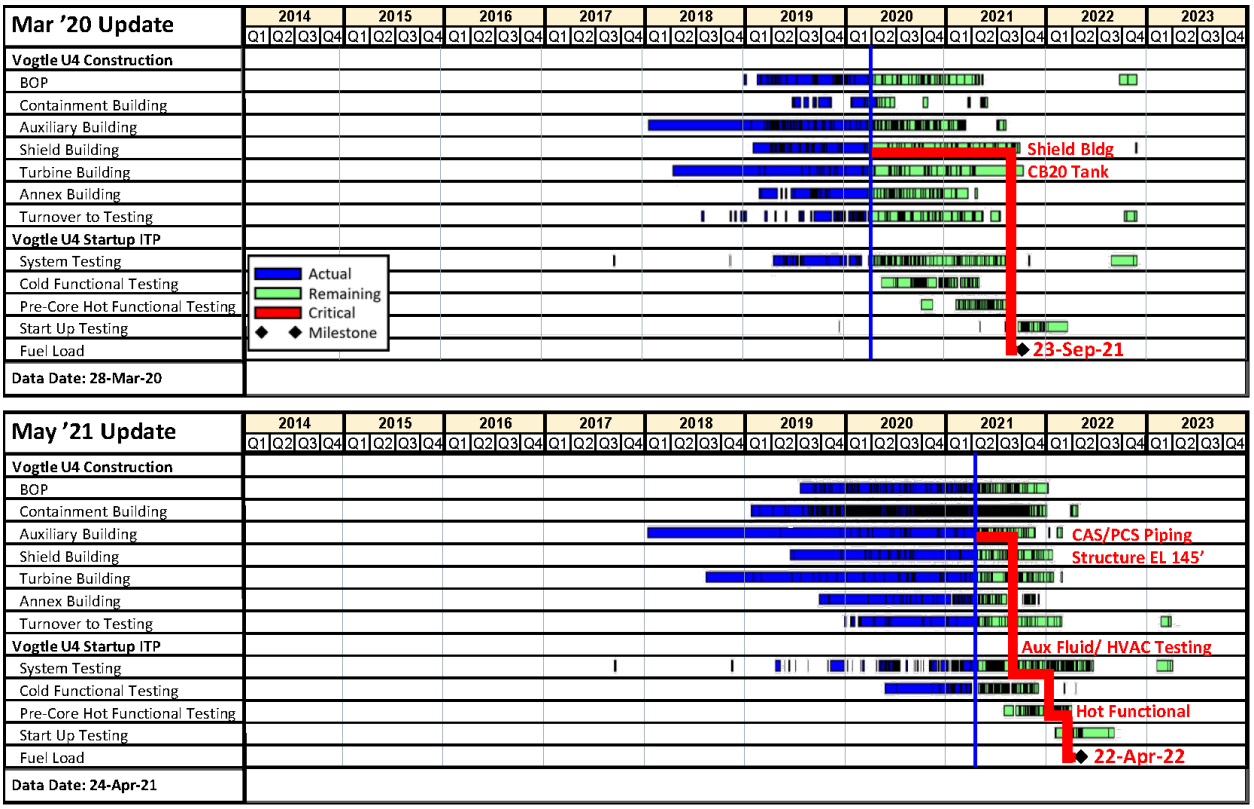
667. The critical path at the beginning of Window #5went through construction work at the auxiliary building, then to CHT, HFT, finally reaching the projected Fuel Load date on November 23, 2020. [514] By April 2021, the critical path shifted to the remaining fire protection system testing activities.[515] Delays in the start of window critical path activities pushed the forecast start date for Unit 3 Fuel Load 266 days from November 23, 2020, to August 16, 2021.

668. The critical paths at the start and end of the window for Unit 4 are summarized in the figure below.

[514] Vogtle Monthly Progress P6 Schedule Data - 20-Apr.
[515] Vogtle Monthly Progress P6 Schedule Data - 21-May.

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Figure 5.4-24 Unit 4 Window #5 As-Planned v. As-Built



669. The critical path at the beginning of Window #5 went through the shield building CB20 tank activities, Fuel Load was projected to start on September 23, 2021, at the start of the window. [516] The critical path at the end of the window shifted to auxiliary building CAS/PCS piping activities, structural activities at El 145', aux fluid testing, HVAC testing, and HFT. During this window the projected Unit 4 Fuel Load date slipped 211 days to April 22, 2022. [517]

5.4.5.2 Causes of Delay – Window #5

670. The dominant cause of delay during the Window #5 period was the COVID-19 pandemic as detailed in Section 3.3.10 of this Report. One important aspect of the COVID-19 impact was that the reduced availability of craft laborers impacted the execution of critical work in Unit 4 because SNC moved several workers from Unit 4 to Unit 3.[518]

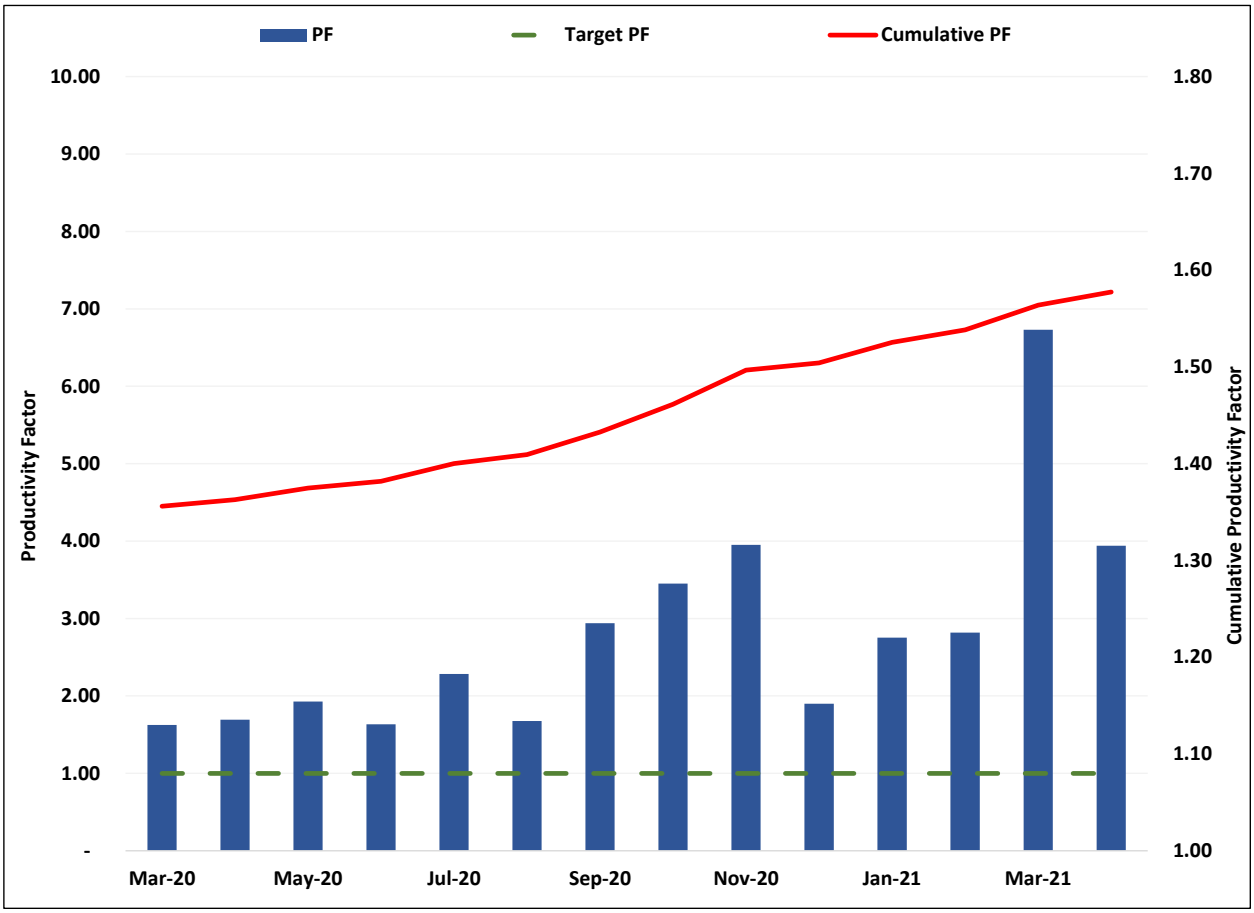
[516] Vogtle Monthly Progress P6 Schedule Data - 20-Apr.
[517] Vogtle Monthly Progress P6 Schedule Data - 21-May.
[518] November 24, 2020, Direct Testimony of Don Grace, VCM 23, page 17.

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671. While the issues of management of the ITP program, incomplete engineering and inadequate engineering management, procurement deficiencies, and resource management continued to exist on the Project, the COVID-19 pandemic was the dominant contributing issue to schedule delay and labor inefficiency.

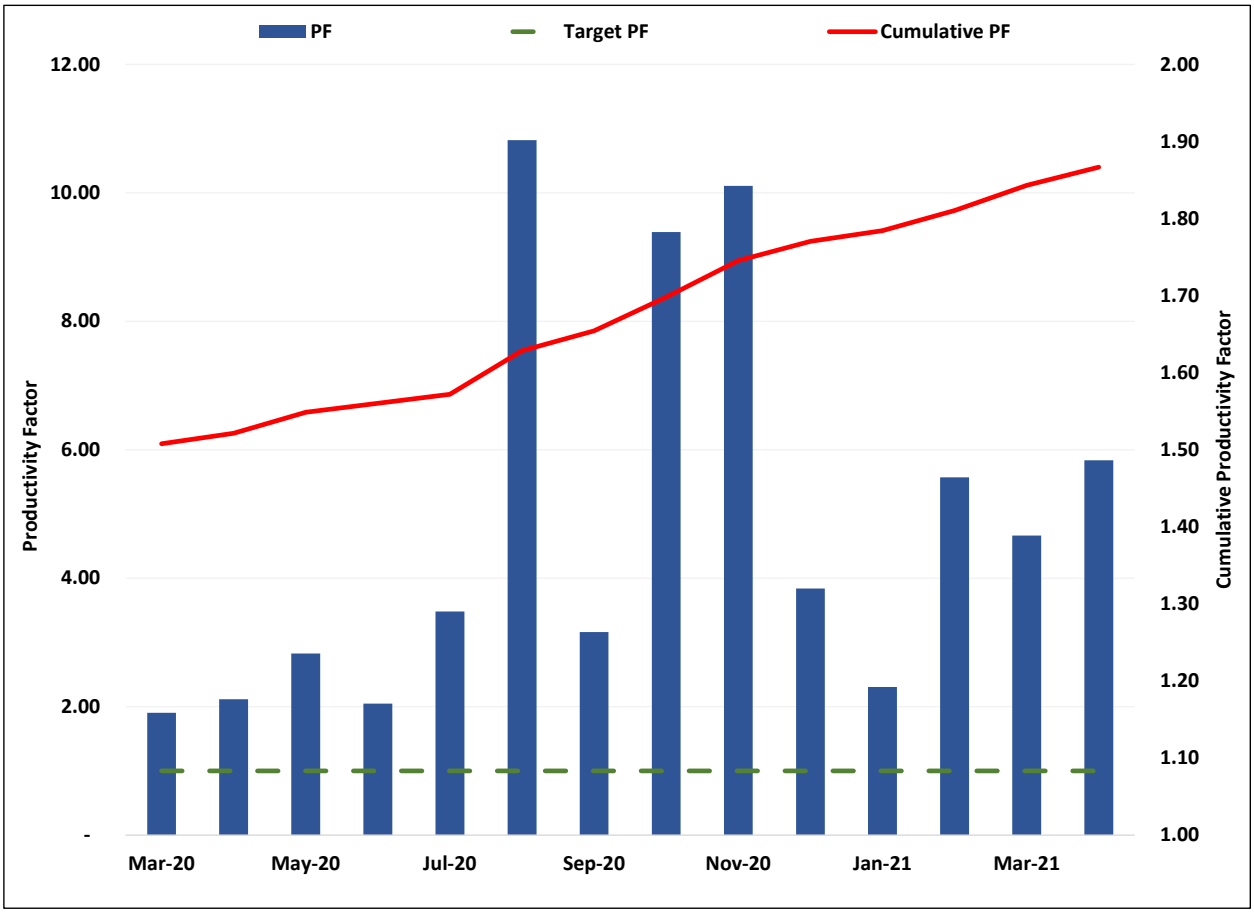
672. The progress and labor productivity curves for the critical path Unit 3 auxiliary and containment buildings from **Attachment 2** are shown below. This includes the driving bulk commodity discipline for electrical. The Window #5 period is highlighted on the charts below which show the Project failed to achieve the planned progress during the Window #5 period in the containment building for the PF, earned hours, and the electrical. This was the result of impacts related to the COVID-19 pandemic.

Figure 5.4-25 Unit 3 Auxiliary Building Adj. PF (Window #5)



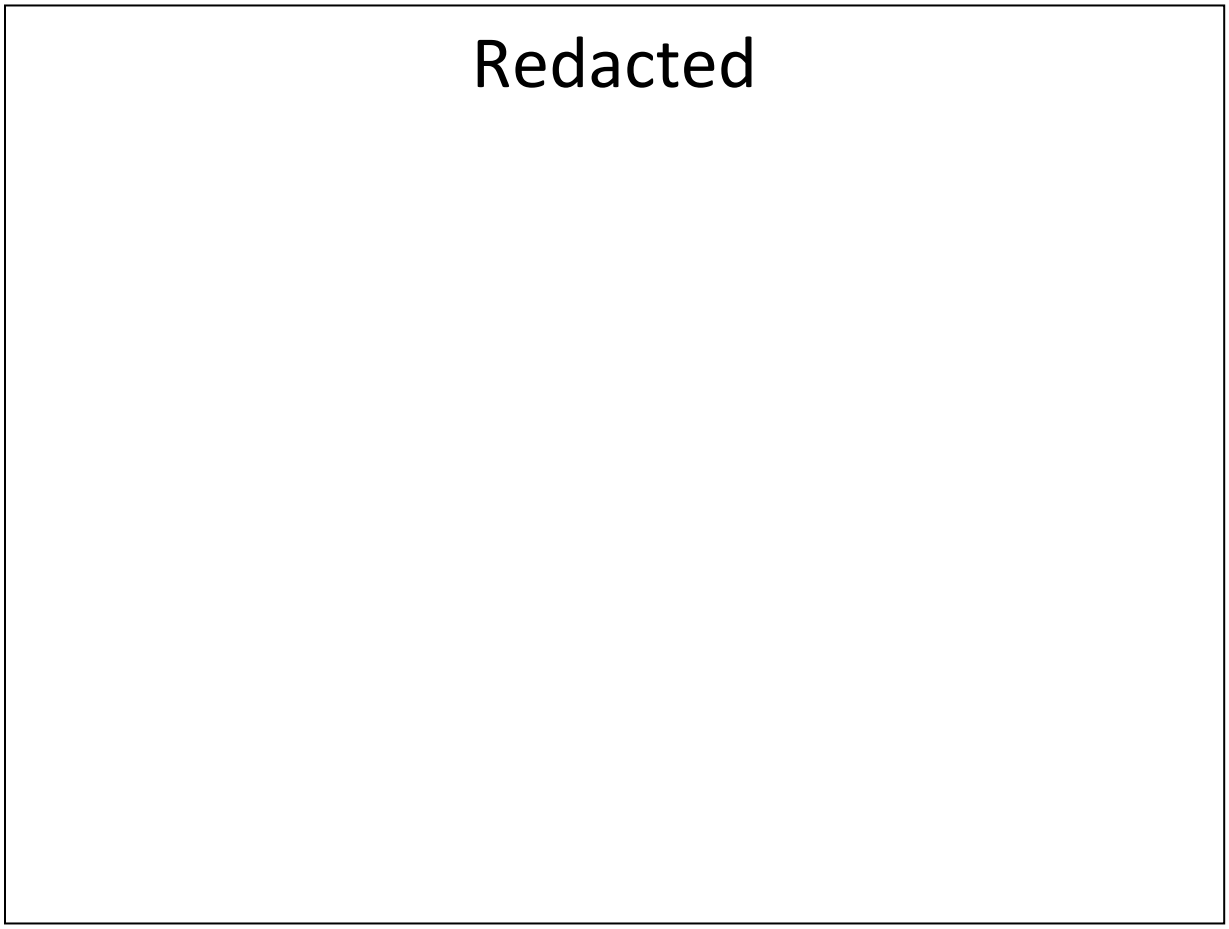
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Figure 5.4-26 Unit 3 Containment Building Adj. PF (Window #5)



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Figure 5.4-27 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



673. The progress curves during Window #5 depict the impact of the COVID-19 pandemic on the achievement of the planned progress resulting in a delay of 266 days to Unit 3, and 211 days of delay in Unit 4 shown in the progress update at the end of the window.

Inefficient Labor Calculation

674. In addition to the delays, the impacts caused disruption to the labor resources and inefficiency. During the period from March 2020 through July 2021, the analysis determined there was a combined total of XXXXXXX inefficient direct labor hours caused by COVID-19 for Units 3 and 4. The observed indirect-to-direct labor hour ratio was applied to the total inefficient direct labor hours to calculate a total of XXXXXXXX inefficient indirect labor hours for COVID-19. The detailed analysis and calculation of inefficient labor is in **Attachment 2**.

675. The total inefficient direct labor hours from March 2020 through July 2021 caused by COVID-19 were

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calculated using Bechtel's Project Hours Earnings Scorecards that were included as an attachment to the Bechtel Monthly Status Reports. The scorecards provided the total spent and earned manhours for the containment, auxiliary, turbine, annex, shield, radwaste, diesel generator, and modules buildings in Units 3 and 4. The table below shows the analysis to calculate the inefficient manhours for the containment building.

Table 5.4-12 Unit 3 Containment Building Inefficient Manhours Calculation		
1	Cumulative PF (March 2020)	1.51
2	Cumulative PF (July 2021)	1.91
3	% Degradation	26%
X	XXXXXXXXXXX	XXXXXXXX
X	**XXXXXXXXXXXXXXXXX**	**XXXXXXXX**

676. As illustrated above, the inefficient manhours were calculated as follows:

- The percent degradation of productivity was calculated by measuring the percent increase in the cumulative productivity factor from March 2020 to July 2021.[519] This was first measured as the difference between the cumulative PF in March 2020 and July 2021 (rows 1 and 2) of 0.4. This was then converted to a percent degradation to the March 2020 PF, of 26% (row 3).

- The percentage degradation was then applied to the total manhours spent from March 2020 through July 2021 (row 4) to calculate the total inefficient manhours in the Containment Building of XXXXXXXXXXXXXXXXX.

- This calculation was performed for the Containment, Auxiliary, Turbine, and Annex Buildings which account for XXX of the manhours spent in Units 3 and 4.

677. For the remaining buildings, a weighted average of the percent degradation was applied to the total manhours spent from March 2020 through July 2021 for each building. The weighted average was calculated using the % degradation factors calculated for the containment, auxiliary, turbine and annex buildings. These buildings account for XXX of the manhours spent in Units 3 and 4 from March 2020 to July 2021. The detailed quantification of the direct labor hours inefficiency related to COVID-19 discussed above is provided in **Attachment 2** and is summarized in the following Table.

[519] The cumulative productivity factor was calculated by dividing the total direct manhours spent by the total direct manhours earned through the end of March 2020 and July 2021.

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Table 5.4-13 Units 3 and 4 Inefficient Manhours Summary (March 2020 – July 2021)		
	XXXXX	**XXXXX**
Containment Building	XXXXXX	XXXXXX
Auxiliary Building	XXXXXX	XXXXXX
Turbine Building	XXXXXX	XXXXXX
Annex Building	XXXXXX	XXXXXX
Shield Building	XXXXXX	XXXXXX
Radwaste Building	XXXXXX	XXXXXX
Diesel Generator Building	XXXXXX	XXXXXX
Modules	XXXXXX	XXXXXX
Total	XXXXXX	XXXXXX
Total Inefficient Manhours		XXXXXX

5.4.5.3 Window Summary

678. The COVID-19 pandemic was the dominant contributing issue to schedule delay and labor inefficiency during Window #5, while the issues of management of the ITP program, incomplete engineering and inadequate engineering management, procurement deficiencies, and resource management continued to exist on the Project. The effects of the COVID-19 pandemic delayed the start of Fuel Load (and by extension COD) in Units 3 and 4 by 266 days and 211 days respectively and resulted in XXXXXXX inefficient manhours. The tables below summarize the delays in Window #5.

Table 5.4-14 Summary of Unit 3 Window #5 Fuel Load Delay					
Window	**Window Start**	**Window Finish**	**Forecast Fuel Load (Window Start)**	**Forecast Fuel Load (Window Finish)**	**Fuel Load Delay (days)**
Window #5	March 2020	April 2021	23-Nov-20	16-Aug-21	266

Table 5.4-15 Summary of Unit 4 Window #5 Fuel Load Delay					
Window	**Window Start**	**Window Finish**	**Forecast Fuel Load (Window Start)**	**Forecast Fuel Load (Window Finish)**	**Fuel Load Delay (days)**
Window #5	March 2020	April 2021	23-Sep-21	22-Apr-22	211

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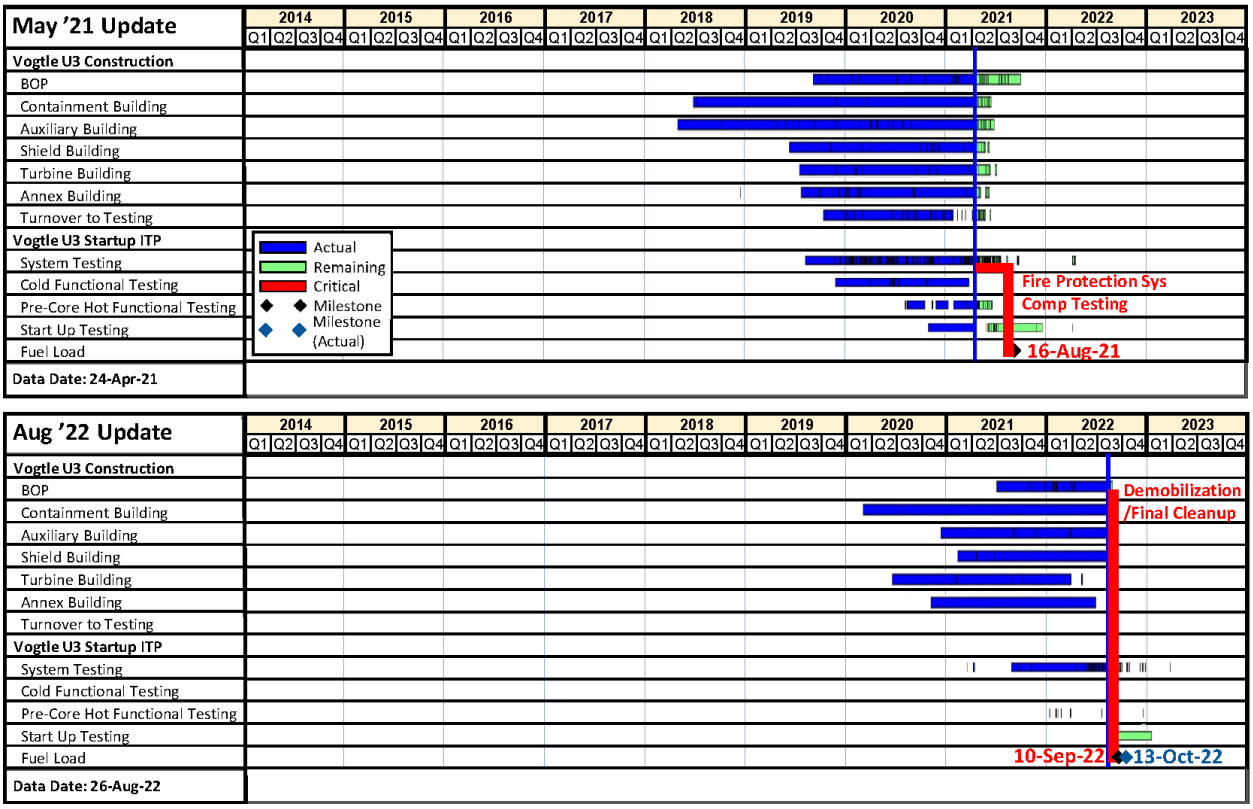
5.4.6 Window #6 – April 2021 through August 2023

679. The Window #6 analysis covers the period from April 24, 2021, to August 17, 2023, which encompasses the post-COVID-19 impact period through the actual start of Fuel Load for Unit 4 on August 17, 2023.

5.4.6.1 Critical Path As-Planned v. As-Built – Window #6

680. The figure below summarizes the Unit 3 critical paths and the beginning and end of the window.

Figure 5.4-28 Unit 3 Window #6 As-Planned v. As-Built



681. The critical path at the beginning of Window #6 went through remaining fire protection system testing activities, the projected Fuel Load date for Unit 3 was August 16, 2021. [520] The actual start date for Unit 3 Fuel Load was October 13, 2022, a 423 day delay when compared to the projected date at the start of the window.

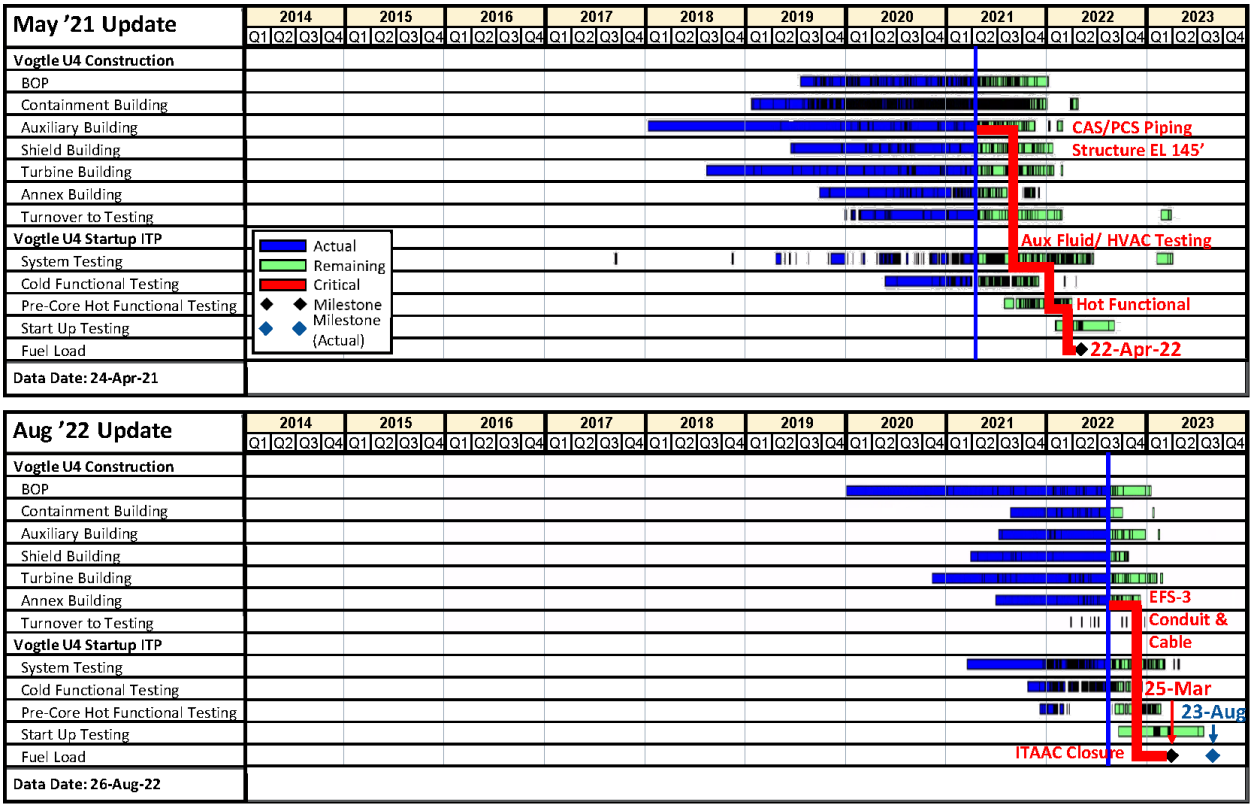
[520] Vogtle Monthly Progress P6 Schedule Data - 21-May.

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682. After Unit 3 achieved Fuel Load on October 13, 2022, the critical path of the Project shifted to Unit 4. SNC forecasted Fuel Load for Unit 4 to be achieved on August 17, 2023, reflecting a delay of 482 days.

683. The critical paths at the start and end of the window for Unit 4 are summarized in the figure below.

Figure 5.4-29 Unit 4 Window #6 As-Planned v. As-Built



684. The critical path at the beginning of Window #6 went through auxiliary building CAS/PCS piping activities, structural activities at El 145', aux fluid testing, HVAC testing, and HFT. [521] Fuel Load was projected to start on April 22, 2022, at the start of the window. The critical path as of August 2022shifted to annex building EFS-3 conduit, cable, and terminations. [522] The critical path then shifted to the ITAAC closure activities, while the projected Fuel Load start date had slipped to March 25, 2023. The actual start date for Unit 4 Fuel Load was August 23, 2023, a delay of 482 days when compared to the projected date at the start of the window.

[521] Vogtle Monthly Progress P6 Schedule Data - 21-May.
[522] Vogtle Monthly Progress P6 Schedule Data - 22-Aug.

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5.4.6.2 Causes of Delay – Window #6

685. By May 2021, the Project schedules indicated that most construction was complete, with mainly some testing remaining prior to the anticipated Fuel Load in August 2021. However, Unit 3 Fuel Load did not start until October 2022, over a year later, primarily due to the ongoing impacts detailed in prior windows and in Section 3.3 of this Report, and the emergence of extensive remediation work due to poor construction quality. Additionally, SNC did not develop or manage the IPS consistent with standard project management principles or industry specific principles. This oversight resulted in inadequate risk mitigation as the Project neared its end and manifested in ongoing delays and labor inefficiency.

686. Several factors contributed to the delay in Window #6, including the following:

- Insufficient craft labor[523]
- Slowdowns in Unit 4 due to craft labor being diverted to support construction on Unit 3[524]
- Required remediation work due to poor construction quality issues[525] [526]

687. Additionally, several issues led to ineffective planning throughout the Project which eventually led to delays manifesting at the end of the Project, such as: [527]

- Premature start of testing activities prior to completion of a greater percentage of bulk commodities leading to stacking of crafts
- Deferment of planned work to meet the start of near-term major milestones, providing an inaccurate impression of having made more progress than what was achieved in previous windows
- Improper management of Project risks
- inadequate implementation of the SNC and contractor Quality Assurance Programs

688. While the impact of the COVID-19 pandemic lingered into Window #6, as detailed in Section 3.3.10 of this Report, this was no longer the driving impact to the execution of critical work on the Project.

689. Inadequate quality management and control was an ongoing issue detailed in Section 3.3.8 of this

[523] Direct Testimony of Stephen Kuczynski and Aaron P. Abramovitz, VCM 25, page 11.
[524] Direct Testimony of Stephen Kuczynski and Aaron P. Abramovitz, VCM 25.
[525] Direct Testimony of Stephen Kuczynski and Aaron P. Abramovitz, VCM 25, page 13.
[526] December 1, 2021, Direct Testimony of Don Grace, VCM 5, page 6.
[527] June 17, 2022, Direct Testimony of Don Grace, VCM 26, page 12.

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Report. Quality management became a driving factor impacting the Project in January 2021, specifically the cable separation issue, and continued through the end of the Project. Inadequate quality management manifested in excessive nonconformances and rework and inadequate quality control documents that contributed to Project delays and labor inefficiency.

690. The early transition from bulk construction to system testing, covered in detail in Section 3.3.4 of this Report, continued to have a negative impact on the execution of the Project both in terms of progress and productivity as work that was deferred in earlier windows was being performed in Window #6.

691. Incomplete engineering and inadequate management of engineering documents continued impacting Project execution. Section 3.3.6 of this Report details the ongoing issues including, the lack of complete design, the steady stream of engineering design documents, design conflicts, engineering holds, the processing of an extensive number of ESRs and E&DCRs, and the slow processing of engineering documents that contributed to Project delays and labor inefficiency.

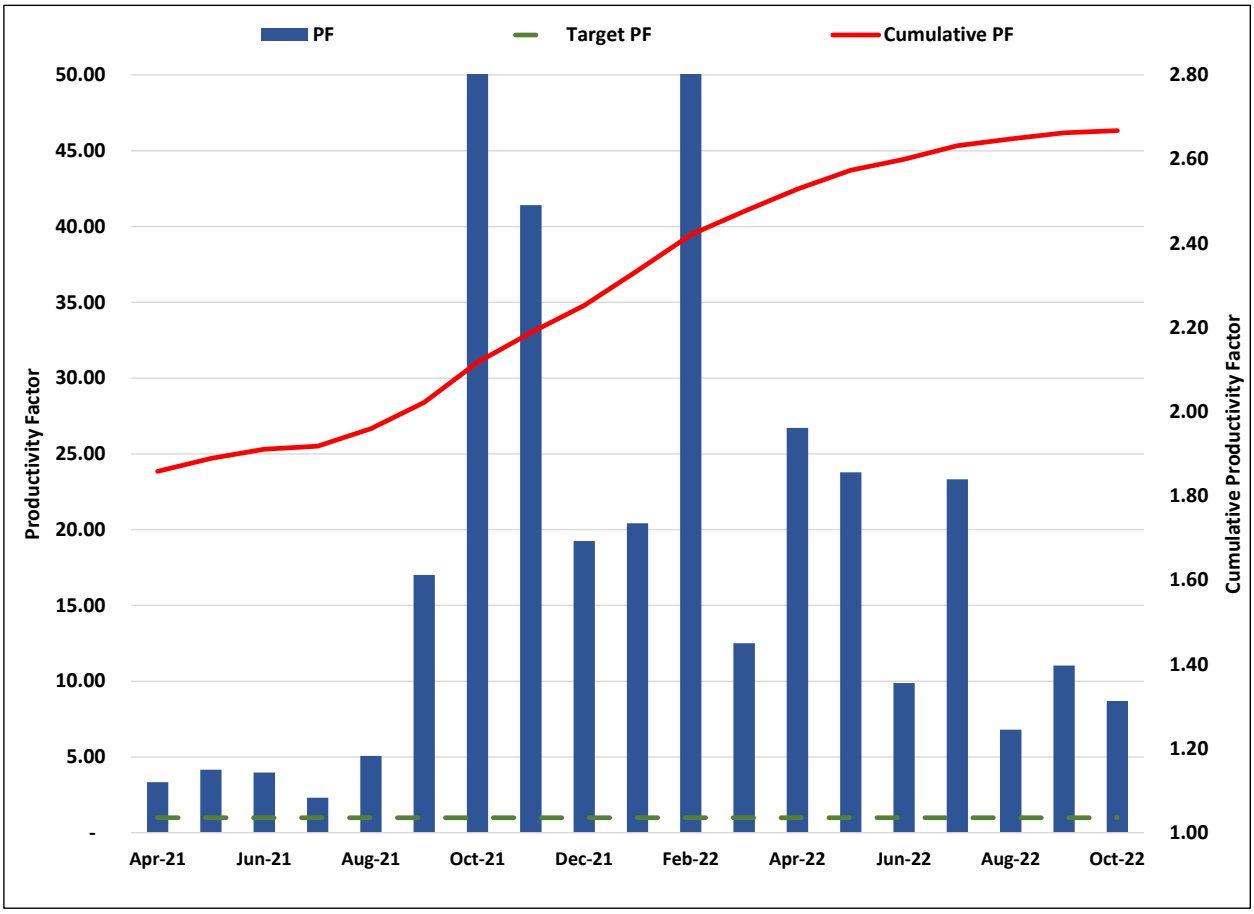
692. Procurement deficiencies and materials/module management impacted the Project and is covered in detail in Section 3.3.7 of this Report. Continuing through this window, the work was impacted by equipment and material defects, material shortages, manufacturing defects, delays in long lead time equipment delivery, and unplanned on-site fabrication due to changes and delays which contributed to Project delays and labor inefficiency.

693. Ineffective resource management and inability to maintain or improve productivity on the Project is covered in detail in Section 3.3.9 of this Report. Despite ongoing efforts to improve craft labor management and productivity, the Project suffered from idle time, inadequate staffing, and little success improving construction performance which contributed to schedule delays and labor inefficiency.

694. The progress and labor productivity curves for the critical path Unit 3 from **Attachment 2** are shown below. This includes the driving critical path testing activities for electrical work across the Project. The Window #6 period is highlighted on the figures below which show the Project failed to achieve the planned progress to complete the work during Window #6 for the PF and earned hours associated with the electrical discipline.

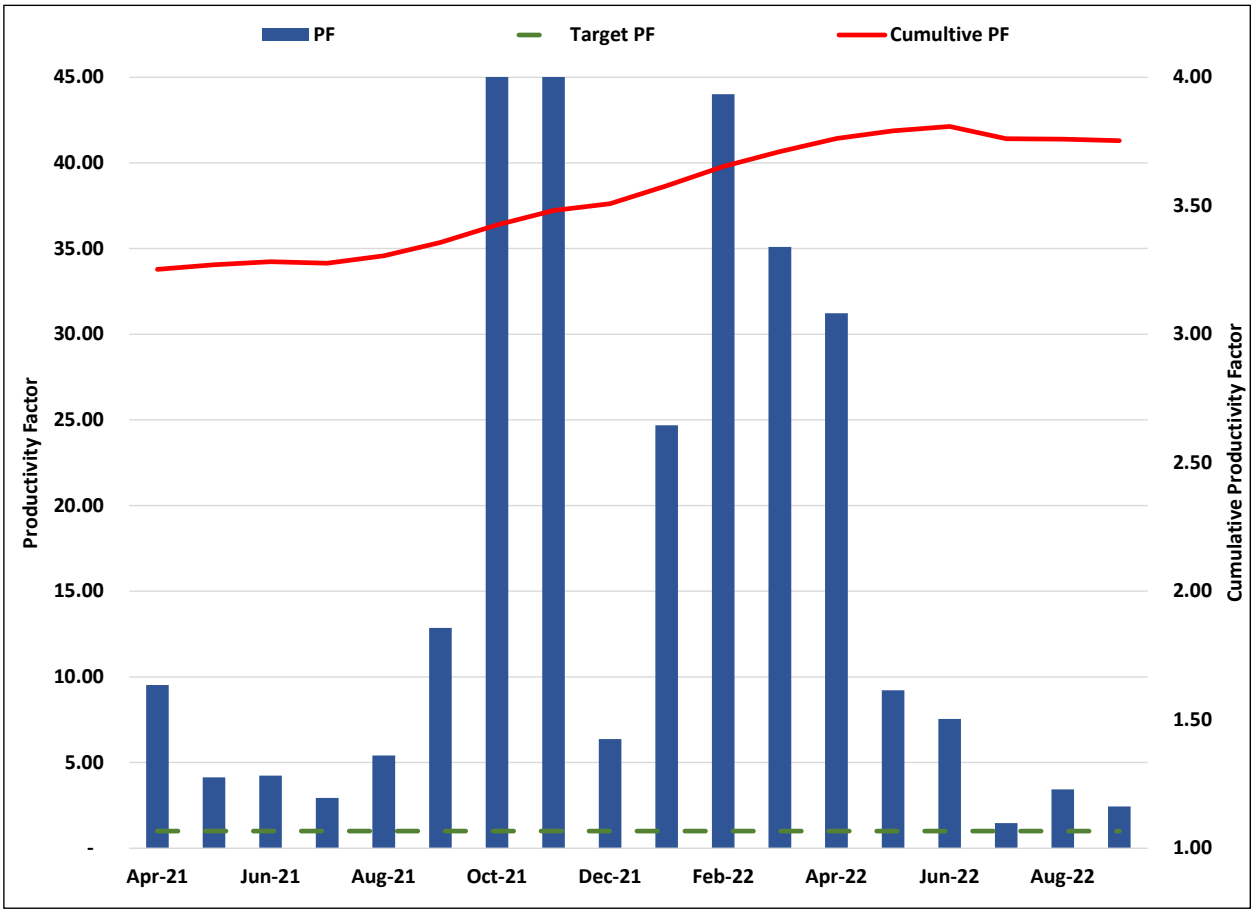
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Figure 5.4-30 Unit 3 Conduit Adj. PF (Window #6)



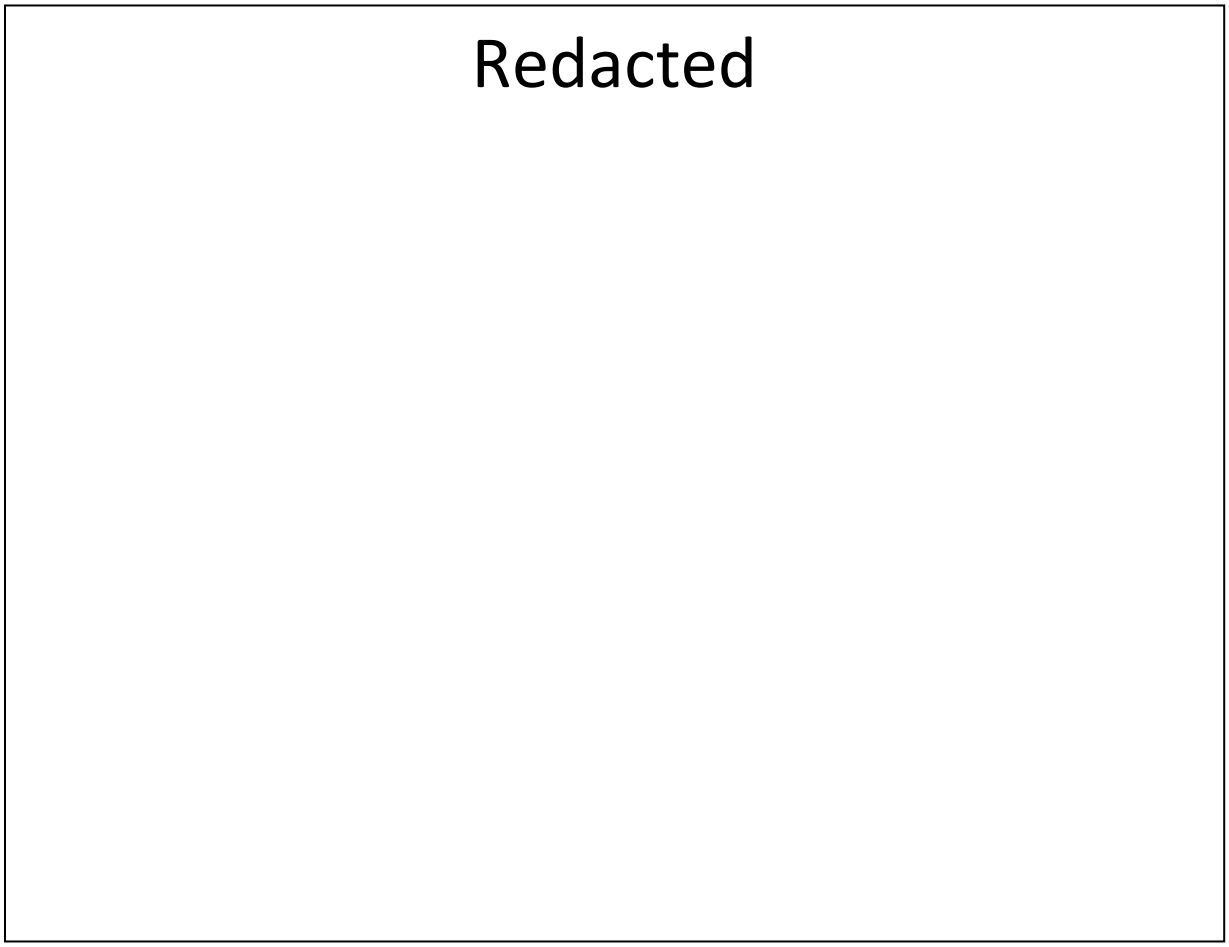
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Figure 5.4-31 Unit 3 Cable Adj. PF (Window #6)



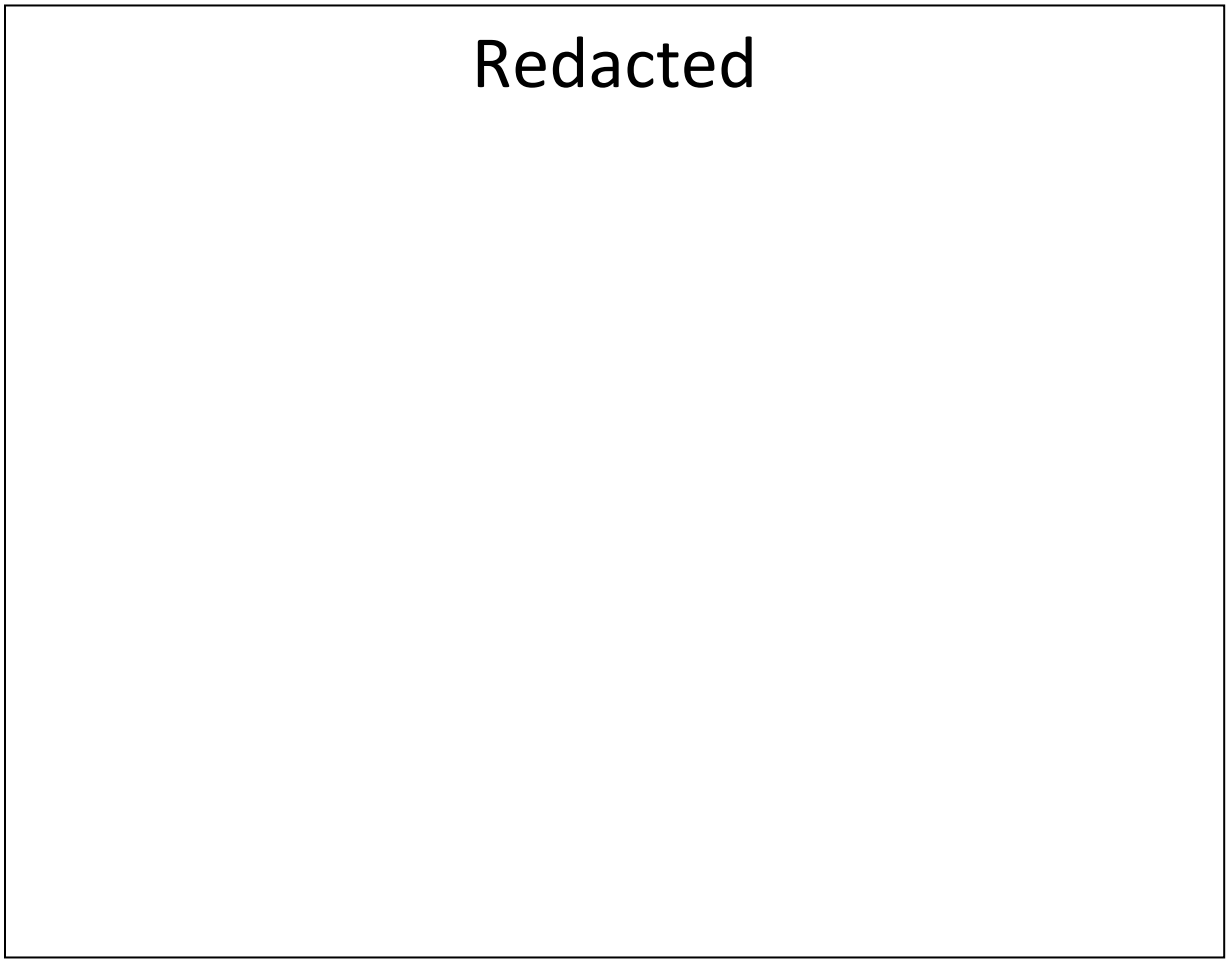
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Figure 5.4-32 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



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Figure 5.4-33 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



695. While the progress curves during Window #6 reflect the continuing failure to achieve the planned progress resulting in a delay that correlates to the 423 days of delay in Unit 3 and 482 days of delay in Unit 4 shown in the progress update at the end of the window.

5.4.6.3 Windows Summary

696. Window #6 saw the impacts from inadequate quality management and control, while ongoing impacts from incomplete engineering and inadequate management of engineering documents, procurement deficiencies and material management, ineffective resource management, and the inability to maintain or improve productivity continued to cause delay and loss of productivity as reflected in the Project data contained in **Attachment 2.** The tables below summarize the delays evidenced in Window #6 for Units 3 and 4.

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Table 5.4-16 Summary of Unit 3 Window #6 Fuel Load Delay					
Window	**Window Start**	**Window Finish**	**Forecast Fuel Load (Window Start)**	**Forecast Fuel Load (Window Finish)**	**Fuel Load Delay (days)**
Window #6	April 2021	Fuel Load Start	16-Aug-21	10-Sep-22	423

Table 5.4-17 Summary of Unit 4 Window #6 Fuel Load Delay					
Window	**Window Start**	**Window Finish**	**Forecast Fuel Load (Window Start)**	**Forecast Fuel Load (Window Finish)**	**Fuel Load Delay (days)**
Window #6	April 2021	Fuel Load Start	22-Apr-22	17-Aug-23	482

5.4.7 Summary of Windows Analysis

697. The table below summarizes the delays in Units 3 and 4 and the impact issues that contributed to the delay and disruption across the six (6) windows in the forensic schedule delay analysis.

Table 5.4-18 Fuel Load Delay Summary					
Window #	**Window Start**	**Window Finish**	**Unit 3 Delay (days)**	**Unit 4 Delay (days)**	**Impact Issues**
1	April 2008	October 2017	1927	1933	• Late Issue of Design Control Document / Combined Operating License • Rebar Non-Conformity • East Side of Unit 3 Shield Building • On-going / Late Design Changes • Late Delivery / Poor Quality Assurance of Modules and Sub-Modules
2	October 2017	October 2018	5	4	• Inadequate resource management and inability to source craft labor.
3	October 2018	March 2019	40	34	• Early transition from bulk installation to the ITP • Incomplete engineering and inadequate management of engineering documents • Procurement deficiencies and materials/module management • Ineffective resource management and inability to improve productivity
4	March 2019	March 2020	0	-61	• Incomplete engineering and inadequate management of engineering documents

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Table 5.4-18 Fuel Load Delay Summary					
Window #	**Window Start**	**Window Finish**	**Unit 3 Delay (days)**	**Unit 4 Delay (days)**	**Impact Issues**
					• Procurement deficiencies and materials/module management • Ineffective resource management and inability to improve productivity
5	March 2020	April 2021	266	211	• COVID-19 pandemic • Ongoing issues in prior windows
6	April 2021	Fuel Load Start (August 2023)	423	482	• Inadequate quality management and control, nonconformance and rework • Performance of deferred construction work from PRT process • Incomplete engineering and inadequate management of engineering documents • Procurement deficiencies and materials/module management • Ineffective resource management and inability to improve productivity • Diversion of craft labor from Unit 4 to Unit 3
		Total	**2661**	**2603**	

698. The Project experienced significant delays, with a Unit 3 total delay of 2,661 days and Unit 4 total delay of 2,603 days resulting primarily from SNC management decisions, the discrete issues discussed in Section 3.3 of this Report and the COVID-19 pandemic. During the post-VCM 17 period, since October 2017, the Project experienced delays of 734 days to Unit 3 and 670 days to Unit 4. The COVID-19 pandemic caused 266 days to Unit 3 and 211 days to Unit 4, which are reflected in Window #5 of the analysis.

699. In addition to the delays, there were impacts that caused disruption to the labor resources in the form of inefficiency. During the period from March 2020 through July 2021, the analysis determined there was a combined total for Unit 3 and Unit 4 of XXXXXXXXXX inefficient direct labor hours caused by COVID-19. The observed indirect-to-direct labor hour ratio was applied to the total inefficient direct labor hours to calculate a total of XXXXXXX inefficient indirect labor hours for COVID-19.

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6 Damages / Cost

700. This section details analysis of the increase in costs incurred on the Project as of VCM 29 to the costs deemed reasonable in VCM 17, and specifically presents J.S. Held's quantification of Cost Overruns with supporting analysis.

6.1 Quantification of Cost Overruns

6.1.1 Summary of Cost Overruns

701. The cost overruns due to COVID-19 including delay, inefficiency, and direct costs, total approximately $404 million for the Company's portion of Project costs, and approximately $884 million on the total Project. These costs are represented below in **Table 6.1-1 Cost Overruns Summary**.

Table 6.1-1 Cost Overruns Summary

		Company Portion of Total Construction & Capital Costs ($ x 1,000,000)
[a.1]	VCM 17 Approved Reasonable Total Construction & Capital Cost Forecast Net of TPG	$ 7,300
[a.2]	COVID-19 Delay Costs	321
[a.3]	COVID-19 Inefficiency Costs	56
[a.4]	COVID-19 Direct Costs	27
	Subtotal COVID-19 Costs:	404
[a.5]	**Total Costs**	**$ 7,704**
[a.6]	Forecasted Total Construction & Capital Costs at Completion Net of TPG	$ 10,188
[a.7]	**Total Cost Overrun**	**$ 2,484**

702. Details for each of the cost components above, including the indirect costs and rates, are discussed below in the following subsections.

- VCM 17 Reasonable Total Construction & Capital Cost Forecast Net of Toshiba Parent Guarantee (TPG) - $7,300 million
- COVID-19 Delay Costs - $321 million
- COVID-19 Inefficiency Costs - $56 million

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- COVID-19 Direct Costs - $27 million
- Forecasted Total Construction & Capital Costs at Completion Net of TPG - $10,188 million
- Total Cost Overrun - $2,484 million

703. Details on the delay and associated days of delay were discussed previously in Section 5 of this Report.

6.1.2 VCM 17 Approved Reasonable Total Construction & Capital Cost Forecast Net of TPG

704. The revised Total Capital Cost forecast of $7.30 billion, net of the TPG, for the Company's portion of the Project was included in VCM 17 and the associated VCM 17 stipulation and order.[528]

Table 6.1-2 VCM 17 Construction & Capital Cost EAC Summary

	VCM 17 Total EAC ($ x 1,000,000)
Original EPC	$ 3,257
Interim Payments & Liens	493
Original EPC and Interim Payments & Liens Subtotal:	**3,750**
New Site Forecast EPC	
Engineering Contractor	545
Procurement	938
Contract Construction	1,374
Construction Support and Project Management	866
New Site Forecast EPC Subtotal:	**3,723**
Remaining Costs	
Owners Cost	996
Ad Valorem Tax	273
Transmission Interconnection	61
Test Fuel Offsets	(33)
Remaining Costs Subtotal:	**1,297**
Total Construction & Capital Cost:	**8,771**
TPG Payment, net of customer refunds	(1,492)
Total Construction & Capital Cost, net of TPG	7,279

[528] January 11, 2018, Georgia Public Service Commission, Verification of Expenditures Pursuant to Georgia Power Company's Certificate of Public Convenience and Necessity for Plant Vogtle Units 3 and 4, Seventeenth Semi-Annual Construction Monitory Report; Proposed Forecast Cost and Schedule Revisions; and Determination of Continuation or Cancellation of the Project, VCM 17 Order and Stipulation, page 11 & 17.

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Table 6.1-2 VCM 17 Construction & Capital Cost EAC Summary	
	VCM 17 Total EAC ($ x 1,000,000)
Amount in VCM 17 Order & Stipulation[529]	**$ 7,300**

705. This is the starting point in the construction cost calculation labeled above as [a.1] in Table 6.1-1. Additional details are included below.

6.1.2.1 Baseline EAC

706. On March 30, 2009, the Commission provided the Company approval for the Project to proceed by issuance of an Amended Certification Order.[530] This Certification Order included an approved total construction and capital and financing cost forecast of $6.45 billion. As part of the first VCM filing in August 2009, the Commission adopted a stipulation which revised the Certified Project Cost to $6.11 billion resulting from a change in Georgia Law which allowed the Company to collect financing costs as incurred from its own customers. Of the $6.11 billion certified amount, approximately $4.42 billion was forecasted for Capital and Construction Costs.[531]

Table 6.1-3 Baseline Project EAC Summary		
	Project Certification Cost at Start per Amended Certification Order ($ x 1,000,000)	
	Company	**Total Project Equivalent Cost**
Construction & Capital Costs	$ 4,418	$ 9,667
Financing Costs	$ 1,695	$ 3,709
Total Certification Cost	$ 6,113	$ 13,376

707. The Certified Project Cost remained the same through the VCM 8 filing in February 2013. However, the Company proposed a revised Capital Construction Cost forecast of $4.80 billion, representing a

[529] January 11, 2018, Georgia Public Service Commission, Verification of Expenditures Pursuant to Georgia Power Company's Certificate of Public Convenience and Necessity for Plant Vogtle Units 3 and 4, Seventeenth Semi-Annual Construction Monitory Report; Proposed Forecast Cost and Schedule Revisions; and Determination of Continuation or Cancellation of the Project, VCM 17 Order and Stipulation, page 11 & 17.
[530] March 30, 2009. Docket No. 27800, Georgia Power's Application for the Certification of Units 3 and 4 at Plant Vogtle and Updated Integrated Resource Plan, Amended Certification Order.
[531] September 21, 2021, Verification of Expenditures Pursuant to Georgia Power Company's Certificate of Public Convenience and Necessity for Plant Vogtle Units 3 and 4, Twenty-Fifth Semi-annual Construction Monitoring Report, page 2.

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$381 million increase from the previous certified cost.[532] In response, the Commission stated in its October 8, 2013, order adopting the July 30, 2013, stipulation.

> *Georgia Power's request to amend the certificate, and any further requests to increase the certified cost, should be held in abeyance until the completion of the Vogtle Unit 3.*[533]

708. The next increase to the forecasted Capital Construction Cost occurred in VCM 12 which included an increase of approximately $246 million from the previous communicated forecasted Construction and Capital Cost to $5.05 billion.[534]

> *the Commission should correct and amend the certificate to reflect the Company's Total Construction and Capital Cost of $5.045 billion.*[535]

709. The Company increased the forecasted Total Construction and Capital Cost in VCM 14 by approximately $395 million, bringing the forecasted Total Construction and Capital Cost to $5.44 billion.[536] On December 20, 2016, the Commission approved a new stipulation which revised the Capital Cost Forecast to $5.68 billion.

> *Capital* ***costs incurred up to $5.680 billion will be presumed reasonable and prudent*** *and the burden would be on any party challenging such costs. The certificate will not be amended and the certified capital cost for purposes of calculating the NCCR will remain at $4.418 billion.*[537] ***[Emphasis Added]***

710. The forecasted Total Construction and Capital Cost remained the same through VCM 16.

711. SNC determined that the remaining ETC as of July 1, 2017 (VCM 17) for the Total Project Cost was $9.45 billion. This ETC corresponded with the Company's share of the Total Construction and Capital Cost EAC of $8.77 billion.

> *The Owners have chosen to adopt the higher confidence +29/+29 schedule and associated revised cost-to-complete forecast of $9.45 billion (from July 1, 2017). Georgia Power's share of the total capital cost is now forecast to be $8.77 billion after*

[532] February 2013, Eighth Semi-Annual Construction Monitoring Report, page 4.
[533] October 28, 2013, Review of Proposed Revisions and Verification of Expenditures Pursuant to Georgia Power Company's Certificate of Public Convenience and Necessity for Plant Vogtle Units 3 and 4, Eighth Semi-Annual Construction Monitoring Report, and Request to Amend Certificate, Page 6.
[534] February 2015, Twelfth Semi-Annual Vogtle Construction Monitoring Report, page 7.
[535] February 2015, Twelfth Semi-Annual Vogtle Construction Monitoring Report, page 7.
[536] February 2016, Fourteenth Semi-Annual Vogtle Construction Monitoring Report, page 14.
[537] February 23, 2017 Review of Proposed Revisions and Verification of Expenditures Pursuant to Georgia Power Company's Certificate of Public Convenience and Necessity for Plant Vogtle Units 3 and 4, Fifteenth Semi-Annual Construction Monitoring Report, page 3.

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considering Georgia Power's non-shareable costs, such as ad valorem taxes, and regulatory and legal fees.[538]

712. Below, is a summary of those ETC costs net of non-shareable Owner's costs which were reported in VCM 17.[539]

Table 1.1

Vogtle 3&4 Project
Georgia Power Company Cost - **Subject to Commission Verification and Approval**
Total Project Costs (1)

	Total Current Forecast ($ millions)
Construction & Capital Cost	
Original EPC (2)	$3,257
Interim Payments & Liens (3)	493
New Site Forecast EPC	
Engineering Contractor	545
Procurement	938
Contract Construction	1,374
Construction Support	388
Project Management	478
	3,723
Owners Cost	996
Ad Valorem Tax	273
Transmission Interconnection	61
Test Fuel Offsets	(33)
	1,298
Total Construction & Capital Cost (1)	**$8,771**

713. The $7,300 million is equivalent to the Total Construction & Capital Cost forecast of $8,771 million less the TPG Payment of $1,492 million. Additional details of the costs and ETC in VCM 17 are provided in this Report.

6.1.3 Calculation of Delay Costs

714. J.S. Held calculated $321 million as the value of the Company's portion of costs associated with

[538] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, Footnote 28 on page 50.
[539] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, page 103.

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COVID-19 delay shown above as [a.2] in Table 6.1-1. This was calculated using 211 total delay days calculated in Section 5 of this Report and the daily average indirect labor rate of $3.33 million per day calculated by J.S. Held and then scaled to 45.7% ownership portion held by the Company.

6.1.3.1 Calculation of delay days

715. J.S. Held calculated the number of delay days of 211 calendar days above in Section 5.4.5.2 of this Report which were isolated to have occurred primarily in Window #5. The primary cause of the delay during this period was COVID-19 related and was not a known impact at the time of VCM 17.

6.1.3.2 Calculation of average indirect costs

716. J.S. Held's schedule analysis isolated the delay event to have occurred primarily in Window #5. Therefore, J.S. Held utilized the daily average indirect cost of $3.33 million per day, equivalent to approximately $100 million per month, from Window #5 to quantify the Company's total delay-related costs.[540]

717. The Commission requested SNC to support estimated COVID-19 Cost and Schedule impacts for 2020 and estimate costs for 2021. In response, SNC submitted an estimate that COVID-19 impacted the Project schedule by approximately three to four months and the cost impact was in the range of $326 million to $416 million "*SNC COVID-19 Cost and Schedule Impacts Assessment*".[541] Within the cost impact provided by SNC, there was an estimate of approximately $90 million per month of delay for hotel load.[542] This amount is reasonable when compared to the approximately $100 million per month calculated by J.S. Held for this Report.

718. J.S. Held calculated the average total daily rates for Windows #3 through #6 including direct, indirect, and other costs, as shown below in **Table 6.1-4 Average Daily Costs for Direct, Indirect, and Other Cost Categories for Defined Windows**.

[540] $3.33 million per calendar day * 30 calendar days per month = $99.9 million per month

[541] TS Attachment STF-199-18-b, COVID-19 Cost and Schedule Estimated Impact for 2020, Page 1. April 2021, Draft 2020 COVID-19 Impact Assessment, TS Attachment STF-199-18-b, COVID-19 Cost and Schedule Estimated Impact for 2020, page 1.

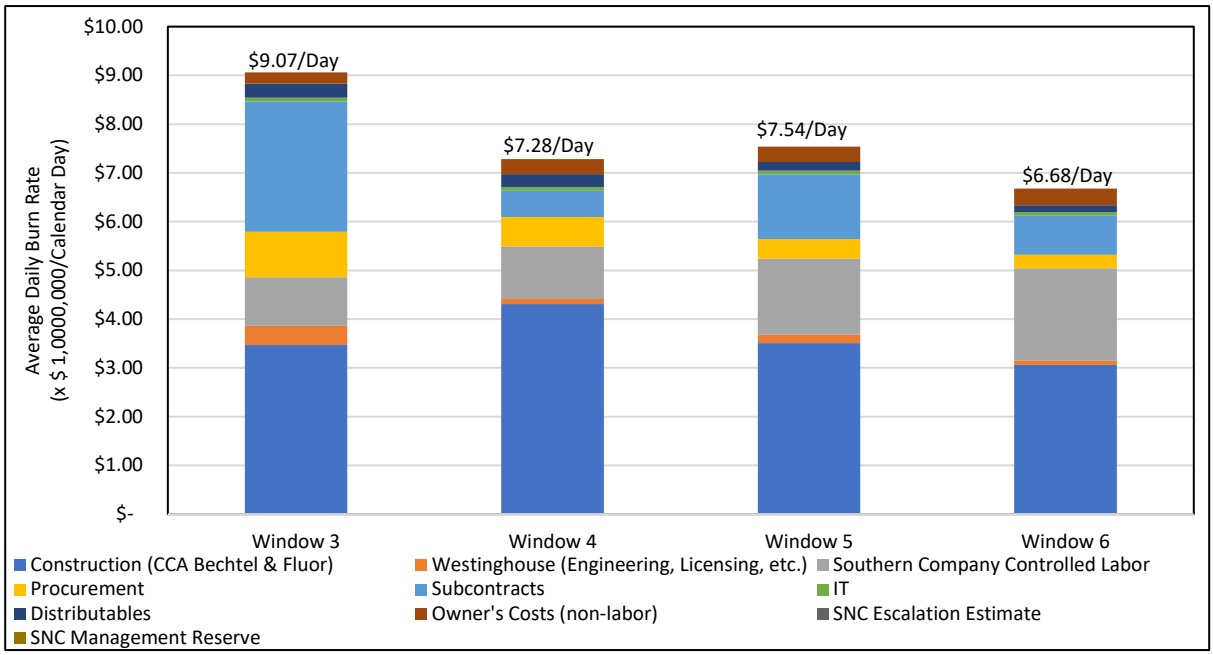
[542] The Department of Energy, Directives Program, Office of Management (MA-1.2) defines Hotel Load as "*A term used to identify the cost associated with level of effort activities and fixed costs that will be incurred until a given piece of work is complete. These costs can include the costs for project management and administration and other direct costs associated with generic facilities, rentals, and other indirect costs that are not part of the direct production activities.*"

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Table 6.1-4 Average Daily Costs for Direct, Indirect, and Other Cost Categories for Defined Windows				
Capital Costs	**Window #3 ($ x 1,000,000/day)**	**Window #4 ($ x 1,000,000/day)**	**Window #5 ($ x 1,000,000/day)**	**Window #6 ($ x 1,000,000/day)**
Direct Costs	3.93	2.62	3.04	2.12
Indirect Costs	3.65	3.30	3.33	3.35
Other Costs	1.48	1.35	1.17	1.20
Total:	**9.06**	**7.28**	**7.54**	**6.68**

719. The corresponding cost categories within the total costs including the Direct, Indirect, and Other Costs from **Table 6.1-4 Average Daily Costs for Direct, Indirect, and Other Cost Categories for Defined Windows** above are presented in **Figure 6.1-1 Total Average Daily Construction & Capital Costs**, below, which shows the total average rate by cost category for Windows #3 through #6.

Figure 6.1-1 Total Average Daily Construction & Capital Costs



720. Details of the analysis including identification of the direct, indirect, and other costs and the quantification of the average daily rates are included below in Section 6.2.1 of this Report.

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6.1.4 Quantification of COVID-19 Inefficiency Costs

6.1.4.1 Quantification of hours

721. In addition to the delay days, J.S. Held separately determined that approximately XXXXXXXXXXX related to the impact of direct labor inefficiency were the result of COVID-19, which is discussed above in Section 5.4.5.2 of this Report. In order to quantify the total labor hour impact, including both direct and indirect labor, J.S. Held applied a XXX indirect-to-direct labor ratio to the direct labor inefficient hours value, yielding a total of approximately XXXXXX hours of indirect labor.[543] The direct and indirect labor inefficient hours total approximately XXXXXXXX hours.[544]

6.1.4.2 Identification of Unit Rates

722. J.S. Held identified a direct labor hourly wage rate of XXXXX per hour and an indirect labor hourly wage rate of XXXX per hour during the COVID-19 impacted period.[545]

723. Applying these wage rates to the respective inefficient hours yields totals of approximately XXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[546,547] Together, the total cost for labor inefficiency resulting from COVID-19 is approximately XXXXXXXXXXXXX. The Company's portion of this total is equal to approximately XXXXXXXXXX which is shown above as [a.3] in **Table 6.1-1 Cost Overruns Summary**.

6.1.5 COVID-19 Direct Costs

724. In addition to the delay and inefficiency-related costs, the COVID-19 delay and disruption resulted in direct costs that were unavoidable for SNC and Bechtel. SNC provided details of these costs as

543 XXX

544 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

545 XXX

546 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

547 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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part of its SNC COVID-19 Cost and Schedule Impacts Assessment.[548] J.S. Held calculated this amount to be XXXXXXXXXX for the Direct Costs shown as [a.4] in **Table 6.1-1 Cost Overruns Summary**.

725. Included in the SNC COVID-19 Cost and Schedule Impacts Assessment, there were discrete costs not included in the monthly Hotel Load costs identified as *Worker Isolation Costs* and *Infrastructure Costs.*

726. The cost account identified as Worker Isolation Costs represents XXX million through March 2021. The SNC COVID-19 Cost and Schedule Impacts Assessment includes separate Worker Isolation cost account line items listed as XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[549] XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

727. Additionally, the Infrastructure Costs (e.g., medical village, medical advisors, increased cleaning, and supplies) represent XXXXXXXX through June XXXX[550]

728. Therefore, the total direct costs resulting from the COVID-19 delay and disruption is XXXXXXXXXX (or the sum of the XXXXXXXX Worker Isolation Costs and XXXXXXXX Infrastructure Costs). The Company's proportion of these costs is XXXXXXXX or 45.7%.

6.1.6 Forecasted Total Construction & Capital Costs at Completion Net of TPG

729. The Total Construction and Capital Cost of $10.19 billion is the total reported EAC that the Company expects to incur at the completion of Unit 4. The $10.19 billion value is net of the TPG and excludes approximately XXXX million of costs associated with the cost-sharing and tender provisions of the joint ownership agreement. The Company is not seeking recovery of the $407 million.[551]

730. The total current forecast EAC for the Total Construction & Capital Cost reported in the most recent VCM filing, VCM 29, is $11.63 billion, excluding approximately $17 million in unspecified Project contingency and $33 million for the Construction Monitor. Including the unspecified Project

[548] April 2021, Draft 2020 COVID-19 Impact Assessment, TS Attachment STF-199-18-b, COVID-19 Cost and Schedule Estimated Impact for 2020.
[549] April 2021, Draft 2020 COVID-19 Impact Assessment, TS Attachment STF-199-18-b, COVID-19 Cost and Schedule Estimated Impact for 2020, page 1.
[550] J.S. Held did not have visibility into the reported COVID-19 Infrastructure Costs, thus, the value reported in the COVID-19 Cost and Schedule Estimated Impact was accepted.
[551] Georgia Power Company's Application to Adjust Rates to Include Reasonable and Prudent Plant Vogtle Units 3 and 4 Costs, page 7.

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contingency and Construction Monitor costs, the total forecast EAC for the Total Construction & Capital Cost net of the $1.49 billion TPG reported in VCM 29 totals $10.19 billion shown as [a.6] above in **Table 6.1-1 Cost Overruns Summary**.[552]

6.1.7 Total Cost Overrun - $2.48 billion

731. Therefore, the Total Cost Overrun is $2.48 billion shown as [a.7] above in **Table 6.1-1 Cost Overruns Summary**. This value represents the difference in the Total Cost and the forecasted EAC Total Construction & Capital Cost and was incurred due to unreasonable and imprudent management decisions and therefore should be disallowed. The Total Cost represents VCM 17 Approved Reasonable Total Construction & Capital Cost, $7.30 billion, with the addition of the COVID-19 Cost Overruns, $404 million, summing to approximately $7.70 billion shown as [a.5] in **Table 6.1-1 Cost Overruns Summary**.

6.2 Supporting Analysis

6.2.1 Identification and Quantification of Direct and Indirect Cost

732. The following section includes analysis of the direct and indirect costs over the life of the Project and specifically focuses on support of the analysis in Section 6.1 of this Report. The analysis focuses on the increases in costs from VCM 17 to VCM 29 and the calculation of average daily direct and indirect Construction & Capital Costs rates.

733. The overall Construction & Capital Cost EAC as of VCM 29 for the total Project is $25.45 billion as shown in **Table 6.2-1 Total Construction & Capital Cost EAC at Selected Time Periods**, below.

Table 6.2-1 Total Construction & Capital Cost EAC at Select Time Periods

	Estimate at Completion ($ x 1,000,000)
Project Start	13,376
VCM 17	19,193
VCM 29	25,446

[552] August 2023, Twenty-ninth Semi-Annual Vogtle Construction Monitoring Report, Table 1.1., page 7.

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734. Based on the ownership arrangement and specifically for the Company portion of 45.7%, the total Construction & Capital Cost EAC as of VCM 29 is $11.59 billion as shown in **Table 6.2-2 Company Portion of Total Construction & Capital Costs at Select Time Periods**, below.

Table 6.2-2 Company Portion of Total Construction & Capital Costs at Select Time Periods	
	Estimate at Completion ($ x 1,000,000)
Project Start	6,113
VCM 17	8,771
VCM 29	11,586

735. The total average daily rates for Windows #3 through #6 were calculated including direct, indirect, and other costs, as shown below in **Table 6.2-3 Average Daily Costs for Direct, Indirect, and Other Cost Categories for Defined Windows**.

Table 6.2-3 Average Daily Costs for Direct, Indirect, and Other Cost Categories for Defined Windows				
Capital Costs	**Window #3 ($ x 1,000,000/day)**	**Window #4 ($ x 1,000,000/day)**	**Window #5 ($ x 1,000,000/day)**	**Window #6 ($ x 1,000,000/day)**
Direct Costs	3.93	2.62	3.04	2.12
Indirect Costs	3.65	3.30	3.33	3.35
Other Costs	1.48	1.35	1.17	1.20
Total:	9.06	7.28	7.54	6.68

736. The various cost categories comprising the Direct, Indirect, and Other Costs from **Table 6.2-3 Average Daily Costs for Direct, Indirect, and Other Cost Categories for Defined Windows,** above, are presented below in **Figure 6.2-1 Total Average Daily Construction and Capital Costs**, which shows the total average daily cost rate by cost category for each Window.

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Figure 6.2-1 XXXXXXXXXXXXXXXXXXXXXXXXXXX



737. Details of the analysis including identification and discussion of the cost categories are included below.

6.2.1.1 Direct and Indirect Labor Costs Defined

738. The total all-in costs reported for a project of this type are typically referred to by the DOE as Capital Costs.

> *Total capital cost. The total capital cost is an all inclusive plant capital cost developed for the purpose of calculating the plant* ***busbar electricity cost****. This cost is the* ***base construction cost plus contingency, escalation, and interest-related costs.***[553] ***[Emphasis Added]***

739. Busbar Cost is the cost per kilowatt hour of producing electricity that includes the cost of capital, debt service, maintenance, and fuel, and represents the levelized cost, or "busbar cost," or average cost per unit of electricity generated at the actual plant, allowing for the recovery of all costs over the lifetime of the plant. The power plant bus, or "busbar", is that point beyond the generator but prior to voltage transformation point in the plant switchyard.

[553] Cost Estimate Guidelines for Advanced Nuclear Power Technologies, ORNL/TM-10071, Dist. Category UC-80. Department of Energy, Engineering Technology Division – Oak Ridge National Laboratory. R. Hudson II, July 1986, page 3.

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> *A total plant energy generation cost or busbar cost includes the capital, nonfuel operation and maintenance (O&M), fuel, and decommissioning costs and is generally expressed as a cost per unit energy.* [554]

740. Within Capital Costs are the Base Construction Costs, which are defined in the same DOE Cost Estimate Guidelines as follows.

> *Base construction cost. The base construction cost is the overnight plant capital cost for the* ***direct and indirect costs only.*** *This cost is lower than the total capital cost because cost components such as contingency, interest, and escalation are NOT included.* [555] ***[Emphasis Added]***

741. Direct Costs are those costs directly associated on an item-by-item basis with the equipment and structures that comprise the complete power plant.

> *2.3.1 Direct cost accounts*
>
> *Direct cost accounts include those construction and installation costs directly associated with the operating plant structures, systems, and components.* [556]

742. According to the AACE RP 10S-90 Cost Engineering Terminology, direct costs are defined as follows.

> *Costs of completing work that are directly attributable to its performance and are necessary for its completion. 1) In construction, the cost of installed equipment, material, labor and supervision directly or immediately involved in the physical construction of th*e permanent facility. [557]

743. Indirect costs are those construction services related to home office engineering and services, and field office engineering and services, including supervision, management, and other costs that typically fall under General Conditions in a construction contract and temporary facilities, utilities, other materials, and overhead that would be considered General Requirements.

> *2.3.2 Indirect cost accounts*

[554] Cost Estimate Guidelines for Advanced Nuclear Power Technologies, ORNL/TM-10071, Dist. Category UC-80. Department of Energy, Engineering Technology Division – Oak Ridge National Laboratory. R. Hudson II, July 1986, page 32.
[555] Cost Estimate Guidelines for Advanced Nuclear Power Technologies, ORNL/TM-10071, Dist. Category UC-80. Department of Energy, Engineering Technology Division – Oak Ridge National Laboratory. R. Hudson II, July 1986, page 3.
[556] Cost Estimate Guidelines for Advanced Nuclear Power Technologies, ORNL/TM-10071, Dist. Category UC-80. Department of Energy, Engineering Technology Division – Oak Ridge National Laboratory. R. Hudson II, July 1986, page 13.
[557] AACE International Recommended Practice, 10S-90 Cost Engineering Terminology, Rev. May 15, 2023, page 47.

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> *The indirect cost accounts include those construction support activities required to design and build the structures and systems described in the direct cost accounts.* [558]

744. The DOE Cost Estimate Guidelines include additional descriptions of those services included as part of indirect costs as well as a table with representative percentages for each.

> *The indirect costs are expenses for services applicable to all portions of the physical plant, such as Architect Engineer (AE) home office engineering and design, AE field office engineering and services, and taxes. Reactor manufacturer (RM) home office engineering and services are also included in a separate account (except as noted in Sect. 2.3).* [559]

745. According to the AACE RP 10S-90, indirect costs are defined as follows.

> *Costs not directly attributable to the completion of an activity, which are typically allocated or spread across all activities on a predetermined basis.*
>
> *…*
>
> *(1) In construction, (field) indirects are costs which do not become a final part of the installation, but which are required for the orderly completion of the installation and may include, but are not limited to, field administration, direct supervision, capital tools, startup costs, contractor's fees, insurance, taxes, etc.* [560]

746. J.S. Held referenced these definitions as well as used professional judgment and experience as necessary when identifying which costs were either direct, indirect, or other costs. Other costs represent cost categories that are expended intermittently on a project and are not regularly utilized on a daily, monthly, or annual basis. The inclusion of other costs with direct or indirect costs would skew the daily average cost rate as to no longer be representative of a typical day during that period, and as such were defined as a separate category.

[558] *Cost Estimate Guidelines for Advanced Nuclear Power Technologies*, ORNL/TM-10071, Dist. Category UC-80. Department of Energy, Engineering Technology Division – Oak Ridge National Laboratory. R. Hudson II, July 1986, page 14.
[559] *Cost Estimate Guidelines for Advanced Nuclear Power Technologies*, ORNL/TM-10071, Dist. Category UC-80. Department of Energy, Engineering Technology Division – Oak Ridge National Laboratory. R. Hudson II, July 1986, page 3. (Section 2.3.2 Indirect Cost Accounts, p. 14 and Table 2.3 Indirect Cost Percentages, p.15).
[560] AACE International Recommended Practice 10S-90 Cost Engineering Terminology, Rev. May 15, 2023, page 64.

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6.2.1.2 Selection of Cost Data Set for Analysis

747. The VPMB prepared monthly reports including various sets of data and the full cost of the Project. Within the monthly VPMB, there was a breakdown of Project costs based on the cost categories shown in an excerpt from August 2022 VPMB presentation, below.[561]



748. The names of the cost categories in the figure above from the source document are used throughout this section in tables but may be defined in text to be consistent with other portions of this report (e.g., Southern Company is defined as SNC in this report, but certain tables may still refer to it as Southern Company if pulled from a source document).

749. Additionally, SNC prepared Project Management Cost Packages (SNC Project Management Report), which were cost reports that included summary level cost data that is also in the VPMB monthly presentations. Within the SNC Project Management Reports, there were more detailed views of each of the underlying categories shown above.[562] These SNC Project Management Reports were selected as the source documents for the analysis, allowing a greater level of detail to analyze whether costs were direct, indirect, or other costs. The more detailed level of cost reports by SNC

[561] August 30, 2022, Plant Vogtle Units 3&4 Project Management Board presentation, page 15.
[562] Provided as Attachments to the update to the Georgia Public Service Commission (GPSC) Document Request STF-132-19 on behalf of SNC.

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were called the Functional Area Cost Review Reports – Updates to TS Attachment STF-132-19 (Functional Area Cost Review). SNC did not begin producing the Project Management Cost Packages or Functional Area Cost Reviews until January 2019 (presenting the cost data for December 2018). The Project Management Cost Packages and Functional Area Cost Reviews were produced through August 2022. Therefore, there are limited details prior to this timeframe.

750. Detailed cost packages for Windows #1 and #2 were not produced as these occurred prior to January 2019. The only available cost data for Window #1 was included in the VCM Reports. For the purpose of consistency of this analysis, the 45.7% portion of total Project costs presented in the VCM Reports was pro-rated by J.S. Held to calculate a comparable 100 percent of the total Project costs for Window #1 to allow for the total Project costs in Windows #2 through #6 to be compared to Window #1. The VPMB presentations served as a confirmation of reported versus calculated Project costs.

751. Due to the lack of access to more detailed cost information for Windows #1 and #2, an indirect and direct cost breakdown of the costs for these periods was not performed. The total costs from these periods were included in the analysis below.

752. The discrete periods of time, or Windows, discussed above in Section 5 of this Report include the following six (6) Windows for which average daily cost rates were determined, shown below in **Table 6.2-4 Selected Window Periods Summary**.

Table 6.2-4 Selected Window Periods Summary

Period	Start	Finish	Period Description
1	Project Start	Nov-17	WEC Period
2	Nov-17	Oct-18	Beginning of Bechtel Period
3	Oct-18	Apr-19	Switch to Systems Approach
4	Apr-19	Mar-20	Earned Value Re-Baseline / Bechtel COVID-19 Claim
5	Mar-20	Apr-21	Cut-off for Bechtel COVID-19 Claim
6	Apr-21	Project Completion	End of Project

753. Since some of the monthly reporting data was not available and the Project Management Cost Packages and Functional Area Cost Reviews were only produced through August 2022, the Windows shown in **Table 6.2-4 Selected Window Periods Summary** above were adjusted slightly to align with periods of supporting data as shown below in **Table 6.2-5 Adjusted Window Periods Summary**.

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Table 6.2-5 Adjusted Window Periods Summary		
Period	**Start**	**Finish**
1	Project Start	Dec-17
2	Jun-18	Oct-18
3	Oct-18	Apr-19
4	Apr-19	Mar-20
5	Mar-20	Apr-21
6	Apr-21	Aug-22

754. Additionally, there is an approximately six-month gap between the end of Window #1 and the start of Window #2. This gap was the result of the limited cost reporting occurring between when Bechtel signed the CCA in December 2017 with a total construction target price of $3.74 billion and the re-baseline estimate of the Project in June 2018. After the June 2018 re-baseline was presented to the VPMB, subsequent VPMB cost reporting structures were realigned and reported as post-June 2018 costs. There is little visibility into the nature of the VPMB realignment of cost categories before and after this point and contemporaneous Project reports such as the VCM Reports are not consistent to the values reported in the VPMB presentations. Therefore, the basis of this analysis relied on the June 2018 "to-go" costs that was presented in the VPMB Presentations from October 2018 forward.

755. The number of days in each window were calculated on a calendar day basis as presented in Section 5 of this Report, shown in **Table 6.2-6 Total Days in Selected Window Periods**, below.

Table 6.2-6 Total Days in Selected Window Periods					
Window #1	**Window #2**	**Window #3**	**Window #4**	**Window #5**	**Window #6**
3,106 Days	122 Days	181 Days	336 Days	395 Days	457 Days

756. These days were used in subsequent analysis below.

6.2.1.3 Quantification of Average Capital Cost Daily Rates

757. The following section includes the details of the analysis to determine the average daily costs for each discrete window.

758. The first step of the analysis was to determine the resulting total Construction & Capital Costs expended in each of the windows in the same categories being reported, the results of which are

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summarized in **Table 6.2-7 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXX**, below.

Table 6.2-7 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXXXXX XXXXXXXXXX	**XXXXXXXX XXXXXXXX XXXXXX**	**XXXXXXXX XXXXXXXX XXXXXX**	**XXXXXXXX XXXXXXXX XXXXXX**	**XXXXXXXX XXXXXXXX XXXXXX**	**XXXXXXXX XXXXXXXX XXXXXX**	**XXXXXXXX XXXXXXXX XXXXXX**
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XXXXXXXXXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
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XX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
XXXXXXXXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
XXXXXXXXXXXXXXXXXXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
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SXXXXXXXXXXXXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX
XXXX	XXXX	XXXX	XXXX	XXXX	XXXX	XXXX

759. The values above represent the period (each column) and total (bottom row) costs from the start of the Project until August 2022, and were based on the cost categories shown above.

760. As noted above, costs reported in VCM 18 produced by the Company were utilized as well as costs reported in the VPMB presentations. J.S. Held adjusted these values to represent the total Project costs. An excerpt of Table 1.1 from VCM 18, showing how the Company reported these costs, is shown below.[563]

[563] February 28, 2018, letter from GPC to GPSC, Re: Georgia Power Company's Eighteenth Semi-Annual Construction Monitoring Report for Vogtle Units 3 and 4; Docket 29849, page 10.

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Table 1.1

Vogtle 3&4 Project
Georgia Power Company Cost - **Subject to Commission Verification and Approval**
Project To Date
Through Period Ending December 31, 2017

	Total Project Capital			Project to Date Capital		
Construction & Capital Cost	VCM 17 ($ millions)	Total Current Forecast ($ millions)	Variance ($ millions)	Actual To Date ($ millions)	Budget To Date ($ millions)	Variance ($ millions)
Original EPC (1)	3,257	3,198	(59)	3,198	3,257	(59)
Interim Payments & Liens	493	440	(53)	467	493	(26)
Site Construction Management						
Engineering Contractor	545	427	(118)	67	90	(23)
Procurement	938	960	22	86	153	(67)
Contract Construction	1,374	1,571	197	208	149	59
Construction Support & Project Management	866	877	11	22	81	(59)
Total Site Construction Management	3,723	3,835	112	383	473	(90)
Owners Costs	996	1,012	16	688	671	17
Ad Valorem	273	273	0	97	97	0
Transmission Interconnection	61	61	0	59	59	0
Test Fuel Offsets	(33)	(33)	0	0	0	0
	1,298	1,313	16	844	827	17
Total Construction & Capital Cost	**8,771**	**8,786**	**16**	**4,892**	**5,051**	**(159)**
Toshiba Parent Guarantee	(1,682)	(1,493)	189	(1,493)	(208)	(1,285)
Total Construction & Capital Cost Net of Parent Guarantee	**7,089**	**7,293** (2)	**204**	**3,398**	**4,843**	**(1,444)**

761. Based on a review of the costs in the SNC Project Management Reports and a comparison the cost categories reported in the VCM reports, the categories of costs that are determined to be directly comparable between the two reports are shown below in **Table 6.2-8 XXXXXXXXXXXXXXXXXX XXXXXXXXXX**

Table 6.2-8 XXXXXXXXXXXXXXXXXXXX	
XXXXXXXXXXXXXXXXXXX	**XXXXXXXXXXXXXX**
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XXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXX
XXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXX
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XXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXX
XXXXXXXXXXXXXXX	XXXXXXXX

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Table 6.2-8 XXXXXXXXXXXXXXXXXXX	
XXXXXXXXXXXXXXXXXXX	**XXXXXXXXXXXXX**
XXXXXXXXXXXXXXXXXXXXXXXXX	XXXX
XXX	XXXX
XXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXX	XXXX

762. The next step of the analysis was to calculate the average daily cost rate for each window. The total capital costs for each window were divided by the total calendar days in that window to determine an average daily rate for total costs. The average total daily cost rate of each VPMB category is shown in **Table 6.2-9 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**, below.

Table 6.2-9 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX						
XXXXXX XXXXXXXXX	**XXXXXX XXXXXXXXX**	**XXXXXX XXXXXXXXX**	**XXXXXX XXXXXXXXX**	**XXXXXX XXXXXXXXX**	**XXXXXX XXXXXXXXX**	**XXXXXX XXXXXXXXX**
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763. These results are visually depicted in **Figure 6.2-2 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**.

Figure 6.2-2 XXXXXXXXXXXXXXXXXXXX



6.2.1.4 Identification of Direct and Indirect Costs

764. As noted above, J.S. Held reviewed SNC's Project Management Cost Reports and Functional Area Cost Reviews to determine the cost categories included in the reports prepared by the VPMB and SNC.[564]

765. Each of the categories from SNC's Project Management Cost Packages are briefly described below as well as J.S. Held's categorization of whether the account is considered a Direct, Indirect, or Other Cost. Other Costs are made up of indirect costs that would not be incurred on a regular basis, such as incentive fees or other one-time costs, and therefore should be excluded from the direct and indirect daily average cost calculation. The categorization of the cost categories as direct, indirect, and other was based on the limited information in the reports and professional judgment and experience.

[564] September 2022, August 2022 Project Management Cost Package – Rev 0.

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766. Additionally, select cost accounts were excluded from the quantification of average daily direct and indirect costs that overlap with the separate quantification of inefficiency related costs. These are discussed where applicable.

Construction (CCA Bechtel & Fluor)

767. SNC's Project Management Cost Report includes a category of costs labeled as "*Construction (CCA Bechtel & Fluor)"*. This category was determined to be primarily costs related to Bechtel and Fluor and includes the following subcategories shown below in **Table 6.2-10 XXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXX**

Table 6.2-10 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	
XXXXXXX XXXXXXXXXXXX	**XXXXXXXXXXXXXXXXXXXXXXX**
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768. The cost accounts above in the sub-category "*Construction (CCA Bechtel & Fluor)*" includes direct, indirect, and other costs, which J.S. Held categorized in the following manner in **Table 6.2-11 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX** for the purposes of the analysis. The reported Actual to Date costs from the August 2022 Project Management Cost Report, which represent costs from July 2018 through August 2022, are also shown.

Table 6.2-11 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
XXXXXXXXXXXXXXX	**XXXXXXXXXXXX XXXXXXXX**	**XXXXXXXXXX XXXXXXXXXXXXX XXXXXXXXX**
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XXXXXXXXXXXXXXXXXXXXX		XXXXX

769. While Cost account *XXXXXXXXXXXXXXXXX* would typically be an indirect cost, for the purpose of this analysis, it was assigned the category of "Other Costs" so it would not be a duplicate cost

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quantification of the inefficient labor being calculated above in Section 6.1 of this Report.

770. Similarly, cost accounts XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX are quantified later as part of COVID-19 direct costs and, as such, were considered an Other Cost. Contingency, Accrual and Fee-related cost accounts were all considered Other Costs, as well.

771. The subtotals and percentage of total cost category of the direct, indirect, and other costs as coded above in **Table 6.2-11 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX** are shown in **Table 6.2-12 XXXXXXXXXXXXXXXXXXXXXXXXXXXX** below.

Table 6.2-12 XXXXXXXXXXXXXXXXXXXXXXXXXX		
	XXXXXXXXXXXXXXXXXX XXXXXXXXXX	**XXXXX XXXXXXXXXXX X**
XXXXXXXXX	XXXXX	XXX
XXXXXXXXXXX	XXXXX	XXX
XXXXXXXXX	XXXXX	XXX
XXXXXXXXX	XXXXX	**XXX**

Westinghouse (Engineering, Licensing, etc.) Category

772. The Westinghouse (Engineering, Licensing, etc.) category is made up of the cost accounts shown below in **Table 6.2-13 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

Table 6.2-13 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXX	
XXXXXXXXXXXXXXXXXXXXX	**XXXXXXXXXXXXXXXXXX**
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	XXXXXXXXXXXXXXXXXXXXXXX
	XXXXXXXXXXXXXXXXX

773. Based on a review of the details from the Project Management Cost Reports, the costs in this category are all indirect costs, and were therefore treated as such as part of the analysis, shown below in **Table 6.2-14 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

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Table 6.2-14 XXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXX	
XXXXXXXXXXXXXXXXXX	**XXXXXXXXXXXXXXXXXX**
XXXXXXXXXXX	XXXXXX
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XXXXXXX	XXXXXX
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XXXXXXXXXXXXXX	XXXXXX
XXXXXXXXXX	XXXXXX
XXXXXXXXXXXXXXXXXXXXXX	XXXXXX
XXXXXXXXXXXXXXX	XXXXXX

SNC Controlled Labor

774. The SNC Controlled Labor capital reporting category is made up of the five following associated cost accounts, shown below in a summary **Table 6.2-15 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX** prepared by J.S. Held.

Table 6.2-15 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
XXXXXXXXX XXXXXX	**XXXXXXXXXXXXXXXXX**	**XXXXXXXXXXXXXXXXXXXXXXX**
XXXXXXXXXX XXXXXX XXXXXXX	XXXXXXXXXXXXXXX	XXXXXXXXXXXXXX
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Table 6.2-15 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
XXXXXXXXX XXXXXX	**XXXXXXXXXXXXXXXXX**	**XXXXXXXXXXXXXXXXXXXXXXXX**
	XXXXXXXXXXXXXXX XXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXXX
	XXXXXXXXXXXX XXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXXXXXXX
	XXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXX
		XXXXXXXXX
		XXXXXXXXXXXXXXXXXXXXXXXXXXXXX

775. The details of each of the five associated cost accounts were reviewed and costs were assigned by J.S. Held as Direct, Indirect, or Other Costs as shown in each of the tables below for the purposes of analysis.

776. For the first category, the cost account of 29: SNC Construction includes the following Level 3 cost accounts listed below in **Table 6.2-16 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX** along with the Direct, Indirect, or Other Cost code assigned by J.S. Held.

Table 6.2-16 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
XXXXXX XXXX XXXXXXX	**XXXXXXXXXXX XXXXXXXXXX**	**XXXXXXXXXXXXXXXXXXXX**	**XXXXXXXXXXXX XXXXXXXXX**
XXXXXX XXXXXXXXXX	XXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXX XXXXXXXXXX	XXXXXXX
		XXXXXXXXXXXXXXXXX	XXXXXXX
		XXXXXXXXXXXXXXXXXXXX XXXXXXXXX	XXXXXXX
		XXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
		XXXXXXXXXXXXXXXXXXX	XXXXXXX
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Table 6.2-16 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
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777. For the next cost account category of 30: SNC Operations, the following were coded as Direct,

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Indirect, or Other Costs as shown below in **Table 6.2-17 XXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXX**

Table 6.2-17 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
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Table 6.2-17 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
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778. The remaining three cost accounts under the SNC Controlled Labor category are shown below in **Table 6.2-18 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**, along with the Direct, Indirect, or Other Cost code assigned by J.S. Held.

Table 6.2-18 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
XXXXXXX XXX XXXXXXX	**XXXXXXXXXXXX XXXXXXX**	**XXXXXXXXXXXXXXXXXXXXX**	**XXXXX XXXXXXXX XXXXXXXXX**
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Remaining Capital Cost Categories

779. The remaining capital reporting categories in the Project Management Cost Packages and VPMBs include the associated cost accounts shown below in **Table 6.2-19 XXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXX** along with J.S. Held's indirect or direct cost decision for each of these cost accounts.

Table 6.2-19 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX		
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780. J.S. Held's identification and assignment of categories of costs were based on the available Project record as well as professional judgment and experience. In many cases, J.S. Held did not have access

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to more information to review the details of certain categories.

6.2.1.5 Quantification of Direct and Indirect Labor Cost Daily Rates per Identified Window.

781. Using the Direct, Indirect, and Other Cost categories defined above and the available Project Management Cost Reports, J.S. Held segregated the average daily rate to show the average daily rate of Direct and Indirect costs individually for Windows #3 through #6.

782. Indirect and Direct cost splits for Windows #1 and #2 are not shown at the requisite level of detail to complete the analysis.

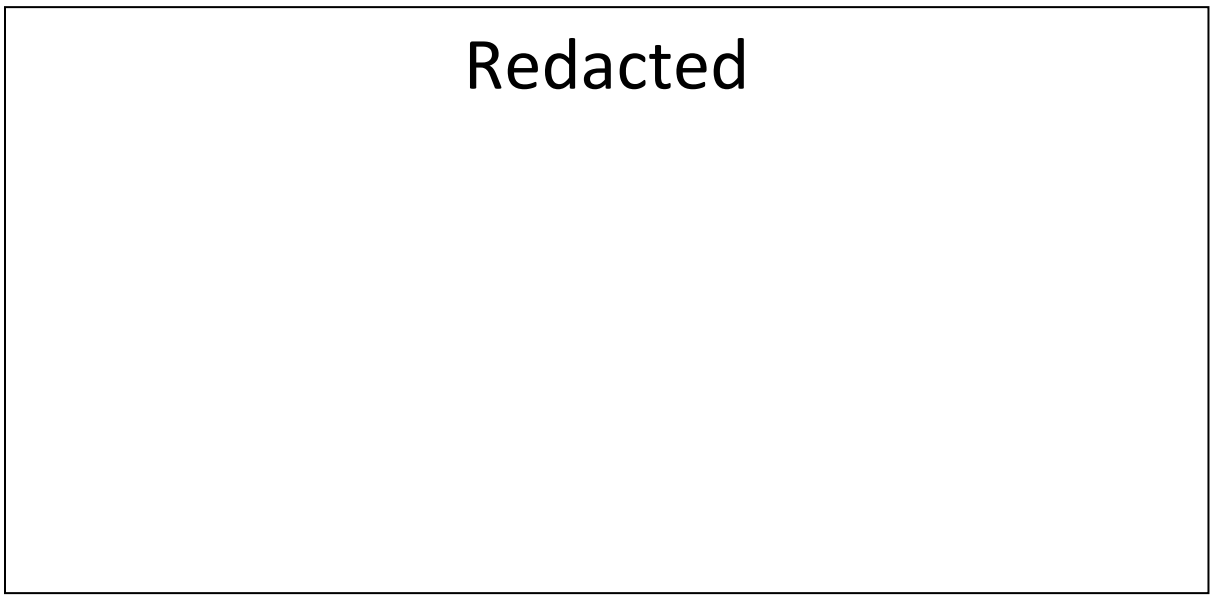
783. The average daily rates for direct costs in Window #3 through #6 are shown in **Table 6.2-20 XXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

Table 6.2-20 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				
XXXXXXXXXXXXXXX	**XXXXXXXX XXXXXXXXXXX**	**XXXXXXXX XXXXXXXXXXX**	**XXXXXXXX XXXXXXXXXXX**	**XXXXXXXX XXXXXXXXXXX**
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784. These results are visually depicted in **Figure 6.2-3 Average Daily Direct Cost Rate for Defined Windows**, prepared by J.S. Held.

Figure 6.2-3 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



785. The average daily rates for indirect costs in Window #3 through #6 are shown in **Table 6.2-21 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**

Table 6.2-21 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXX	XXXXXXXX XXXXXXXXXX	XXXXXXXX XXXXXXXXXX	XXXXXXXX XXXXXXXXXX	XXXXXXXX XXXXXXXXXX
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Table 6.2-21 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX				
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786. These results are visually depicted in **Figure 6.2-4 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXX**, prepared by J.S. Held.

Figure 6.2-4 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Redacted

787. As shown above, the Daily Average Indirect Cost Rater during Window #5 is approximately $3.33 million per calendar day.

6.2.2 Summary of Cost Growth

788. Vogtle Units 3 and 4 experienced significant cost growth for the duration of the Project, vastly

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outpacing the original EAC for the Project and nearly every subsequent update. The Commission most recently deemed reasonable the revised Total Construction & Capital Cost forecast at $7.30 billion, net of the TPG, for the Company's portion of the Project in VCM 17.[565] However, since VCM 17, the Company's Total Construction & Capital Cost Forecast, net of the TPG, has grown to $10.19 billion.[566] This change equates to a $2.89 billion overrun of the VCM 17 forecast. The changes from VCM 17 to date are shown in detail in **Table 6.2-22 VCM 17 to VCM 29 Project EAC Change**, broken out into categories based on the Company's reporting in the VCMs, below.

Table 6.2-22 VCM 17 to VCM 29 Project EAC Change

	VCM 17 Total EAC ($ x 1,000,000)	VCM 29 Total EAC ($ x 1,000,000)	Change in EAC from VCM 17 to VCM 29 ($ x 1,000,000)
Original EPC	$3,257	$3,198	$(59)
Interim Payments & Liens	493	411	(82)
Original EPC and Interim Payments & Liens Subtotal:	**3,750**	**3,609**	**(141)**
New Site Forecast EPC			
Engineering Contractor	545	665	120
Procurement	938	1,548	610
Contract Construction	1,374	3,213	1,839
Construction Support and Project Management	866	968	102
New Site Forecast EPC Subtotal:	**3,723**	**6,394**	**2,671**
Remaining Costs			
Owners Cost	996	1,233	237
Ad Valorem Tax	273	336	63
Transmission Interconnection	61	62	1
Test Fuel Offsets	(33)	(4)	29
Remaining Costs Subtotal:	**1,297**	**1,627**	**330**
Total Construction & Capital Cost:	**8,771**	**11,630**	**2,859**
TPG Payment, net of customer refunds	(1,492)	(1,492)	-
Construction Monitor		33	33
Unspecified Project Contingency		17	17
Total net of TPG & Other:	**$7,300**	**$10,188**	**$2,888**

[565] January 11, 2018, Georgia Public Service Commission, Verification of Expenditures Pursuant to Georgia Power Company's Certificate of Public Convenience and Necessity for Plant Vogtle Units 3 and 4, Seventeenth Semi-Annual Construction Monitory Report; Proposed Forecast Cost and Schedule Revisions; and Determination of Continuation or Cancellation of the Project, VCM 17 Order & Stipulation, page 11.

[566] August 2023, Twenty-ninth Semi-Annual Vogtle Construction Monitoring Report, Table 1.1., page 7.

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789. As part of VCM 19, the Company decided that it would not seek recovery for $694 million of the cost overrun exceeding the $7.30 billion forecast deemed reasonable in VCM 17. In the Company's *Application to Adjust rates to Include Reasonable and Prudent Plant Vogtle Units 3 and 4 Costs*, the Company proposed that it would not seek an additional $668 million of alleged prudent but not reasonable costs for recovery, bringing the total to $1.36 billion of costs that the Company would not pass on to the Georgia ratepayers. After removing the $1.36 billion from the VCM 29 Total Construction and Capital Cost Forecast, a Total Capital Cost which the Company believes to be prudent and reasonable of $8.83 billion remains. This capital cost expenditure would correspond with a $1.53 billion overrun from the $7.30 billion deemed reasonable at VCM 17.

790. The Company and Commission Staff have agreed to a final value of $7.56 billion as a reasonable and prudent Total Construction and Capital Cost for the Project to be included in the rate base, per the August 29, 2023, Vogtle Units 3 and 4 Rate Adjustment Stipulation (Rate Adjustment Stipulation). The final approved Total Construction & Capital Cost forecast corresponds with an increase of $262 million from the VCM 17 revised Total Construction and Capital Cost forecast. The Company's agreement in the Rate Adjustment Stipulation to a final increase of $262 million, represents a decision by the Company to absorb approximately $1.25 billion that the Company claims was prudent and reasonable Construction and Capital Costs. **Table 6.2-23 Company Prudent Cost Distinction**, below, depicts the various costs that the Company has decided to forgo seeking recovery for after the agreement of the Rate Adjustment Stipulation.

Table 6.2-23 Company Prudent Cost Distinction

	Total Construction & Capital Costs ($ x 1,000,000)
VCM 29 Total Construction and Capital Cost Forecast Net of TPG and Construction Monitor	$10,188
Company Alleged Prudent but not Reasonable Construction and Capital Costs	1,362
Company Alleged Prudent and Reasonable Construction and Capital Costs	8,826
Company and Commission Agreed Final Total Construction and Capital Cost	7,562
Total Value of Company Alleged Prudent and Reasonable Construction Costs That Company Will Not Recover	$1,264

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6.2.2.1 VCM 17 EAC and ETC

791. WEC filed for bankruptcy on March 29, 2017. Following the bankruptcy of WEC, SNC was designated to manage the Project on behalf of the Owners pursuant to a revised Ownership Participation Agreement. The Company entered into a Construction Completion Agreement with Bechtel on October 23, 2017, as the prime construction contractor.[567]

792. After the WEC bankruptcy and SNC taking over management of the Project, SNC prepared an ETC of the remaining construction costs to complete the design, engineering, procurement, construction, testing, and startup of Vogtle Units 3 and 4, with the assumption that SNC would self-perform management of the Project.[568] The updated ETC was based on estimates provided by WEC and Fluor, including SNC specific schedule analysis and historical and industry experience. This was presented to the Commission in VCM 17 dated August 31, 2017.[569]

793. The ETC for the Project as of June 1, 2017, was $9.00 billion to $9.90 billion (total Project costs, inclusive of the Company portion). SNC's estimate was based on a range of completion dates with the most optimistic scenario being a "*+20/+20*", signifying that both Units 3 and 4 would finish 20 months after the original proposed baseline schedule, ranging to a "*+33/+33*" scenario which would correspond to an approximate $9.90 billion ETC. The SNC ETC Report included a table which included breakdown of each cost into various categories, shown in the excerpt below.[570]

[567] October 23, 2017, Construction Completion Agreement Between Georgia Power Company, for Itself and as Agent for Oglethorpe Power Corporation (An Electric Membership Corporation), Municipal Electric Authority of Georgia, MEAG Power Spvj, Llc, Meag Power Spvm, Llc, Meag Power Spvp, Llc, and the City of Dalton, Georgia, Acting by and through its Board of Water, Light and Sinking Fund Commissioners, as Owners and Bechtel Power Corporation.
[568] SNC Vogtle 3 & 4 Estimate to Complete (ETC) Report.
[569] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A.
[570] SNC Vogtle 3 & 4 Estimate to Complete (ETC) Report, page 3.

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Table 1 – Cost Estimate Range				
	+20/+20	+23/+23	+29/+29	+33/+33
Craft Labor	$1,505,256,226	$1,508,902,711	$1,515,119,904	$1,518,627,229
Non-Manual Labor	$2,829,986,904	$2,974,495,034	$3,245,435,989	$3,457,567,732
Procurement	$765,964,872	$767,265,321	$769,521,984	$770,817,476
Sub-Contracts	$1,281,482,754	$1,317,084,237	$1,362,863,141	$1,381,947,793
Distributables	$281,433,081	$285,250,944	$292,786,421	$297,753,343
Contingency	$1,159,397,384	$1,159,397,384	$1,159,397,384	$1,159,397,384
Other	$1,169,374,537	$1,205,505,806	$1,277,288,156	$1,325,934,024
Total	**$8,992,895,758**	**$9,217,901,437**	**$9,622,412,979**	**$9,912,044,981**

794. SNC developed its direct and indirect labor estimate by estimating the remaining quantities to be installed and then unit rates (with localization factors) to calculate the number of work hours required. The work hours were multiplied by a productivity factor based on the area of the work (Nuclear Island, Turbine Island, Balance of Plant) and the unit (Unit 3 and Unit 4). The PF multiplied the baseline work hours by a factor to account for the work hours that SNC projected for the work based on the nominal conversion of remaining quantities to work hours. The ETC assumed that a higher PF would apply to the Nuclear Island work and that a slightly lower PF would apply to the Unit 4 work, assuming an improvement based on lessons learned. This approach recognizes that the Nuclear Island work may require more work for the same installed quantities and that Unit 4 will achieve increased productivity when compared to Unit 3 based in part on lessons learned. SNC's ETC Report utilized Fluor's basis of estimate assumed PFs. Fluor's PFs included a 12.5 percent performance improvement for work completed for Unit 4 as compared to Unit 3.[571] Indirect labor costs were assumed to be 33 percent of total craft hours.

795. The blended PFs utilized in VCM 17 for the estimate are shown below in an excerpt from SNC's ETC Report (Units A and B refer to Units 3 and 4, respectively).[572]

	Nuclear Island		Turbine Island		BOP
Vogtle Site	Unit A 1.63	Unit B 1.49	Unit A 1.51	Unit B 1.35	1.31

796. It should be noted that actual PFs were significantly higher and the assumptions above were never achieved, leading to delays and cost overruns.

[571] SNC Vogtle 3 & 4 Estimate to Complete (ETC) Report, page 11.
[572] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, page 47.

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797. SNC determined that the remaining ETC as of July 1, 2017 (VCM 17) for the total Project was $9.45 billion. This ETC corresponded with the associated increase in the Company's share of the Total Construction & Capital Cost EAC to $8.77 billion.

> *the Owners have chosen to adopt the higher confidence +29/+29 schedule and associated revised cost-to-complete forecast of $9.45 billion (from July 1, 2017). Georgia Power's share of the total capital cost is now forecast to be $8.77 billion after considering Georgia Power's non-shareable costs, such as ad valorem taxes, and regulatory and legal fees.*[573]

798. Below, is a summary of the ETC costs net of non-shareable Co-owner's costs which were reported in VCM 17.[574]

Table 1.1

Vogtle 3&4 Project
Georgia Power Company Cost - **Subject to Commission Verification and Approval**
Total Project Costs (1)

	Total Current Forecast ($ millions)
Construction & Capital Cost	
Original EPC (2)	$3,257
Interim Payments & Liens (3)	493
New Site Forecast EPC	
Engineering Contractor	545
Procurement	938
Contract Construction	1,374
Construction Support	388
Project Management	478
	3,723
Owners Cost	996
Ad Valorem Tax	273
Transmission Interconnection	61
Test Fuel Offsets	(33)
	1,298
Total Construction & Capital Cost (1)	**$8,771**

799. SNC also requested Bechtel to perform a cost and schedule assessment which was limited to the direct construction labor; field non-manual labor; indirect construction labor, construction equipment, construction materials/equipment; and supporting construction organization as

[573] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, Footnote 28 on page 50.
[574] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A, page 103.

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necessary for the installation of SNC-provided quantities to accomplish a system-by-system construction complete/turnover to startup/commissioning for each unit (the "Direct Hire Construction Scope").

800. Additionally, The Kenrich Group LLC (Kenrich) prepared an Analysis of Project Estimate-To-Complete, dated August 11, 2017, in support of VCM 17 (Kenrich ETC Report). Kenrich's analysis focused primarily on projected productivity factors and utilized a range of scenarios labeled as "improved performance", "similar performance", and "worsening performance" to scale SNC's ETC estimates accordingly. The Kenrich ETC Report stated:

> *Performance on the Project is a major determinant of the ETC costs. Not only do direct labor costs go up as performance worsens, indirect costs and non-construction costs supporting the direct labor effort increase as well, and direct subcontractor performance may deteriorate as well. For example, for each* ***10% decrease in productivity (that is, moving from a performance factor of 2.0 to 2.1), the ETC increases approximately $203 million*** *as a result of increased direct labor costs, activity-related subcontractor costs, activity-related indirect and non-construction costs, and the corresponding contingency and markups. Similarly, each 10% improvement would reduce the ETC by approximately $203 million.* [575] ***[Emphasis Added]***

801. J.S. Held's analysis of the actual productivity achieved is included above in Section 5.3 of this Report.

802. Kenrich projected an ETC range of approximately $7.40 billion to $10.10 billion based on the scenarios listed above. The "*Summary Of Cost ETC Findings*" table, from Kenrich's report, summarizes the different scenarios below.[576]

Summary Of Cost ETC Findings

	Total Dollars To Complete ($ Millions)		
Schedule Extension	Improved Performance (PF = 2.0)	Similar Performance (PF = 2.5)	Worsening Performance (PF = 3.0)
Early Date (U3/U4 Commercial Operation Date = Feb 2021/2022)	$7,413	$8,438	$9,540
Late Date (U3/U4 Commercial Operation Date = Nov 2022/2023)	$7,929	$8,953	$10,056

Kenrich projects an ETC range of $7.4 billion to $10.1 billion, depending on the scenario.

803. SNC's final estimate determination of the +29/+29 schedule falls in between the similar range for

[575] August 11, 2017, Analysis of Project Estimate-To-Complete, The Kenrich Group, page 13.
[576] August 11, 2017, Analysis of Project Estimate-To-Complete, The Kenrich Group, page 20.

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Early and Late Schedule Extension dates provided in Kenrich's report.

804. Separately, PwC prepared a Quantitative Risk Assessment (PwC Report) as a supplement to the VCM 17 process. The PwC Report, dated August 29, 2017, analyzed three separate scenarios including the completion of both Units 3 and 4, the cancellation of both Units 3 and 4, and the completion of Unit 3 and the cancellation of Unit 4. For the completion of Units 3 and 4 scenario, PwC identified that the four potential risk events with most significant impact on the Project ETC included: performance costs, schedule delay, additional WEC fees and/or craft per diem cost, and start-up testing for new technology. PwC estimated a range of "Risk Adjusted ETC" for this same scenario from approximately $8.98 billion to $10.46 billion, shown below.[577]

	Risk Adjusted ETC ($M)			
	P20	P50	P80	P90
1. Estimate Uncertainty Total	$8,427	$8,903	$9,537	$9,864
2. Event Driven Risk	$437	$531	$663	$842
Project Cost Total*	$8,981	$9,484	$10,129	$10,461

805. The Company presented a forecasted ETC value of $8.77 billion, net of the TPG, to the Commission in VCM 17. During a Special Administrative Session on December 21, 2017, the Commission issued an order allowing the Company to move forward to complete the construction of Units 3 and 4.[578]

806. Additional orders resulting from this Special Administrative Session included the approval of the revised Project schedule, approval of the new Project structure, and the revised capital cost forecast was deemed reasonable up to $7.30 billion. The $7.30 billion capital cost forecast accounts for $8.77 billion in ETC costs net of the TPG. The TPG totaled $3.68 billion with the Company's proportionate share of this guarantee equaling approximately $1.68 billion. A separate order approved by the Commission stipulated that of the Company's $1.68 billion portion of the TPG, approximately $188 million would be refunded to the Company's customers. The $8.77 billion with the inclusion of the TPG and the resulting customer refunds, brought the total value to $7.30 billion. The Commission Staff stipulated that the $3.50 billion was deemed to be prudent. As part of the December 20, 2016 Supplemental Information, Staff Review, and Opportunity for Settlement (SIR), costs between $3.50 billion and $5.68 billion were to have a presumption of prudence, and for costs above $5.68 billion

[577] August 29, 2017, Georgia Power Company, Plant Vogtle Units 3 & 4, Quantitative Risk Assessment, page 10.
[578] August 31, 2017, Georgia Power Company's Seventeenth Semi-Annual Construction Monitoring Report, Request for Approval of the Expenditures Made Between January 1, 2017 and June 30, 2017, and Request for Approval of the Revised Project Cost Estimate and Construction Schedule Pursuant to O.C.G.A.

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the burden of prudency rests with the Company. In VCM 17, it was stated that the $7.30 billion is reasonable with the burden of whether costs are reasonable above $7.30 billion resting with the Company. The Company still retained the burden of proof on prudency on all capital costs above $5.68 billion.[579]

807. Therefore, the Company was to move forward with a total revised EAC cost of $7.30 billion and the +29/+29 month schedule for Unit 3 and Unit 4 CODs to be November 2021 and November 2022, respectively.

Contingency

808. The $7.30 billion revised capital cost forecast included approximately $1.16 billion as SNC contingency. The breakdown of these costs, as provided in the SNC ETC Report, are shown in the excerpt below.[580]

Table 8 – Contingency Costs

Contingency Category	Cost
Risk Register	$331,643,500
Management Reserves	$422,253,884
WEC Incentives - Engineering Deliverables	$2,500,000
WEC Incentives - Fuel Load Date	$3,000,000
Per Diem and VCS Cancellation	$400,000,000
Total Cost	**$1,159,397,384**

809. Approximately six to eight months later during the VCM 19 reporting period, the Company reported that its revised capital cost forecast had increased by over approximately $1.10 billion from the $7.30 billion deemed reasonable in VCM 17 to $8.40 billion.[581] This increase in the capital cost forecast corresponded with the extinguishment of almost the entire contingency reserve in VCM 17.

810. The Company decided not to seek recovery for $694 million of the approximately $1.10 billion and categorized these costs as base capital cost increases. The Company categorized the remaining $366 million as contingency replenishment. The increases in Forecasted Costs at Completion reported in

[579] February 17, 2022, Georgia Public Service Commission, Verification of Expenditures Pursuant to Georgia Power Company's Certificate of Public Convenience and Necessity for Plant Vogtle Units 3 and 4, Twenty-Fifth Semi-Annual Construction Monitoring Report, page 2.
[580] SNC Vogtle 3 & 4 Estimate to Complete (ETC) Report, page 16.
[581] August 31, 2018, letter from GPC to GPSC, Re: Georgia Power Company's Nineteenth Semi-Annual Construction Monitoring Report for Plant Vogtle Units 3 and 4; Dockets No. 29849.

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VCM 19 as compared to VCM 17 are shown below in **Table 6.2-24 VCM 17 to VCM 19 Project EAC Growth**.

Table 6.2-24 VCM 17 to VCM 19 Project EAC Growth ($ x 1,000,000)			
	VCM 17 Total EAC	**VCM 19 Total EAC**	**Change in EAC from VCM 17 to VCM 19**
Construction & Capital Cost			
Original EPC	$3,257	$3,198	$(59)
Interim Payments & Liens	493	440	(53)
New Site Forecast EPC			
Engineering Contractor	545	270	(275)
Procurement	938	1,244	306
Contract Construction	1,374	2,142	768
Construction Support and Project Management	866	719	(147)
Total Site Construction Management	3,723	4,375	652
Owners Cost	996	1,173	177
Ad Valorem Tax	273	273	-
Transmission Interconnection	61	61	-
Test Fuel Offsets	(33)	(33)	-
	1,297	1,474	177
Total Construction & Capital Cost	8,771	9,487	716
Toshiba Parent Guarantee Payment, net of customer refunds	(1,682)	(1,493)	189
Total to be Absorbed by Company		(694)	(694)
Total Construction & Capital Cost, net of Parent Guarantee and amounts to be absorbed by Company	$7,089	$7,300	$211

811. The Company stated that the costs presented in VCM 19 do not include the additional $366 million that the Company requested for contingency replenishment.[582] Therefore, that amount needs to be added to the totals above. Despite the increased EAC reported in VCM 19, the Commission did not increase the approved cost of $7.3 billion. The Company's Forecasted Cost at Completion continued to grow after VCM 19 with Total Construction & Capital Costs forecasted to be $11.629 billion for the Company's portion as of VCM 29.[583] The increases in each cost category from VCM 17 to VCM

[582] August 31, 2018, letter from GPC to GPSC, Re: Georgia Power Company's Nineteenth Semi-Annual Construction Monitoring Report for Plant Vogtle Units 3 and 4; Dockets No. 29849, page 5.
[583] August 2023, Twenty-ninth Semi-Annual Vogtle Construction Monitoring Report, Table 1.1., page 7.

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29 are shown in **Table 6.2-25 VCM 17 to VCM 29 Project EAC Growth**.

Table 6.2-25 VCM 17 to VCM 29 Project EAC Growth ($ x 1,000,000)			
	VCM 17 Total EAC	**VCM 29 Total EAC**	**Change in EAC from VCM 17 to VCM 29**
Construction & Capital Cost			
Original EPC	$3,257	$3,198	$(59)
Interim Payments & Liens	493	411	(82)
New Site Forecast EPC			
Engineering Contractor	545	665	120
Procurement	938	1,548	610
Contract Construction	1,374	3,213	1,839
Construction Support and Project Management	866	968	102
Total Site Construction Management	3,723	6,394	2,671
Owners Cost	996	1,233	237
Ad Valorem Tax	273	336	63
Transmission Interconnection	61	62	1
Test Fuel Offsets	(33)	(4)	29
	1,297	1,627	330
Total Construction & Capital Cost	8,771	11,629	2,858
Toshiba Parent Guarantee Payment, net of customer refunds	(1,682)	(1,492)	190
Total to be Absorbed by Company		(694)	(694)
Allocated Contingency Included Above		(2,143)	(2,143)
Total Construction & Capital Cost, net of Parent Guarantee and amounts to be absorbed by Company	$7,089	$7,300	$211

812. The Company stated in VCM 29 that the above costs do not include an additional $17 million in "*unspecified project contingency*".[584] Additionally, following the inclusion of the "*Total to be Absorbed by GPC*" amount of $694 million as part of VCM 19, the Company began including an "*Allocated Contingency Included Above*" cost category which served to offset the Total Construction & Capital Cost to not exceed the $7.30 billion value. As of VCM 29, the "*Allocated Contingency Included Above*" reached $2.14 billion.

[584] August 2023, Twenty-ninth Semi-Annual Vogtle Construction Monitoring Report, Table 1.1., page 7.

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6.2.2.2 CPI Analysis

813. The CPI is a key performance indicator on a given project measuring the cost efficiency with regard to the budgeted amount. The ratio is actual costs divided by the earned value with a value greater than 1 indicating that costs are running over budget.

814. According to the Project Management Body of Knowledge Guide:

> *effective measures allow for tracking, evaluating, and reporting information that can communicate project status, help improve project performance, and reduce the likelihood of performance deterioration.*[585]

815. The CPI is different than the productivity factor which measures the ratio of hours spent on an activity relative to hours earned. Don Grace noted this difference in his VCM 19 Testimony in which he described how SNC and Bechtel measured CPI as the following.

> *Cost Performance Indices ("CPI"), which for the reporting period divides the actual costs (or, as is reported by Bechtel, the "hours") incurred for work done during the period by the earned hours of that same work that had been completed for that period. For example, if for the completed work the actual hours were 110 hours, and the earned value of that same work was 100 hours, then the CPI for that period would be 1.10.*[586]

816. Throughout the Project record, CPI has been defined as shown below.[587]

> **Construction Cost Performance**
>
> The Cost Performance Index ("CPI") is a measure of the cost efficiency of direct construction resources expressed as a ratio of earned value to actual cost:
>
> $$CPI = \frac{hours\ spent}{hours\ earned}$$
>
> If the CPI is above 1.0, the Project is spending more hours than planned to complete a task. If CPI is less than 1.0, the Project is spending fewer hours than planned to complete a task.

817. However, it should be noted that this definition as used by the Company in VCM 19 and by SNC and Bechtel, is actually not CPI, but productivity factor. As noted above in this Report, CPI is a measure

[585] A Guide to the Project Management Body of Knowledge, PMBOK Guide, Seventh Edition, 2021, page 105.
[586] November 30, 2018, Direct Testimony of Don Grace, VCM 19, page 24.
[587] August 31, 2018, letter from GPC to CPSC, Re: Georgia Power Company's Nineteenth Semi-Annual Construction Monitoring Report for Plant Vogtle Units 3 and 4; Dockets No. 29849, page 20.

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of cost efficiency and is the ratio of actual costs divided by the earned costs.[588]

818. One main use of CPI is forecasting the projected EAC. As noted in the excerpts from the Project records, the parties on the Vogtle Project used the ratio of Actual Hours Spent divided by the Hours Earned and a CPI of greater than 1.0 is unfavorable, and a CPI of less than 1.0 is favorable.

819. In the SNC Plant Vogtle Units 3 and 4 Project Execution Plan, SNC underlined the importance of a favorable CPI stating XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[589]

820. An important application of the CPI is its use as part of any ETC calculations including the Total to Complete Performance Index (TCPI). PMBOK defines TCPI as the following:

> *An earned value management measure that estimates the cost performance required to meet a specified management goal. TCPI is expressed as the ratio of the cost to finish the outstanding work to the remaining budget.*[590]

821. When TCPI is calculated based on an established budget, past performance CPI can serve to establish the feasibility of the TCPI level being achieved in the remaining work. If a significantly improved performance from the work that has already been completed is required to meet the established budget, that budget no longer becomes feasible. At this point, management needs to establish a new budget to complete this work based on a realistically achievable CPI performance. This is important as inaccurate or unreasonable CPI estimates for ETC calculations can significantly underestimate true EACs.

822. CPI also plays an important role in the completion of variance analysis, which is a critical aspect of project management for a successful project.

> *Variance analysis can be used as a tool that allows the project team to forecast more realistically, based on the project's demonstrated history with productivity rates, communication between subcontractors, ability to meet milestones, design quality and other project factors. In fact when calculating the estimate at completion (EAC) for the project, the trends and variances to cost and schedule should be reviewed as a primary*

[588] It should be noted that in some industry guidance's, a value less than 1 indicates that costs are running over budget. In this case, the parties were measuring it as a value above 1 was indicative of costs running over budget.
[589] April 2018, SNC Plant Vogtle Units 3&4 Project Execution Plan, Version 8.1, page 15.
[590] A Guide to the Project Management Body of Knowledge, PMBOK Guide, Seventh Edition, 2021, page 105.

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basis. This retrospective project analysis allows more accurate forecasting of the expected final cost and completion date.[591]

The VAR can be a useful document to the entire project team when it is correctly analyzed and the necessary follow-up actions are taken. The VAR contains:

- *Information on the root causes of the variance.*
- *Identification of any corrective actions or mitigation actions required.*
- *Identification of changes to the budget at completion (BAC), estimate at completion (EAC) or estimate to completion (ETC).*
- *Documentation of any management actions*[592]

823. Therefore, it is important that this metric and its use in the planning of future EACs and the ETC to complete the project are properly analyzed, calculated, and applied.

6.2.2.3 Summary of Findings of CPI Trends

824. Generally, throughout the Project, there was a trend of increasing CPI, corresponding with a deteriorating performance factor. Despite this apparent trend of declining cost performance, SNC continued to forecast and manage the Project based on unachievable ETC productivity and cost performance rates. As a result, SNC's EACs were consistently unrealistic, unachievable, and unreliable. Regardless, SNC reported forecasted EACs with these unrealistic CPIs.

Contemporaneous Analysis and Feedback

825. The unrealistic planned cost performance on remaining work is supported contemporaneously by a productivity study by the Vogtle Monitoring Group (VMG) which found that the Bulk Commodity installation rates being utilized to plan and forecast the estimate to complete the Project as part of the April 2019 Baseline were:

significantly lower than the experienced rates.[593]

826. Experienced rates from the time Bechtel started on the Project in October 2017 through the time that this study was completed were found to be between 46 percent and 271 percent higher than

[591] AACE International Recommended Practice, 86R-14, Variance Analysis and Reporting, Rev. October 19, 2015, page 1.
[592] AACE International Recommended Practice, 86R-14, The Authority for Total Cost Management, Recommended Practice No. 86R-14, Variance Analysis and Reporting, Rev. October 19, 2015, pages 1-2.
[593] November 22, 2019, Direct Testimony of Don Grace, VCM 20/21, page 8.

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the planned rates. This analysis lead VMG to conclude:

> *…the primary reason for our determination that the **April 2019 Baseline is unreasonable**, among others, is that the Integrated Project Schedule ("IPS") is **too aggressive** and the a**ssumed commodity installation unit rates** (electrical, piping, supports, etc.) are **not based on what craft labor ("Craft") has been able to achieve to date.** Furthermore, we see no indication that SNC will be able to sufficiently improve performance of craft labor to achieve the unit rates assumed in the April 2019 Baseline.* [594] ***[Emphasis Added]***

827. One example of the unrealistic planned rates utilized for Unit 3 were in VCM 20 and shown below.[595]

Table 1

Vogtle Unit 3; Planned and Actual Bulk Commodity Installation Rates				
Bulk Commodity	Unit of Measure	Actual Rates October 2017 – March 2019	Planned Rates in April 2019 Schedule Baseline	Actual Rates October 2017 – Sep 2019
		Column 3	Column 4	Column 5
Piping				
Large Bore Pipe	Hours / LF	11.74	6.49	11.75
Large Bore Pipe Supports	Hours / each	108.35	123.61	107.95
Small Bore Pipe	Hours /LF	3.45	2.72	3.97
Electrical				
Conduit	Hours / LF	1.98	1.95	2.87
Cable Trays	Hours / LF	3.71	2.39	4.23
Cable Tray Supports	Hours / each	63.10	46.64	64.79
Cable	Hours / LF	0.36	0.10	0.33
Terminations	Hours / each	2.67	0.72	2.67
Bases of Above Rates				
1. Actual Rates, October 2017 – March 2019: Equals hours spent divided by quantities earned and was derived from numbers in the Bechtel March 2019 Updated Monthly Status Report page 142.				
2. Rates Used in April 2019 Schedule Baseline: Planned Hours divided by new baseline quantities and was derived from the Bechtel April 2019 updated monthly status report, page 145.				
3. Actual Rates, October 2017 – Sept 2019: Again, equals hours spent divided by quantities earned, and was derived from the Bechtel September 2019 Updated Monthly Status Report pages 200.				
4. "LF" denotes "Linear Foot"				

828. Further, the VMG contemporaneous productivity study reported that Bechtel had achieved an exceedingly poor cumulative CPI of approximately 1.53 from its Project start to April 2019.[596]

829. While Bechtel and SNC repeatedly failed to achieve planned CPI, project management failed to understand the drivers of these failures, how to remediate them, and ultimately forecasted that

[594] November 22, 2019, Direct Testimony of Don Grace, VCM 20/21, page 4.
[595] November 22, 2019, Direct Testimony of Don Grace, VCM 20/21, page 9.
[596] November 22, 2019, Direct Testimony of Don Grace, VCM 20/21, page 12.

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performance would improve despite observed trends pointing to a continued decline. Specifically, the VPMB comprised of representatives from each of the members of the ownership group, identified in the monthly progress presentations that production had not achieved expectations and CPI was deteriorating month-over-month, and yet continued to forecast an improvement in CPI in each of the months to come.

830. For example, in June 2021, the VPMB Presentation forecasted CPI for both Unit 3 and 4 to improve despite a continuous declining trend, signified by a negative slope shown in the excerpt below. While the Unit 4 CPI is observed to remain relatively stable, even including small improvement at various points in time (i.e., 0.01 from January to February and 0.02 from April to May), the Unit 4 CPI is predicted to improve by almost 0.5 in the next month.[597]

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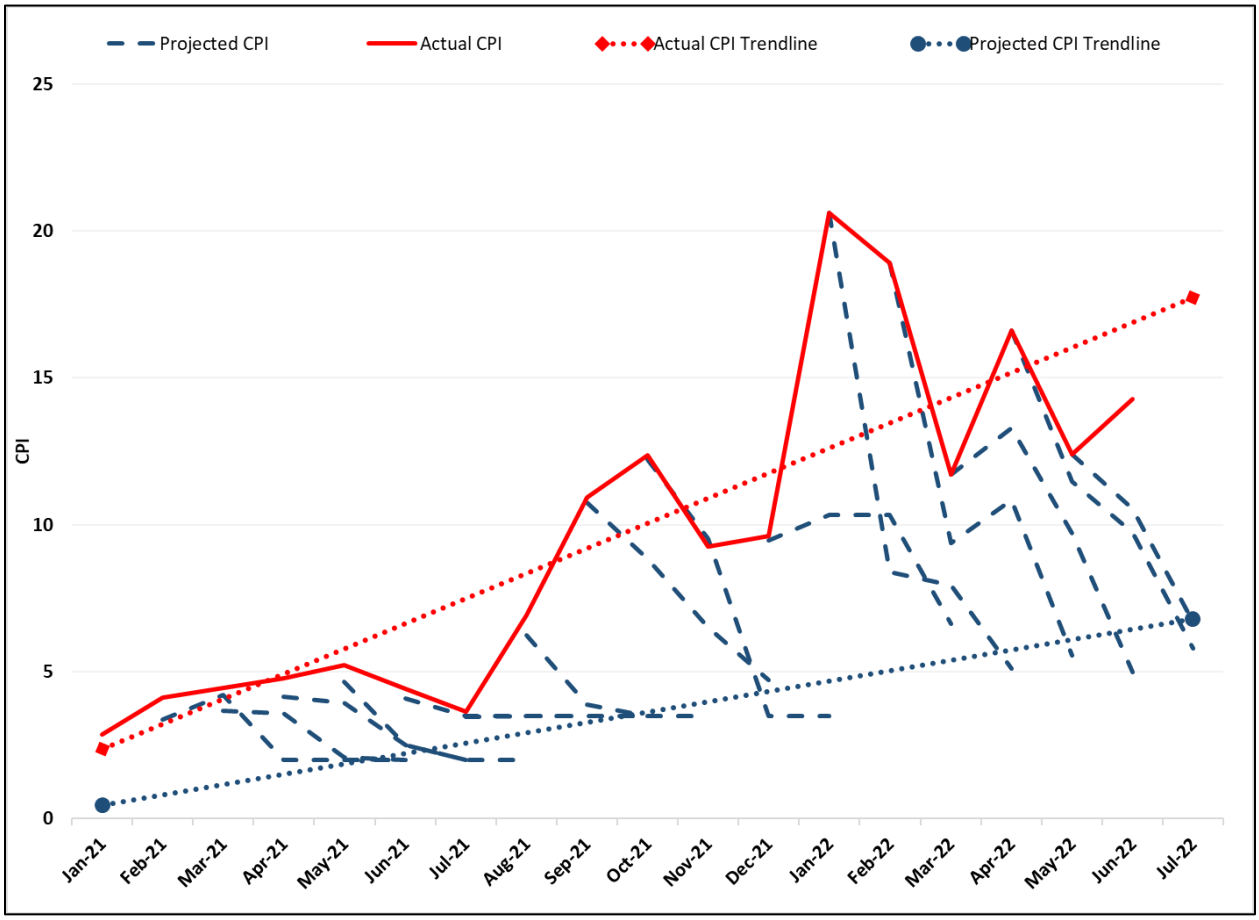
831. Based on review of the Project documents, it appears that the Company, SNC, and Bechtel were incorrectly using CPI as productivity factor. As noted in this Report and industry guidance, these two metrics, while similar in trends, measure different variables.

[597] June 30, 2021, Plant Vogtle Units 3&4 Project Management Board presentation, page 15.

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832. J.S. Held analyzed the CPI reported in the VPMB presentations, as shown above, over time against the monthly forecasted CPI values reported in the VPMB presentations and found the practice demonstrated above was utilized on an almost monthly basis. The results of the analysis for Unit 3 are shown below in **Figure 6.2-5 Unit 3 Reported CPI Over Time**.

Figure 6.2-5 Unit 3 Reported CPI Over Time

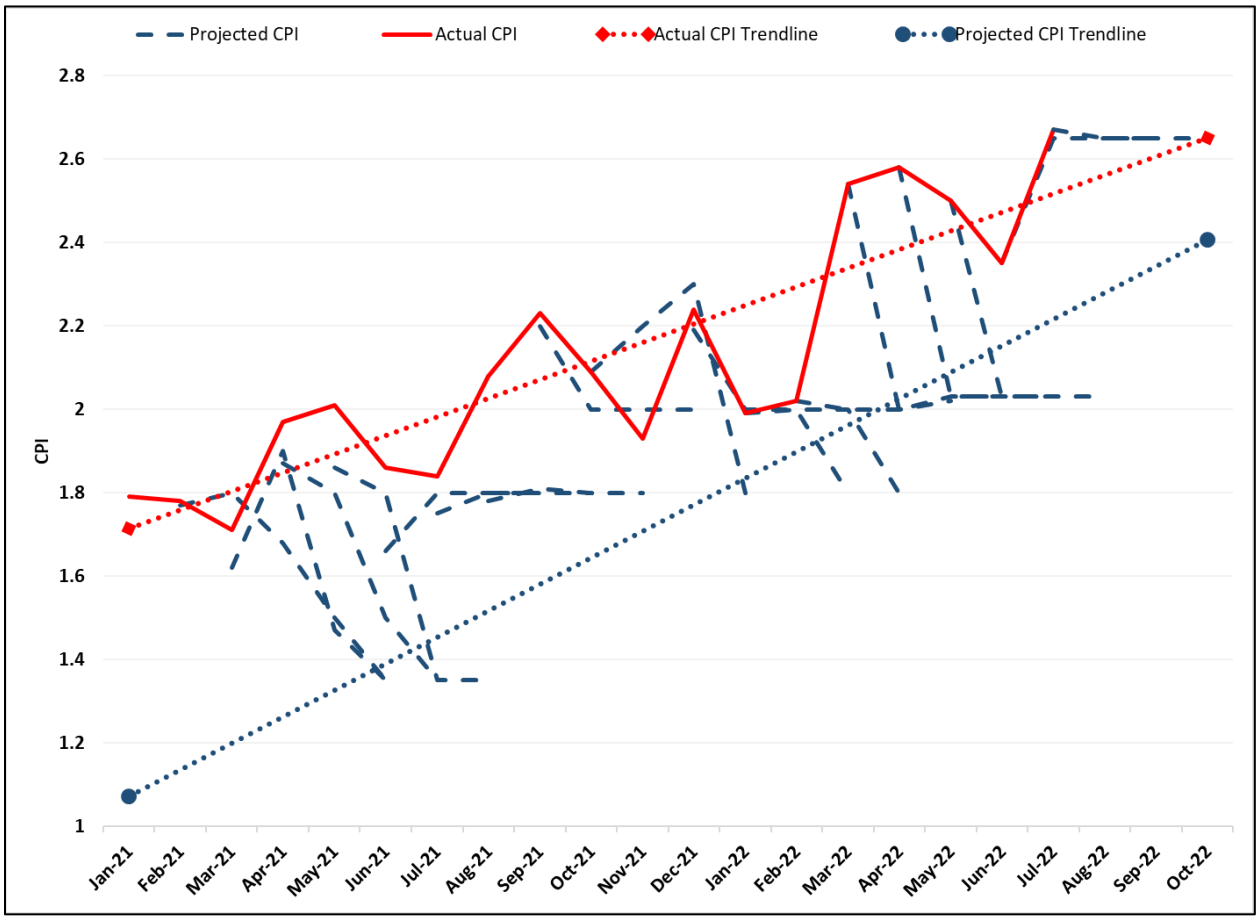


833. As shown above, the month-over-month CPI projections were consistently overly optimistic and unachievable. The actual CPI for each period (shown as the solid red line above) was consistently higher than what was being projected each month (the dashed blue line shown above). This trend of over projecting a better CPI in the ETC creates a visual wave over time as shown above. A simple trend line for both sets of data including the actual CPI (the dotted red line) and projected CPI (the dotted blue line) is shown for illustrative purposes. The trend line for actual CPI shows a steeper slope than the projected CPI trend line, showing that SNC was unable to properly address and forecast reasonable CPI projections compared to the actual site conditions. Similar trends were

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observed in Unit 4, shown in **Figure 6.2-6 Unit 4 Reported CPI Over Time** below, although the overall performance from Unit 3 to Unit 4 is improved.

Figure 6.2-6 Unit 4 Reported CPI Over Time



834. As a whole, the Unit 4 CPI is better in comparison to Unit 3. However, as with Unit 3, the actual CPI for each period (shown as the solid red line above) was consistently higher than what was being projected each month (the dashed blue lines shown above). As of July 2022, the reported Unit 4 CPI is 2.65 versus 14.28 for Unit 3.

835. Overall, in both Units 3 and 4, the actual CPI value consistently increased over time and was significantly higher than the projected CPI values on a month-over-month basis, showing a failure to properly address performance issues and adjust CPI projections to be more achievable. This ultimately led to the failure in management of the project by not communicating or utilizing actual data to make informed business decisions.

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836. In both Units, a trend of increasing CPI with projected improvements resembles a wave as shown above in **Figures 6.2-5 and 6.2-6**. This "wave" is reminiscent of the "*'future bow wave' of work*"[598] referenced by Don Grace in his VCM 20/21 Testimony. Grace refers to the "bow wave" as representing the rescheduling of work planned for completion at an earlier date and then re-planning/adding it to already planned future work. This is shown primarily in the repackaging of work packages designated for turnover to a later planned date and partial release to testing of systems that creates a significant variance from the baseline schedule. These work plan variances, creating the bow wave, impact productivity through the creation of various factors including stacking of trades, reassignment of manpower, concurrent operations, dilution of supervision, joint occupancy, and ripple, defined in the Mechanical Contractors Association of America (MCAA) Management Methods Manual. MCAA states on average that each of the above productivity impact factors can individually create percent of loss factors of 20%, 10%, 15%, 15%, 12%, and 15%, respectively.[599] Combined these individual productivity impact factors could create a significant loss of efficiency.

837. In certain cases, failure to achieve productivity and cost performance goals can be quantified as an approximate dollar cost impact. The AACE RP 25R-03 Estimating Lost Labor Productivity in Construction Claims states:

> *… earned hours are then compared to the actual hours expended for the period of the impact and the difference between the two may be used to calculate the productivity loss experienced. Earned value measurement of contemporaneous project documentation, such as percentages complete from schedule updates or payment applications can assist with calculating labor productivity.*[600]

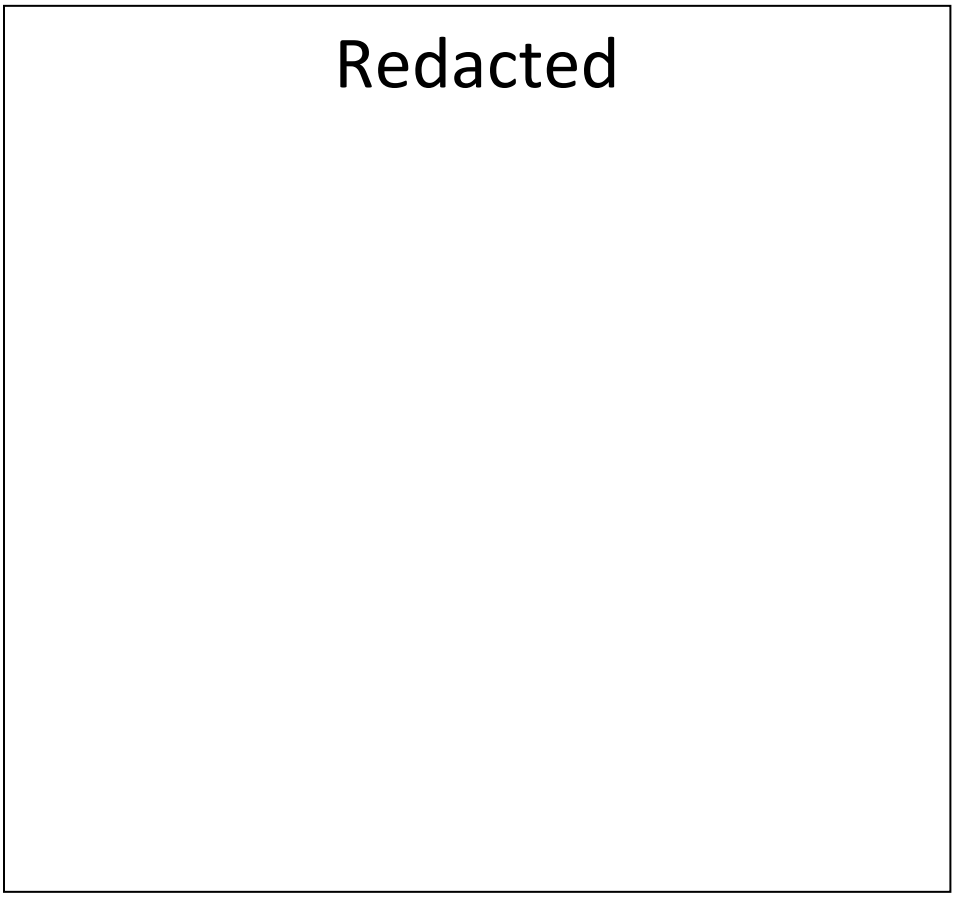
838. The VPMB presentations often attempted to estimate the cost impact of the failure to achieve the projected CPI. For example, in the June 2021 VPMB presentation, the VPMB estimated that per 20 points of missed CPI forecast for Unit 4 (one point of CPI is equivalent to one hundredth, i.e. 0.01 CPI), an approximate impact of $95 million would be added to the Project EAC. Similarly, for Unit 3, the VPMB estimated an approximate impact of $20 million per 15-20 points of missed CPI

[598] November 22, 2019, Direct Testimony of Don Grace, VCM 20/21, page 13.
[599] Mechanical Contractors Association of America, MCAA, Management Methods Manual, 2015, Bulletin No. PD2 Revised, Factors Affecting Labor Productivity.
[600] AACE International Recommended Practice, 25R-03, Estimating Lost Labor Productivity in Construction Claims, Rev. April 13, 2004, page 13.

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forecast.[601]

839. The VPMB summarized the cost impact of a range of forecasted achieved CPI in the *Total Incremental Cost Risk to Base Estimate Matrix View* table included in the June 2021 VPMB presentation, below. [602]



840. The VPMB targeted a best-case scenario of 2.1 to-go CPI for Unit 3 and 1.4 to-go CPI for Unit 4 with an unrealistic finish date of January 2022 for Unit 3 and August 2022 for Unit 4. The CPIs recorded in Units 3 and 4 in the month prior to this forecast were 4.65 and 1.86, respectively. Had SNC used more realistic, historically supported CPIs, such as the CPIs achieved in the month prior, along with the most reasonable target finish date presented in its table, June 2022 for Unit 3 and February 2023 for Unit 4, the EAC would have been impacted by an at least XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

[601] June 30, 2021, Plant Vogtle Units 3&4 Project Management Board presentation, page 17.
[602] June 30, 2021, Plant Vogtle Units 3&4 Project Management Board presentation, page 17.

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increase.[603,604]

841. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[605] XXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[606]

842. Bechtel XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*[607] XXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX* XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[608]

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843. Bechtel would XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX* XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX* *XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*

844. Separate from these XXXXXXXXXXXX requests, Bechtel tracked XXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX[609]

603 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

604 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

605 September 2022, Bechtel's Vogtle Units 3&4 Construction Completion Monthly Status Report, page 9.

606 September 2022, Bechtel's Vogtle Units 3&4 Construction Completion Monthly Status Report, pages 61-62.

607 April 20, 2021, letter 26139-000-TC-GAM-00304, from Bechtel to GP and SNC, Subject: 2020 COVID-19 Impact Evaluation – Change Order Request.

608 April 20, 2021, letter 26139-000-TC-GAM-00304, from Bechtel to GP and SNC, Subject: 2020 COVID-19 Impact Evaluation – Change Order Request, page 25.

609 August 2018, Bechtel's Vogtle Units 3&4 Construction Completion Monthly Status Report, page 6.

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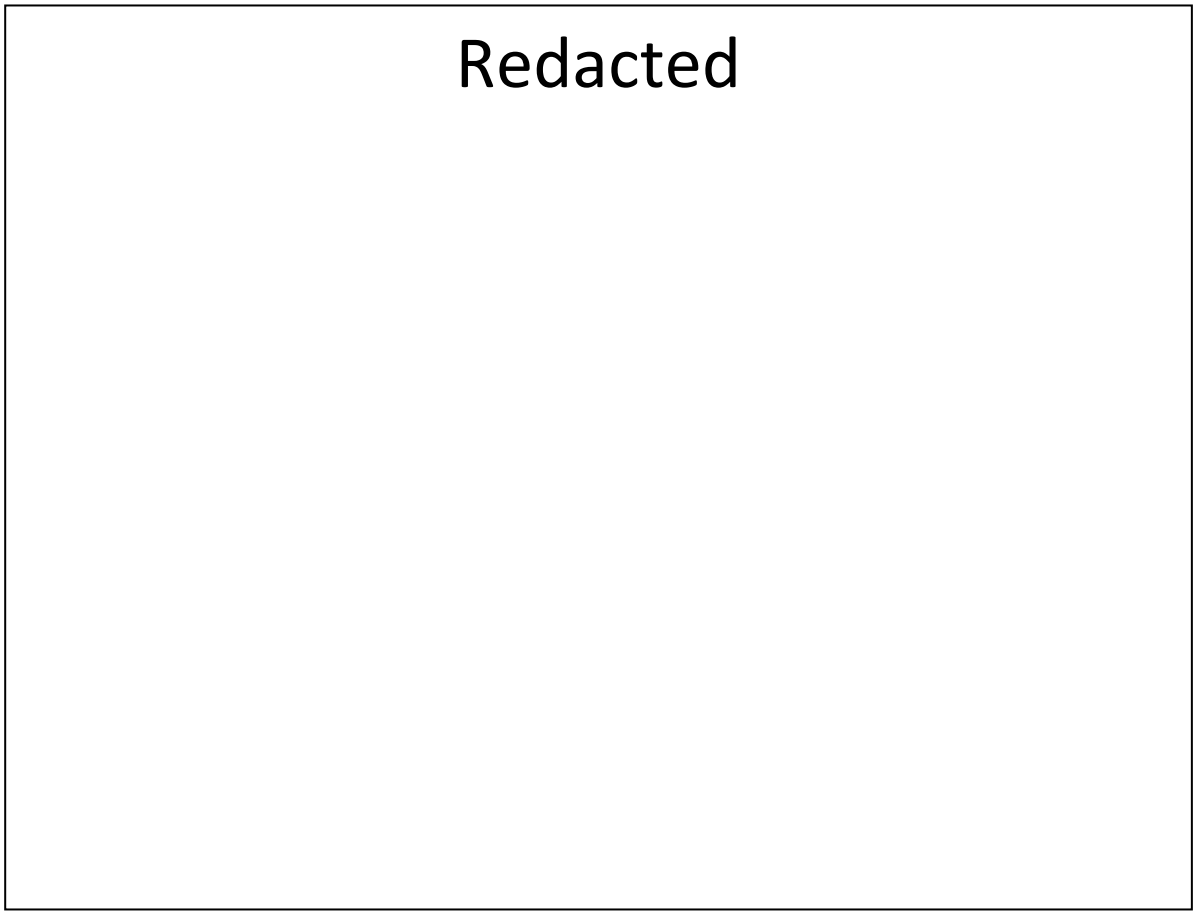


845. The same data was included within subsequent MSRs through September 2022, with the exceptions of January 2020 and April 2020, although it was noted that each successive update did not reconcile exactly with the previous month update, representing another management failure.

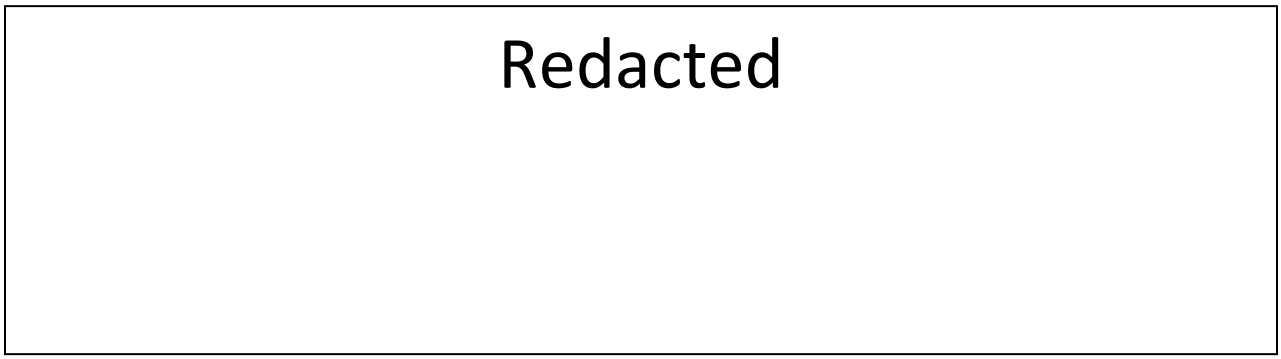
846. The cumulative lost hours reported in the Bechtel MSRs for the period of August 2018 through August 2022 are shown in **Figure 6.2-7 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXl**, below.

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Figure 6.2-7 XXXXXXXXXXXXXXXXXXXXXXXXX



847. As of the September 2022 MSR, Bechtel had reported a total value of nearly XXXXX million lost hours, equating to a direct cost of approximately XXXX million reported by Bechtel and shown below in the excerpt. Bechtel utilized a blended labor rate of approximately XXXXX per hour to calculate the total

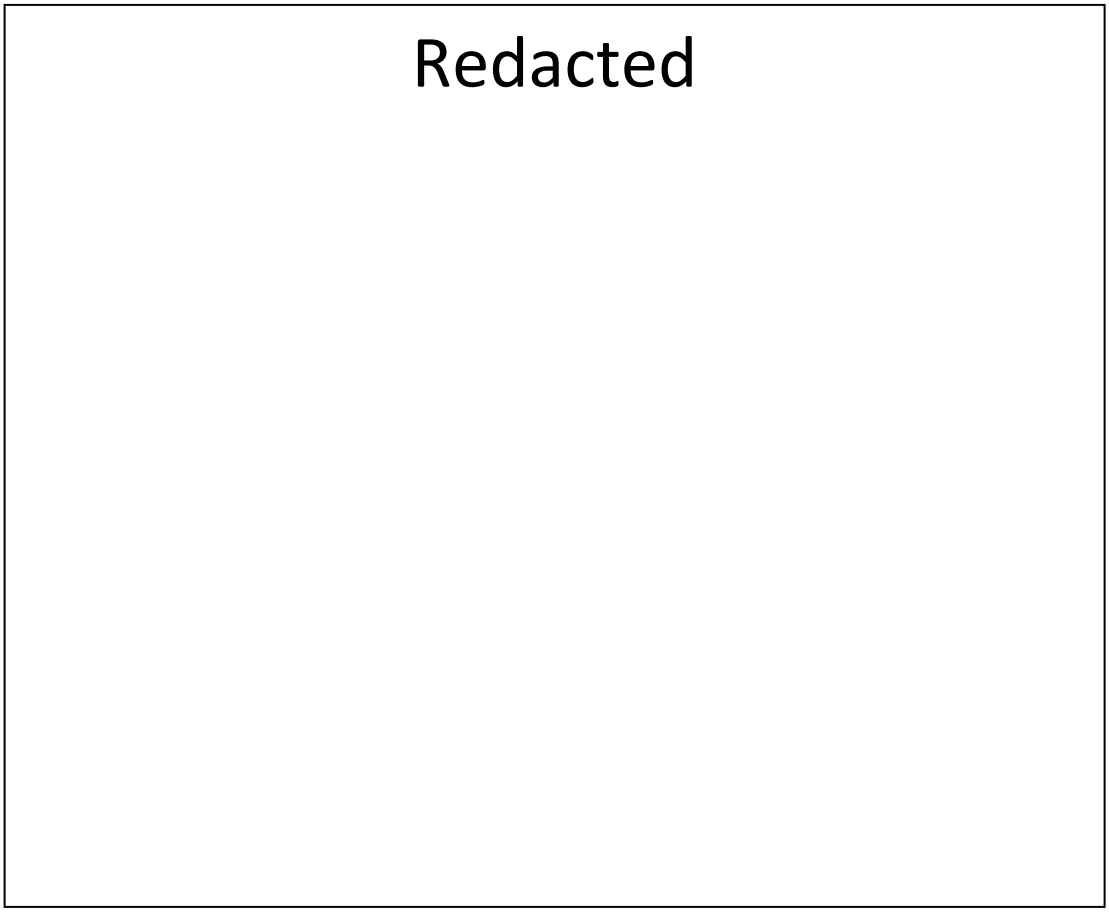


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cost impact of the XXXXXXXXXX[610]

848. **Figure 6.2-8** below shows a monthly perspective of the "Lost Hours" reported by Bechtel.

Figure 6.2-8 XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX



849. October 2021 represents the peak month in increase in "Lost Hours" with approximately XXXXXXXXX hours. Utilizing the same blended labor rate of XXXXXXXXXXXXX per hour used by Bechtel above, the approximate cost impact in XXXXXXXXXX alone was approximately XXXXXXXXXXX

850. Ultimately, SNC and Bechtel **were aware of the poor CPI estimates** and continued decline in efficiency yet failed to properly address the underlying issues and improve the accuracy of their estimates in a timely manner. See below for an example of SNC and Bechtel's contemporaneous understanding of the failure to achieve unrealistic CPI values.[611]

[610] September 2022, Bechtel's Vogtle Units 3&4 Construction Completion Monthly Status Report, pages 61-62.
[611] July 28, 2021, Plant Vogtle Units 3&4 Project Management Board, page 56.

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851. Bechtel's reporting shows it anticipated an improvement in CPI from 1.9 to 1.3 by the end of June 2021. Time and again, Bechtel forecasted unrealistic CPI improvements such as the approximately 60 percent improvement above that are rarely achievable in a standard construction project, and even much less so in a nuclear construction project.

Over-Reporting Progress

852. A review of the VPMB presentations shows that on multiple occasions Bechtel and SNC realized that earned value of work to date was significantly over reported and a downward adjustment was necessary. For example, in the October 2020 VPMB presentation the earned hours were adjusted down by approximately XXXXXXXXXXXXXXXX. Additionally, there was an increase in direct hours of approximately XXXXXXXXX hours to complete the remaining scope. These changes coupled together correspond with an approximately XXXXXXX-hour change in the CPI calculation. Another example is in Bechtel's "*2020 COVID-19 Impact Evaluation – Change Order Request*", where Bechtel states that approximately XXXXXXXXXX XXXXXXXXX were over reported and that an adjustment was necessary

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during the pre-COVID period.[612] See the excerpt below, which details the October 2020 VPMB presentation changes.[613]

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853. In other cases, rather than adjusting the previously earned value downward, Bechtel and SNC added to-go (or ETC) labor hours. This addition effectively accomplishes the same task as adjusting previously earned labor hours down and proves to make the previously reported CPI values inaccurate. Refer to the excerpt below for an example of a to-go labor hour increase in the July 2020 VPMB presentation.[614]

Redacted

[612] April 20, 2021, letter 26139-000-TC-GAM-00304, from Bechtel to GP and SNC, Subject: 2020 COVID-19 Impact Evaluation – Change Order Request.
[613] October 28, 2020, Plant Vogtle Units 3&4 Project Management Board presentation, page 22.
[614] July 28, 2020, Plant Vogtle Units 3&4 Project Management Board presentation, page 15.

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854. Therefore, failure to properly understand and manage the CPI impacts the success of a project as an accurate CPI forecast is necessary for the development of an accurate EAC. Not only were the forecasted CPI values unreliable, Bechtel and SNC consistently had difficulty managing and reporting the earned value of work to date, and overreporting progress, meaning that the actual CPIs reported likely were unreliable as well.

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7 Acronym / Abbreviation List

Acronym / Abbreviation	Term
AA	Advance Authorization
AACE	Association for the Advancement of Cost Engineering International
AFR	Audit Finding Report
ASME	American Society of Mechanical Engineers
Bechtel	Bechtel Corporation
CAP	Corrective Action Program
CAR	Condition Action Record
CB&I	Chicago Bridge & Iron
CD	Calendar Day
CFC	Certified for Construction
CFR	Code of Federal Regulations
CHT	Cold Hydro Testing
CISA	Cybersecurity and Infrastructure Security Agency of the United States Department of Homeland Security
CMAA	Construction Management Association of America
COD	Commercial Operation Date
COL	Commission Combined License
Commission	Georgia Public Service Commission
Company	Georgia Power Company
CPM	Critical Path Method
CR	Condition Report
CV	Containment Vessel
CWA	Construction Work Authorization
Dalton	Dalton Utilities
DCD	Design Certification Document
DCMA	Defense Contract Management Agency
DOE	United States Department of Energy
E&DCR	Engineering and Design Coordination Report
EAC	Estimate at Completion
XXX	XXXXXXXXXXXXXXXXXXXXXXXXX
EOC	Extent of Condition
EPC Agreement	Engineering, Procurement and Construction Agreement
ESP	Early Site Permit
ESR	Engineering Service Requests
ESSOW	Engineering Services Scope of Work
ETC	Estimate of Completion

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Acronym / Abbreviation	Term
Fluor	Fluor Corporation
FNC	First Nuclear Concrete
FOAK	First of a Kind
HFT	Hot Functional Testing
HVAC	Heating / Ventilation/ and Air Conditioning
IE	Initial Energization
IEEE	Institute of Electrical and Electronics Engineers
IF	Integrated Flush
IFC	Issued-For-Construction
INPO	Institute of Nuclear Power Operations
IPS	Integrated Project Schedule
IR	Inspection Records
ITAAC	Inspections, Tests, Analyses, and Acceptance Criteria
ITP	Initial Testing Program
J.S. Held	J.S. Held LLC
Kenrich	The Kenrich Group LLC
Kenrich ETC Report	Analysis of Project Estimate-To-Complete
KPI	Key Performance Indicators
KPMG	Third-Party Firm
LOTO	Lock Out Tag Out
LWA	Limited Work Authorization
MCAA	Mechanical Contractors Association of America
MCR	Main Control Room
MEAG	Municipal Electric Authority of Georgia
MPR	Monthly Project Review
MSRs	Monthly Status Reports
MW	Megawatts
MWh	Megawatt Hours
ND	Nuclear Development
NDQA	Nuclear Development Quality Assurance
NDQAM	Nuclear Development Quality Assurance Manual
NRC	United States Nuclear Regulatory Commission
OPC	Oglethorpe Power Corporation
OVT	Open Vessel Testing
P6	Primavera
PEP	Project Execution Plan
PF	Productivity Factor
Plant Vogtle	Alvin W. Vogtle Electric Generating Plant
PMBOK	Project Management Body of Knowledge

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Acronym / Abbreviation	Term
PMI	Project Management Institute
PMO	Project Management and Organization
POD	Plan of the Day
Project	Plant Vogtle Units 3 and 4 Nuclear Project
PRT	Partial Release for Test
PwC Report	Quantitative Risk Assessment
QA/QC	Quality Assurance and Quality Control
QURR	Quantity Unit Rate Report
RCC	Richmond County Constructors
RCD	Root Cause Determination
XXXXX	XXXXXXXXXXXXXXXXXX
RM	Risk Management
RMWG	Risk Management Working Group
RP	Recommended Practices
XXX	XXXXXXXXXXXXXXXXXX
SMS	Shaw Modular Solution
SNC	Southern Nuclear Operating Company
SNC Project Management Report	Project Management Cost Packages
SPI	Schedule Performance Index
Staff	Commission Staff
Stone & Webster	Stone & Webster Inc.
TCPI	Total to Complete Performance Index
TDL	Technical Document List
Toshiba	Toshiba Corporation
TPG	Toshiba Parent Guarantee
Trend Report	Vogtle 3 & 4 Aggregate Trend Report
VCM	Vogtle Construction Monitoring
VCRB	Vogtle Construction Review Board
VEOC	Vogtle Execution Oversight Committee
VIAM	Vogtle Initial Test Program Administrative Manual
Vitale	Vitale & Associates
VMG	Vogtle Monitoring Group
VPEP	Vogtle Project Execution Plan
VPMB	Vogtle Project Management Board
WEC	Westinghouse Electric Company LLC
WP	Work Package

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8 Attachment List

Attachment	Description
1	Curriculum Vitae of J.S. Held Engagement Personnel
2	Project Performance Curves and Calculations
3	Bibliography - Industry Practices and Treatises

Disclaimer and Reservation of Rights

"Should you have any questions regarding the findings or opinions expressed in this report, please advise.

Additional information may be material to this analysis. However, the documentation and information that was available allowed J.S. Held to reach the conclusions stated herein to a reasonable degree of certainty. J.S. Held reserves the right to supplement this Report, and the opinions expressed, and the observations made, upon receipt of additional information.

This Report has been prepared for the use of Counsel. J.S. Held is not responsible for the conclusions, opinions, or recommendations made by others based on the information in this Report. J.S. Held has made every effort to perform a thorough assessment within the focused scope defined."

End of Report

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