Watts Bar Nuclear Plant
Unit 2 Completion Project

Estimate to Complete
Executive Final Report
April 2012

Estimate to Complete - Executive Final Report
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Section 1

Estimate to Complete
Summary of Results

Problem Statement

The Watts Bar Nuclear Unit 2 (WBN2) Completion Project was approved by the Board in August of 2007. Approval was based on a Detailed Scoping, Estimating and Planning (DSEP) document prepared for the project. However, the project was not successful in meeting the milestones outlined in the project approval. Previous efforts at project recovery were not successful.

The Estimate to Complete (ETC)

In 2011, a new management team was established to get the project back on track. The team took immediate corrective action to improve project performance. The team also began the process of developing a new project completion estimate, the Estimate to Complete (ETC).

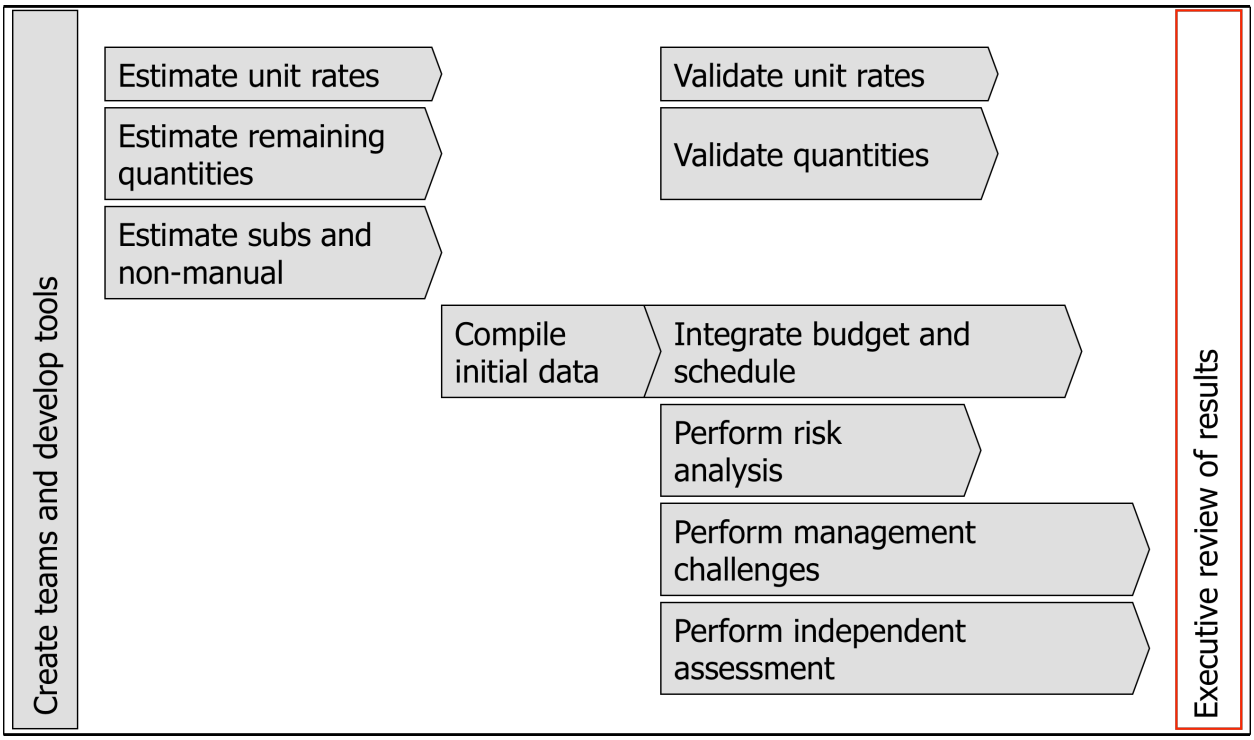
The ETC is the project forecast for completion of work for the remaining duration of the project. It includes detailed estimates for performance of direct work using known work commodities and estimated unit rates. Also included are estimates for subcontractors, non-manual support and material costs. The goal of developing the ETC is to provide a high confidence estimate containing the revised forecast schedule and cost.

How This ETC is Different

The WBN2 project has undertaken efforts previously to re-estimate the project. The estimates resulting from those efforts did not provide a reliable estimate that supported actual project performance. The following additional actions were undertaken to ensure the quality of this ETC:

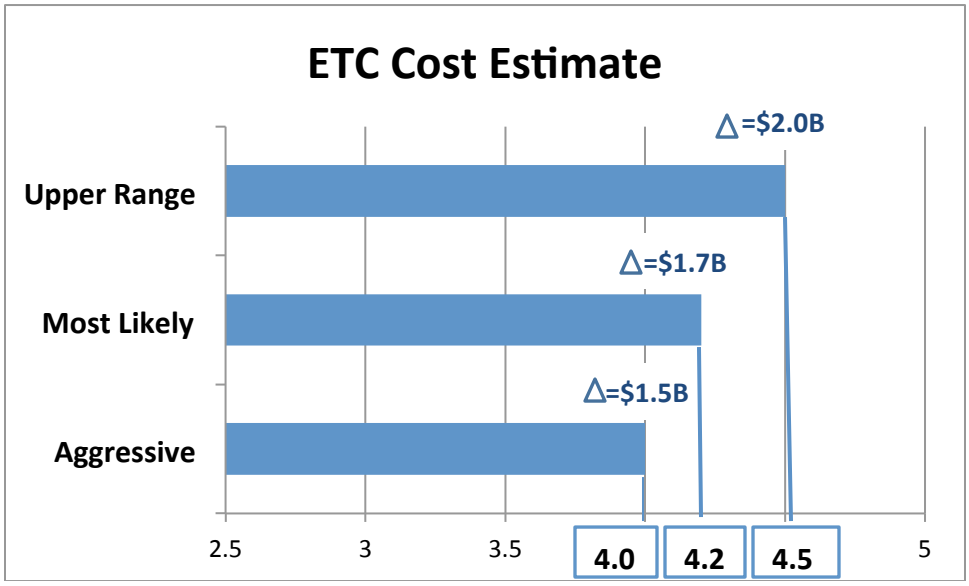
- This ETC was a consensus led effort by TVA and the contractors involved with the project.
- Multiple and redundant data sources were used to develop estimates
- The basis for commodity estimates was subjected to formal management challenge teams
- Databases were created to capture the information and data owners were assigned to maintain integrity of the estimates and control changes
- Engineering “to be issued” designs were identified, estimated, and included in the ETC
- Estimates were prepared and included for all sub-contracts, support organizations, and non-manual tasks
- Risk rankings were established for all unit rates in order to provide a risk based contingency and management reserve
- Detailed monitoring reports and performance improvement activities have been implemented
- Independent assessments were used to provide oversight and a high level of confidence

ETC Process Flow Chart



ETC Results

Cost Results



Schedule Results

	Fuel Load	Initial Criticality	Commercial Operation
Most Likely	**Jun. 2015**	**Sept. 2015**	**Dec. 2015**
Aggressive	**Mar. 2015**	**Jun. 2015**	**Sept. 2015**

Feasibility Analysis

For a project of the size and complexity of WBN2, a risk profile must be established in order to describe the feasibility of completing the project as estimated. The analysis considers risks such as potential changes in production rates, delays due to equipment delivery and outstanding licensing issues, (i.e., Fukushima). Using these risks, a range of project estimates is developed to encompass the feasibility of achieving project completion goals. This range of estimates is described as follows:

- **Aggressive** - Achieving the aggressive estimate requires nearly perfect project execution. Contingency to account for risk is minimized. Implementing the aggressive plan would require a cash flow of up to $500M per year and craft resources that would exceed 700 personnel over a long period.
- **Most Likely** - This is the estimate that the project expects to achieve and is the most feasible. This estimate incorporates reasonable contingency items based on analysis and industry benchmarks. Implementing the Most Likely plan allows for a reduction in cash flow to a maximum of $450M per year. Further, craft resources are levelized such that higher levels of efficiency are maintained. While this plan is more feasible, it brings the unit on-line to meet projected power supply demands.

- **Upper Range** - In order to establish the upper range, a Monte Carlo analysis of risk distribution was performed. The purpose of the analysis was to establish the upper range of spending under a high risk scenario.

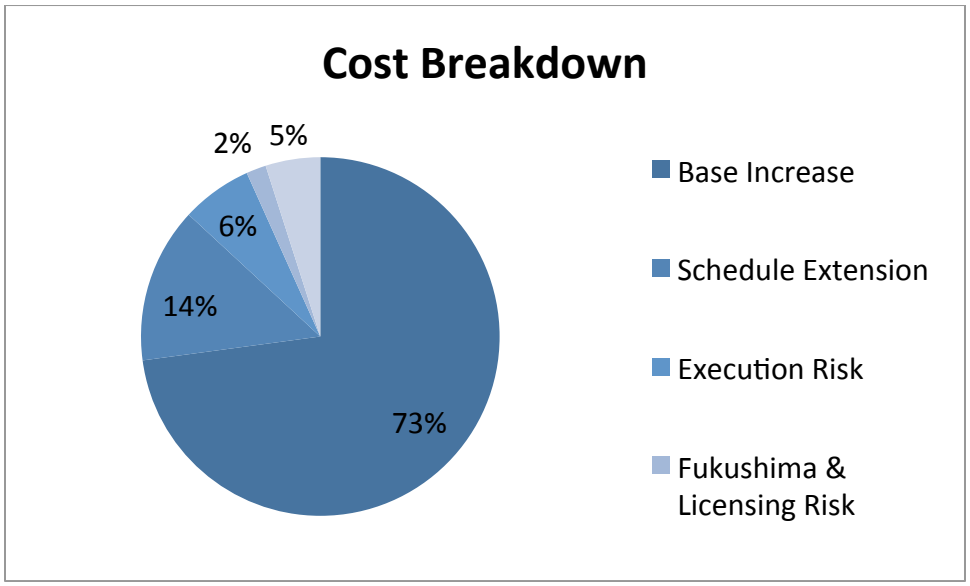
  An independent assessment of the estimate methodology was performed by *Highbridge and Associates*. The findings of this independent analysis are incorporated into the results above.

Spend Plan
The estimated spend plan required to achieve the Most Likely plan is as follows:

	FY12 ($M)	FY13 ($M)	FY14 ($M)	FY15 ($M)	FY16 ($M)
Most Likely	**500**	**500**	**500**	**500**	**116**

Note - includes Fukushima and Hydrology impacts.

Cost Increase Breakdown
Cost increases for the Most Likely scenario are compared below to the original DSEP estimate. This chart aids in defining the categories of the cost increase.

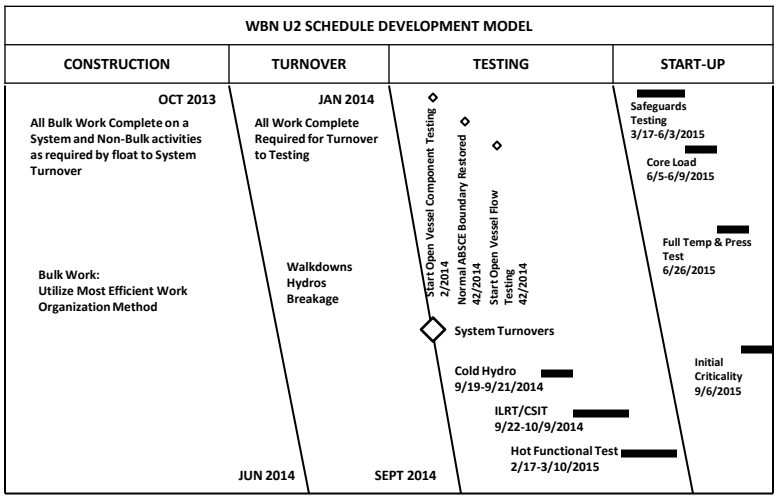


Project Implementation

The critical aspect of establishing schedule logic development is establishing the prerequisites for system turnover from construction to the startup test process for initial component testing. To accomplish this, detailed reviews were performed for each system with the responsible startup test engineer to validate that all of the existing work required for the system being reviewed was correctly tied to that system. This process will continue as each new work order generated will be reviewed by the engineer and coded in a controlled WITEL database, which scheduling uses as a basis for adding scope/logic to a specific system.

A transition window was established for each system. This window is a minimum of three months in duration and is scheduled to allow completion of bulk work to complete on each system prior to progressing into the turnover window. The turnover window will be focused on final system walk downs, breakage resolution, and construction testing and work document closure. The man-hours estimated for expected breakage on each system are scheduled during this three month timeframe.

A bulk work window has been established and is scheduled to complete prior to the transition window for each system. This window is designed to allow maximum efficiency in the organization and sequencing of work.



Root Cause Analysis

Causes
A root cause analysis was performed to provide an understanding of what caused the cost and schedule performance problems at WBN2. The Root Cause Team established the causes to fall into the following categories:

- Leadership - Organization and management capabilities misaligned with unique project characteristics
- Estimate - Lack of rigorous understanding of the work to be done led to low initial estimates and impeded planning
- Execution - Management did not execute a robust execution plan or fully utilize available capabilities
- Oversight - Inadequate oversight and project assurance

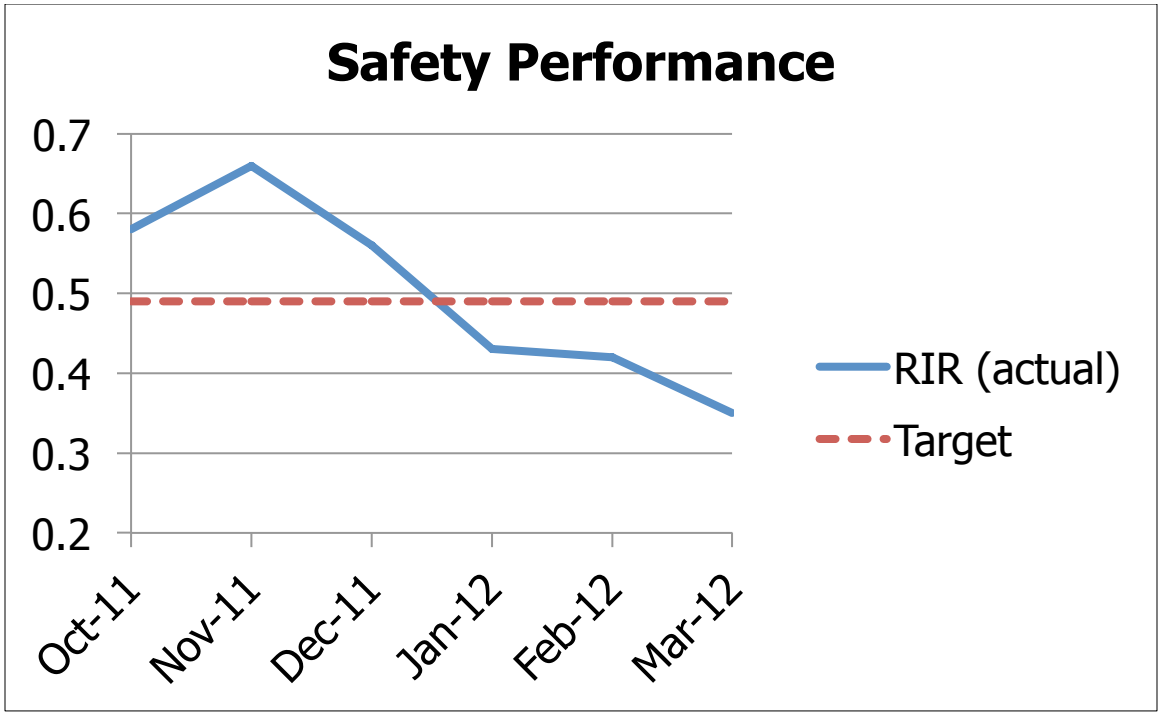
Corrective Actions
The following corrective actions have been undertaken to correct the findings of the root cause team:

- Improved quality and timing of planning documents
- Improved effectiveness of field engineering
- Established independent, integrated schedule and cost-monitoring tools
- Increased transparency of project performance
- Restructured project organization
- Improved craft morale
- Established process and oversight improvements
- Established a process to control project scope
- Initiate regular executive sponsor meetings
- Ensure buy-in of revised cost/schedule
- Streamline work package rebuilds
- Surface productivity measures
- Developed a new Estimate to Complete

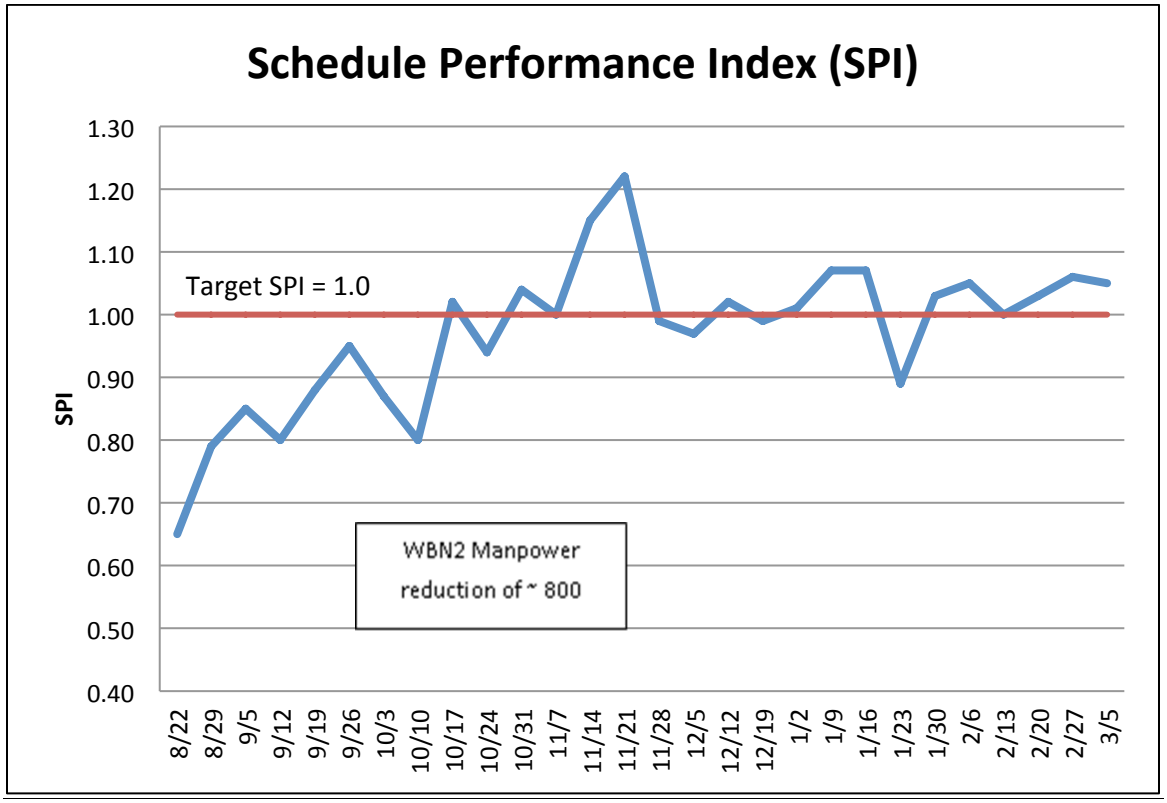
McKinsey & Co. performed an independent review of the root cause analysis. The findings of the independent analysis have been incorporated into the Root Cause Report and in the above.

Lessons Learned
The issues found and corrective actions performed are being incorporated into the Bellefonte project.

Effectiveness of Corrective Actions
Project monitoring indicators demonstrate project performance has improved. Additional project performance metrics are in the body of this document.



	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Acceptance %	98.1%	98.5%	97.6%	98.1%	97.6%	97.5%	98.1%	96.5%	97.0%	97.0%	96.5%	97.9%


Schedule Performance Index (SPI)
SPI
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
0.50
0.40
Target SPI = 1.0
WBN2 Manpower reduction of ~ 800
8/22
8/29
9/5
9/12
9/19
9/26
10/3
10/10
10/17
10/24
10/31
11/7
11/14
11/21
11/28
12/5
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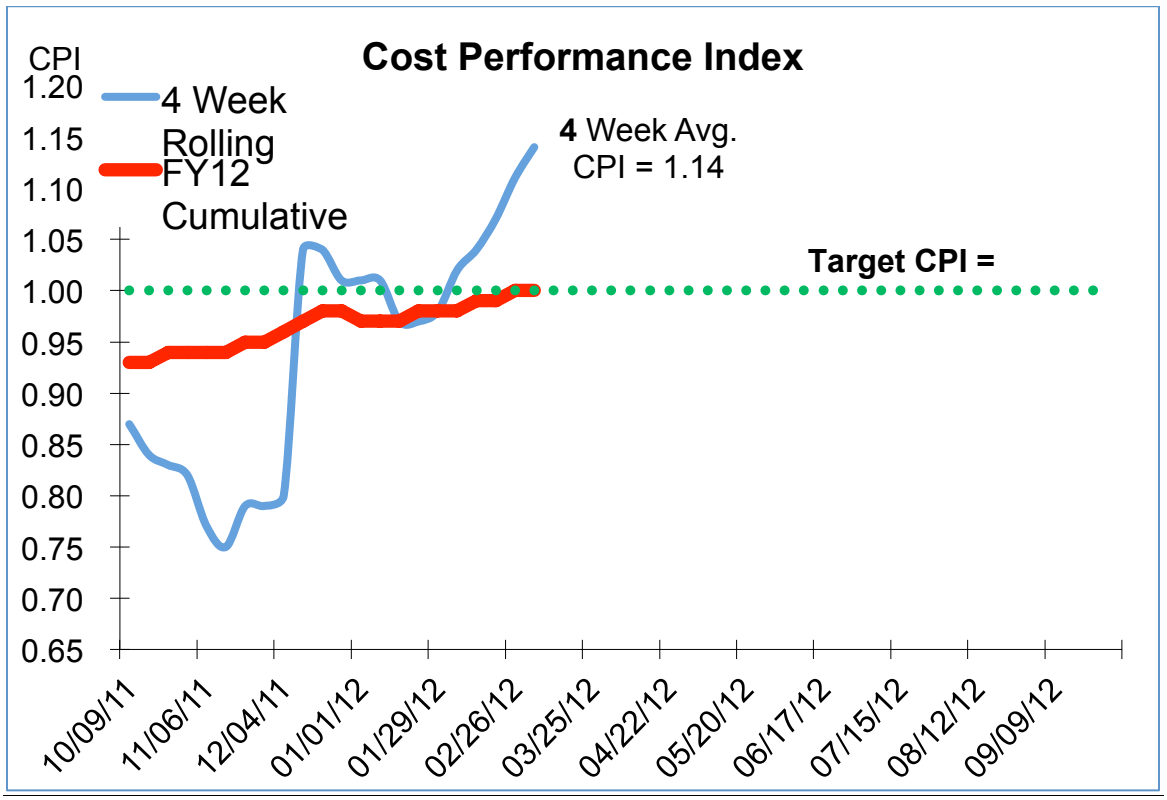
1/16
1/23
1/30
2/6
2/13
2/20
2/27
3/5

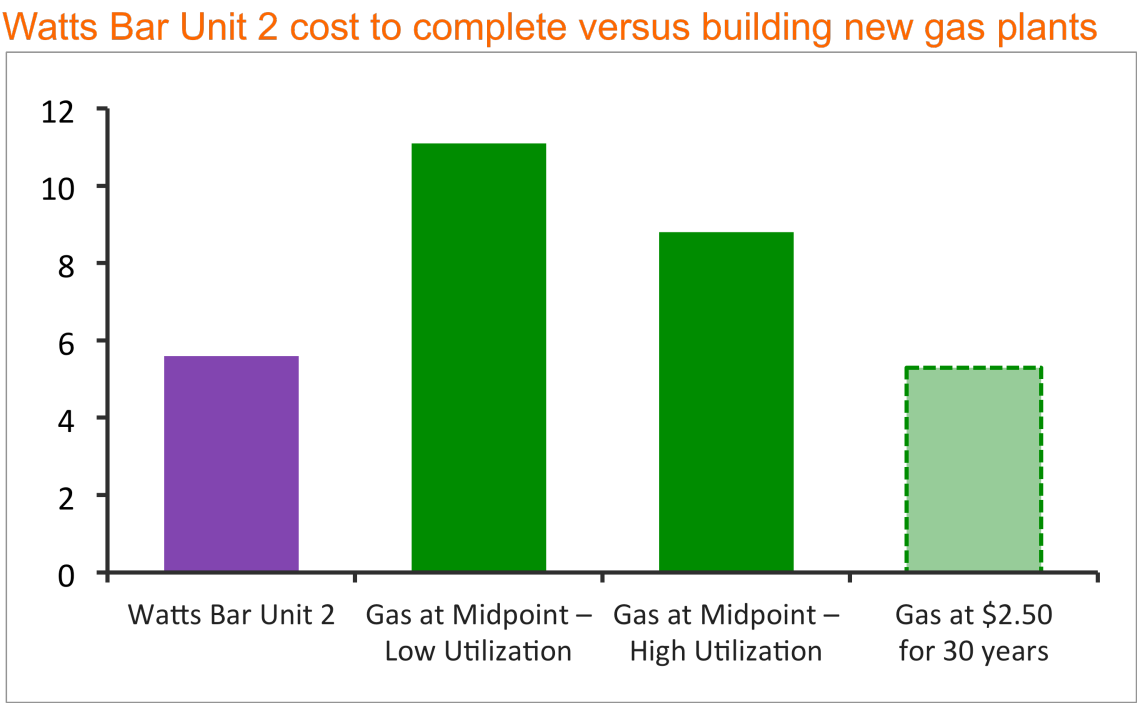

Cost Performance Index
CPI
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
4 Week Rolling
FY12 Cumulative
4 Week Avg. CPI = 1.14
Target CPI =
10/09/11
11/06/11
12/04/11
01/01/12
01/29/12
02/26/12
03/25/12
04/22/12
05/20/12
06/17/12
07/15/12
08/12/12
09/09/12

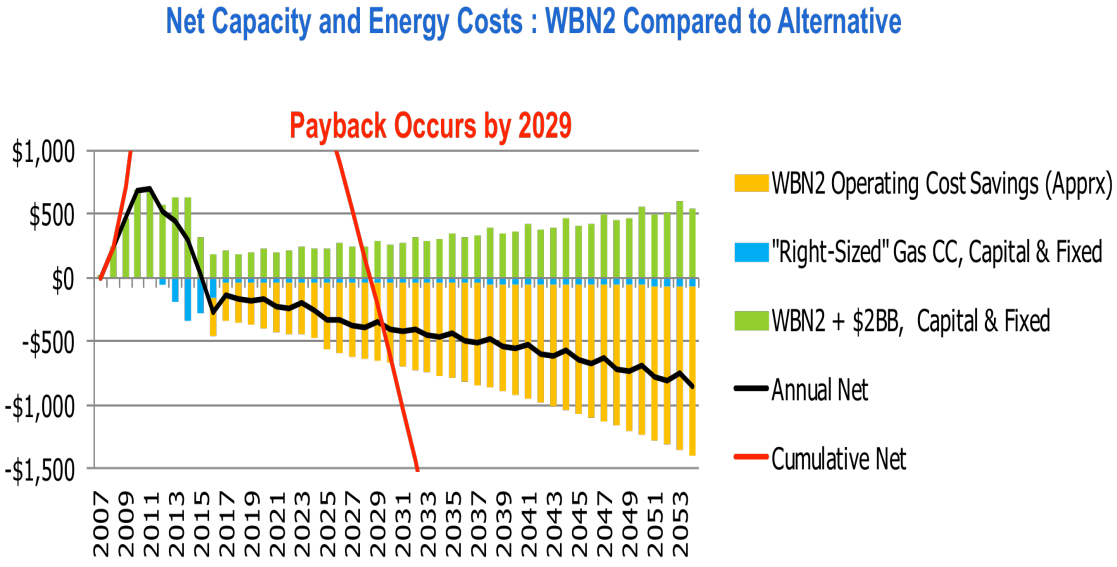
Project Cost Justification

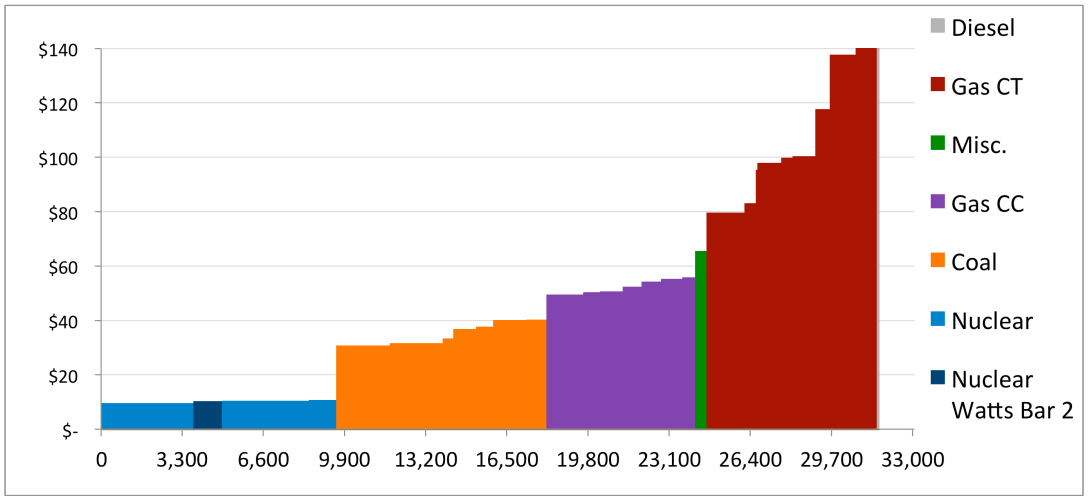
Cost analyses were performed to provide information on three aspects:

a) Cost comparison of WBN2 compared to building a new gas plant
b) Total capital investment and payback
c) Dispatch cost

Curves reflecting these analyses are below. The cost analyses indicate that WBN2 is a good alternative to provide base load capacity and maintain a diverse generation mix.







Summary

The WBN2 ETC was developed using extensive data gathering and analysis to provide a high confidence cost estimate and schedule for completion

A cause analysis was performed to understand the reasons for the project performance problems and corrective actions have been taken to resolve those problems

Independent assessments were used to increase the confidence level in the accuracy of the ETC effort

Completion of WBN Unit 2 remains a cost effective solution to providing additional base load capacity for the TVA Power System.

Project performance is improving under the new plan

Section 2

WBN2 Project Background

Introduction

TVA's third nuclear power plant, Watts Bar Nuclear Plant, is located on 1,700 acres on the northern end of Chickamauga Reservoir in eastern Tennessee. The plant was named for a sandbar at Watts Island that hampered navigation on the Tennessee River until it was flooded by Watts Bar Reservoir.

Groundbreaking on Watts Bar Nuclear (WBN) Plant occurred in 1972, with major construction beginning a year later. WBN Unit 1, the last commercial nuclear unit in the United States to come online in the 20th century, began commercial operation in May 1996. WBN Unit 1 is capable of producing 1,170 megawatts of electricity.

In August of 2007, following detailed studies of energy needs, schedule, costs, environmental impacts, and financial risks, TVA decided to complete construction of WBN Unit 2 to help meet the Tennessee Valley's growing demand for power.

WBN Unit 2 will be the first new reactor to achieve commercial operations in the U.S. since WBN Unit 1 in 1996. WBN Unit 2 will put an existing asset to work for TVA customers and will add 1,180 megawatts to the TVA power system.

Background Information

WBN Units 1 and 2 have a unique licensing history and regulatory framework. TVA received a construction permit for each unit in 1973 under 10 CFR Part 50. Construction proceeded until 1985, when WBN Unit 1 was thought to be essentially complete and nearly ready to receive an operating license.

As a consequence of the identification of a large number of deficiencies shortly before the WBN Unit 1 license was expected to be issued, the Nuclear Regulatory Commission (NRC) sent a letter to TVA on September 17, 1985, requesting information under 10 CFR 50.54(f), on TVA's plans to address the deficiencies for its operating and construction activities at Watts Bar and TVA's other nuclear facilities. In response to this letter, TVA developed a Nuclear Performance Plan (NPP) to address corporate and site-specific issues, establishing programs to address a wide variety of material, design, and programmatic deficiencies. WBN Unit 2 construction was suspended at about that time, with major structures in place and equipment such as reactor coolant system piping installed.

On October 13, 1999, TVA filed a request for extension of the completion date for WBN Unit 2, and by letter dated July 14, 2000, TVA informed the NRC that WBN Unit 2 meets the NRC's definition for deferred nuclear plant units as described in the Commission's Policy Statement on Deferred Plants, 52 FR 38077 (October 14, 1987). On October 24, 2000, the NRC issued an order extending the WBN Unit 2 construction permit to December 31, 2010.

TVA informed the NRC in a November 14, 2006, letter of its intent to perform a study of the feasibility of completing WBN Unit 2, with the goal of producing power from the reactor in 2013.

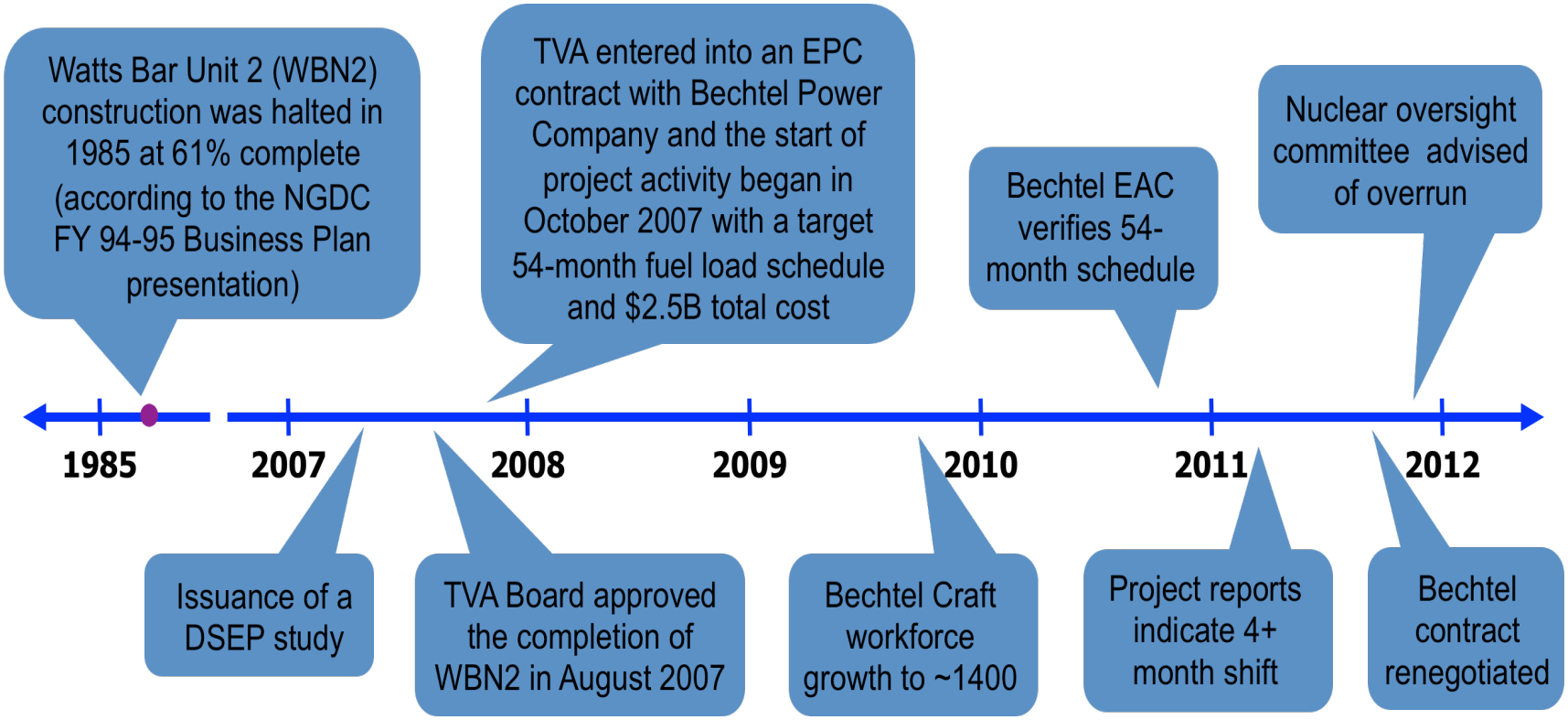
Results of this study were presented to the TVA Board of Directors in August 2007. The Board decided to resume construction of WBN Unit 2. The NRC review of the operating license application is in progress.

Project History and Management Overview

After the TVA Board approved the WBN Unit 2 completion project in August 2007, the start of completion activities began in October 2007. TVA entered into an Engineering, Procurement and Construction (EPC) contract with Bechtel Power Company (Bechtel). With this contract, Bechtel was tasked with the overall project EPC under their Quality Assurance Program and TVA would be in an oversight role.

Before project approval by the TVA Board, TVA contracted with Bechtel to develop an estimate and schedule to complete and start up. This estimate became the Watts Bar DSEP study. This study provided details for the project execution; schedule, estimates and risks. In essence, this study became the “road map” or execution plan for the project. The WBN Unit 2 site manager de-staffed Bechtel’s DSEP team before the estimate was complete and finished the estimate with a reduced team structure.
During execution, the first sign of problems with the project appeared in January 2008, approximately four months after project approval. The project began experiencing false starts and missed deadlines. Review of available documents found these problems persisted almost monthly through December 2010. Throughout this period, project reports and assessments presented an inconsistent view of schedule status. Starting in July 2009, monthly reports present schedule risk and indicate construction hours’ lag grew dramatically in a very short period (hours behind schedule grew from 200,000 to 1.3 million hours between March and September 2009).
To provide additional oversight, a project assurance process was developed in 2010. The purpose and scope of this process was to provide for an independent assessment of approved NGDC projects during construction and transition to operation phases. The intent of this group is to assure that specific and programmatic processes were reviewed, deficiencies were identified and addressed, and NGDC Project goals were achieved. Consistent with this purpose and scope, an organization was formed and an assessment plan developed to assess items such as milestones, schedule, completions, and other programs. During one of these assessments (February 10, 2010), the fact that the 54-month schedule for WBN Unit 2 was in jeopardy was identified.
No monthly project reports were published between February and October 2010, but the November 2010 report indicated the project was on track to meet the 54-month schedule. This outlook reflected revised cost and schedule estimates from the October 2010 Bechtel Estimate At Completion (EAC). The EAC included a recovery plan that required major changes both in terms of scope and performance trends. The reports did not explain how these major changes (i.e., production increases by as much as 50 percent over current levels) would be achieved. Site constraints, labor demands and engineering staffing prevented the plan from ever being achieved.
Until late 2010, WBN Unit 2 Project Management team believed that the lost time could be recovered. Starting in December 2010, the project began to be consistently reported as being at risk to overrun the 54-month schedule.
TVA management began stepping outside the oversight role from shortly after the beginning of the project. The original Bechtel Project Director pushed back against the TVA management and was removed. Throughout the project, five different Bechtel Project Directors and seven Site managers have been assigned to WBN Unit 2. WBN Unit 2 TVA managers cited lack of capability as the primary reason for changing out most of the Bechtel managers. Bechtel interviews indicated hostility from TVA management led to this leadership turnover.
Early evidence indicates that WBN Unit 2 management took an owner-integrated approach that was not compliant with the EPC contract terms, causing role ambiguity and confusion between TVA and Bechtel. Bechtel site management were clearly aware of the trends in the project but continued to sign reports that did not clearly identify the project health
In early 2011, WBN Unit 2 Senior Project Management was replaced. Shortly after that, an independent analysis of the WBN Unit 2 schedule was performed to determine if WBN Unit 2 fuel load could be completed earlier than September 2012. This analysis evaluated systems 74 (RHR), 63 (SI), 62 (CVCS), 67 (ERCW) and 70 (Component Cooling). This analysis concluded neither the original nor the added scope of systems work activities were accurately defined and progress reported was overstated.

Project Timeline



Section 3

Cause Analysis and Corrective Action Plan

Watts Bar Unit 2 Completion
Root Cause Assessment
Condensed for Executive Final Report

Problem Statement:

Performance for construction completion of the Watts Bar 2 Project is not meeting schedule. This is resulting in the likelihood that both the baseline fuel load and commercial operation dates will not be achieved, and the approved project budget will be exceeded.

Preparer: Tennessee Valley Authority Nuclear Construction, McKinsey and Company & Westney Consulting Group

Approver: Michael Skaggs

Executive Summary

This root cause analysis identified the cause(s) for the following problem description:

Performance for construction completion of the Watts Bar Nuclear Unit 2 (WBN2) Project is not meeting schedule. This is resulting in the likelihood that both the baseline fuel load and commercial operation dates will not be achieved, and the approved project budget will be exceeded.

This section contains a summary of the assessment results. For a detailed description of the root cause findings, see section Conclusion**.**

- **Root Cause 1: Ineffective Leadership - Organization and management capabilities misaligned with unique project characteristics.**

  WBN2 Project Management did not properly evaluate and understand the complexity of the project. Lessons learned experience from the Browns Ferry Nuclear Unit 1 (BFN1) restart were not fully applied to WBN2 and, had they been, would not have been sufficient to prevent some issues due to dissimilar project scope. Nuclear Generation, Development and Construction (NGDC) Senior Management's view of the WBN2 restart as a maintenance turnaround, instead of a major construction project, led them to discount the importance of applying construction project planning and execution of construction best practices. WBN2 Project Management discounted early indicators of project overruns and rejected the use of Engineering, Procurement and Construction (EPC) standard project controls, construction practices or contractually defined project team roles.

- **Root Cause 2: Inaccurate Estimate - Inadequate understanding of the work to be done led to less than adequate initial engineering quantity estimates, planning, contingency and risk.**

  The project scope and complexity was significantly underestimated. The Detailed Scoping Estimating and Planning study (DSEP) was, in certain cases, an order of magnitude estimate versus a detailed estimate. Walk downs to confirm plant condition, construction quantities and work scopes were stopped before being completed. Estimated unit rates were low and did not take into account industry productivity declines and challenging conditions at WBN2. Given this level of project definition, contingency and risk for the execution plan were critically underestimated at project approval. The DSEP team was de-staffed before completion of the DSEP by the WBN2 Senior Manager causing a loss in core engineering and construction knowledge.

  In addition, the estimate in the DSEP presented a deterministic target cost and schedule rather than a range of potential outcomes. The deterministic approach allowed the team to under-emphasize project risks, contributing not only to an optimistic cost and schedule outlook, but also to the lack of a robust risk mitigation approach throughout execution.

- **Root Cause 3: Ineffective Execution - Management did not execute a robust execution plan or fully utilize available capabilities.**

  WBN2 Senior Project Manager did not implement EPC plant construction protocols on the project and instead used operations maintenance and modification protocols. WBN2 Project Management did not adequately plan the overall project up front and did not fully define the scope. Additionally, WBN2 Project Management did not put in place sufficient construction planning staff to support construction planning (e.g., walk downs, work scheduling, packaging of the design and work planning). This resulted in lower field execution productivity. The project was managed primarily through financial metrics rather than commodity or system completion key performance indicators (KPIs) that tracked actual engineering and field progress. This limited the ability to effectively forecast progress or plan work.

- **Contributing Cause 1: Inadequate NGDC/TVA oversight and project assurance.**

  External oversight of the project was not sufficient to recognize early warning signs and identify corrective actions required. As the project proceeded, WBN2 Project Management, initially charged with an oversight role, shifted focus increasingly to direct project management. This left a void in the oversight role that was exacerbated by a lack of visibility into project status from outside the project. Neither the Project Assurance Organization (put in place during 2010) nor executive oversight from NGDC effectively used to fill the void. Additionally, project reports did not provide reliable and consistent indication of project status and the reports were not circulated, consistently, outside the site.

- **Corrective actions** developed to prevent recurrence are detailed in corrective action plan section.

Description of the Event/Issue

Project History and Management Overview

WBN2 construction was halted in 1985 at 61 percent complete (according to the NGDC FY 94-95 Business Plan presentation). This completion number does not take into account degradation and use of equipment at other TVA facilities after 1995. The TVA Board approved the WBN2 completion project in August 2007, and start of completion activities began October 2007. TVA entered into an (EPC) contract with Bechtel Power Company (Bechtel). With this contract, Bechtel was tasked with the overall project EPC under their Quality Assurance Program and TVA was placed in an oversight role.

Before project approval by the TVA Board, TVA contracted with Bechtel to develop an estimate and schedule to complete and start up WBN2. This estimate became the Watts Bar DSEP study. This study provided details for the project execution; schedule, estimates and risks. In essence, this study became the "road map" or execution plan for the project. The WBN2 Senior Project Manager de-staffed Bechtel's DSEP team before the estimate was complete and finished the estimate with a reduced team structure. WBN2 Senior Project Manager curtailed the team to help control costs and because they believed a reduced team was sufficient.

The first sign of problems with the project appeared in January 2008, approximately four months after project approval. The project began experiencing false starts and missed deadlines. Review of available documents found these problems persisted almost monthly through December 2010. Throughout this period, project reports and assessments presented an inconsistent view of schedule status. Starting in July 2009, monthly reports present schedule risk and indicated that construction hours lag grew dramatically in a very short period. (Hours behind schedule grew from 200,000 to 1.3 million hours between March and September 2009).

To provide additional oversight, a new project assurance process was developed in 2010. The purpose and scope of this process was to provide for an independent assessment of approved NGDC projects during construction and transition to operation phases. The intent of this project assurance group was to assure that specific and programmatic processes were reviewed, deficiencies were identified and addressed, and NGDC Project goals were achieved. Consistent with this purpose and scope, a project assurance organization was formed and an assessment plan developed to assess items such as milestones, schedule, completions, and other programs. During one of these assessments February 10, 2010, the fact that the 54-month schedule for WBN2 was in jeopardy was identified. This report was not accepted by WBN2 Project Management and was therefore not effectively used as input to the project. WBN2 Project Manager and NGDC Senior Manager's failure to use the project assurance process, consistently, coupled with their shift from project oversight to direct management resulted in inadequate project cost and schedule oversight and a lack of external transparency into project status.

This outlook reflected revised cost and schedule estimates from the October 2010 Bechtel Estimate At Completion (EAC). The EAC included a schedule and budget recovery plan that required major changes both in terms of scope and performance trends. The reports did not explain how these major changes (i.e., production increases by as much as 50 percent over current levels) would be achieved. Site constraints, labor demands, and engineering staffing prevented the plan from ever being achieved. The difficultly of achieving the EAC was not explained in the monthly summary report dated October 2010. It was reported that the project was on schedule for 54-month completion. WBN2 Project Management did not issue project reports for a seven-month period beginning in February 2010; however, when the project team resumed issuing reports, the November 2010 report indicated the project was on track to meet the 54-month schedule.

Until late 2010, WBN2 Project Management believed that the lost time could be recovered**.** This is evident from the messages between the NGDC Senior Manager and the NGDC Controller dated July 12 and 13, 2010, in which the COO Performance Review Package was discussed.. In these messages, the Schedule Performance Index (SPI) and Cost Performance Index (CPI) were discussed and on July 13, 2010, the NGDC SVP directed that the SPI be red because he did not believe that performance could be recovered in fiscal year 2010. Up to that point, WBN2 Senior Project Manager represented the project could recover the schedule even though performance indicators and independent reports identified performance issues from early 2009. Starting in December 2010, the project began to be consistently reported as being at risk to overrun the 54-month schedule. *See Figure 1: WBN2 History and Governance Overview.*

WBN2 Project Management began stepping outside the oversight role shortly after the beginning of the project. The original Bechtel Project Director pushed back against WBN2 Senior Project Management on the change in direction of the project and was removed from the project. Throughout the project, five different Bechtel Project Directors and seven Bechtel Site managers have been assigned to WBN2. TVA managers cited lack of capability as the primary reason for changing out most of the Bechtel managers. Bechtel interviews indicated hostility from WBN2 Senior Project Management led to this leadership turnover. The relationship between TVA and Bechtel was strained throughout most of the project and this strain contributed to the high turnover of Bechtel senior staff. This strained relationship with contractors and a culture that did not tolerate bad news discouraged effective dialogue and collaboration on critical project issues.

Early evidence indicates that WBN2 Project Management took an owner-integrated approach that was not consistent with the EPC contract terms, causing role ambiguity and confusion between TVA and Bechtel. Despite indications that Bechtel was being turned into a “body shop,” Bechtel corporate leadership did not appear to become decisively engaged. Other than some letters and anecdotal evidence of one meeting of a Bechtel corporate VP with TVA senior management above the project level, Bechtel passively accepted TVA’s involvement at levels of work inconsistent with the terms of the contract. In addition, Bechtel site management was clearly aware of the trends in the project but continued to sign reports that did not clearly identify the project health.

In early 2011, the WBN2 Senior Project Manager was replaced. Shortly after that, an independent analysis of the WBN2 schedule was performed to determine whether WBN2 fuel load could be completed earlier than September 2012. This analysis evaluated systems 74 (RHR), 63 (SI), 62 (CVCS), 67 (ERCW) and 70 (Component Cooling). This analysis concluded that neither the original nor the added scope of systems work activities were accurately defined and progress reported by WBN2 Project Management was overstated.

Currently, WBN2 Project Management is undergoing an Estimate to Completion (ETC) process to develop a realistic view of schedule and cost going forward. WBN2 Project Management expects to issue the revised ETC by April 2012.

Detailed Description of the Event- Inadequate Estimate

Review of DSEP's initial estimate of the project found that it did not adequately plan for the amount and nature of work needed to complete WBN2. The craft unit rates in the estimate did not reflect actual field production rates achieved on the project. The initial estimate also did not account for the potential risks facing the project and contained a contingency amount that was well below what was required for a level of confidence contained in the DSEP. The quantities included in the DSEP also did not accurately reflect the actual quantities in the plant. Certain sections of the DSEP were not a detailed study but an unverified order of magnitude estimate. Verification activities were stopped prior to completion of the DSEP based on direction from WBN2 Senior Project Manager. Furthermore, the WBN2 Senior Project Manager de-staffed the team involved in the creation of the DSEP. The de-staffing was undertaken in an effort to save money and accelerate project pace. WBN2 Project Management felt that the DSEP was of sufficient definition for a turnaround operation based on recent experience at Brown's Ferry Unit 1 (BFN1). This de-staffing decision was the beginning of a series of instances throughout the project where WBN Senior Project Manager stepped beyond an oversight role and engaged in more direct management of the project.

The DSEP estimate contained craft unit rates that were much lower than what has actually been achieved on the project. The unit rate estimates were based on boiling water reactor recovery BFN1 experience, not on pressurized water reactor construction experience. This error was compounded due to the ice condenser configuration of WBN2. To create the estimates, the DSEP team used the BFN1 craft unit rates and discounted them by 20 percent. This method did not accurately reflect the project conditions as WBN2 differed significantly in design, which involved much more cramped working conditions in the containment auxiliary buildings than at BFN1. The DSEP team also underestimated the demand and productivity changes in the labor market that drove unit rates higher from the time of the estimate. The best practice unit rate estimating method would have been to use the Watts Bar Unit 1 (WBN1) rates and apply the industry productivity degradation rates, which were 20 percent to 40 percent since WBN1. The initial DSEP estimate contained a 7 percent contingency, which was inadequate for the level of project definition at DSEP. The industry standard contingency for a project like this (e.g., brownfield, operating plant, incomplete, and idle project) is 25 percent to 40 percent. Therefore, the contingency in the DSEP estimate was 18 percent to 33 percent too low. The DSEP team did not adequately evaluate risks associated with this project. The risk log in the initial estimate was focused on risks such as potential hotel load costs, instead of the more serious risks the project faced.

Detailed Description of the Event- - Ineffective Project Management

In a possible effort to save money and accelerate the project completion, WBN2 Senior Project Manager made decisions to deviate from the original plan of beginning construction after engineering Front End Loading was adequate to support field operations. Both engineering and construction began essentially at the same time, before establishing the upfront planning and infrastructure to support the decision. This resulted in preparation lagging throughout the project, specifically in walk downs, work scheduling, packaging of the design, and work planning, procurement and implementation. Work hour data suggests that construction work of more than 40,000 hours per month overlapped with significant engineering activity from July 2008 through at least April 2010; however, construction hours ended up falling behind the DSEP planned level between 2008 and 2010 due to the lags created by incomplete engineering. In addition, a major workforce increase during 2010 in an attempt to catch up with schedule negatively affected productivity on site because it was not sufficiently supported by a clear backlog of workable work packages. In essence, the inadequate execution plan had a negative impact on field productivity.

Complex and cumbersome work packages were another contributor to reduced field productivity and slipped schedule. The issues with work packages lay not only in package planning, but also in engineering as well as field operation. Engineering-issued design packages in a format intended for maintenance/outage work, rather than in a format intended for bulk construction. In addition, rushed by WBN2 Project Management to meet tight issuance deadlines, Engineering did not complete plant and system walk downs and left them to be done by work package planning. Engineering packages were also multi-discipline (i.e., mechanical, electrical, civil), complex, and often inadequate. For example, engineering packages principally addressed only the changes made in Watts Bar Unit 1 that needed to be made in Unit 2 to meet regulatory and license requirements. After issuance of the engineering packages, work packages were developed to implement the work, but problems arose there as well. Understaffed, rushed to meet milestones, and faced with design packages in an unfamiliar format, planning did not break down work packages into manageable work instructions for craft. There were no consistent templates for packages, and walk downs were often skipped and left to be done by craft. At some point, creating work packages became a simple exercise of "putting the shell together," where only the necessary formatting pages such as cover sheets were added. The work package issues ultimately led to reduced productivity in the field, as craft did not know how to implement work packages and consequently had trouble closing them. Closing work packages became even more difficult over time as missing signatures and paperwork increased. There is evidence to suggest that WBN2 Project Management's overstepping its oversight role to an active owner role (e.g. insisting on TVA engineering formats rather than giving the EPC contractor autonomy, rushing EPC Contractor to meet milestones) contributed too many of the key work package issues ultimately leading to reduced field productivity.

WBN2 did not fully use available project control tools and capabilities.

At the direction of the WBN2 Senior Project Manager, many of the standard tools and processes typically used in construction were not implemented. In many cases, they were not replaced

with TVA's own tools either because TVA's tools were not usable or because WBN2 Senior Project Manager did not think they were needed. For example, Bechtel's standard quantity and cost databases were not used, and quantity tracking remains an area requiring improvement.

A risk management system was not adequately implemented and there was a lack of a change control system. There was no Change Control Board (CCB), or any other similar process in place, ultimately resulting in inadequate control of project scope. Project staffing level remained inadequate on many fronts throughout the project, but WBN2 Senior Manager did often not approve additional staffing requests.

During project execution, several KPIs were in place to measure progress but they were not calculated on a consistent basis and were not effectively used to improve performance or to alert management of potential problems. Among these KPIs were Cost Performance Indicator (CPI), Schedule Performance Indicators (SPI), and various completion curves. These KPIs are reflected in the WBN2 Plan of the Day and Monthly Management review Packages as appropriate. However, some of these KPIs were calculated on an inconsistent basis, given the lack of effective quantity and schedule tracking tools at the time of calculation. For example, SPI was calculated by dividing actual time spent by expected time to complete roughly estimated by craft, whereas the accurate calculation calls for using quantity to go multiplied by appropriate unit rates (schedule performance vs. schedule adherence). Moreover, these KPIs were not used consistently and effectively to improve performance. Even though the indicators reflected performance shortfalls, there were no areas for improvement or corrective actions documented to correct these performance shortfalls. Monthly reports had limited information on KPIs and had no clear action items. No dashboard was utilized to develop and execute corrective actions. Since performance shortfalls continued to exist, either adjustments were not made or the adjustments made were not effective.

The project did not have a detailed, resource-loaded schedule.

The original completion schedule in DSEP was 60 months to commercial operation. The WBN2 Project worked to a 54-month schedule to commercial operation with a stretch of 48 months to commercial operation. After approval, the schedule was not integrated or resource loaded. To compensate for this, the project actually worked from a "waterfall" for system turnover that neither the engineering nor the work packages supported.

Analysis of Key Attributes:

Original Project Plan - The original project plan appeared at a high level to contain elements consistent with a project of this type (e.g., complete engineering prior to construction start, complete walk-downs prior to construction start, EPC contractor leading effort, etc.) However, the execution plan was at a summary level and did not address the issues of processes and training.

Project Strategy - The project strategy that is depicted in the DSEP study was achievable. As stated above, the project execution deviated from that originally approved. These differences

ranged from beginning construction before engineering completion to TVA taking an active management role in the project.

Implemented Project - The implemented project was different from that originally planned or contracted. As mentioned previously, the role of TVA changed from oversight to taking an active part in managing the project. This was inconsistent with the original project strategy. The impact of this was magnified because the TVA management did not have the construction background needed to fully understand and direct a project of this nature.

Identify deltas between original plans and implemented

Lessons Learned from Browns Ferry Nuclear (BFN1) and the industry – the lessons learned from BFN 1 and the industry were not effectively incorporated into the design or construction processes. Review of INPO 08-005, "Historical Construction Experience to Apply to New Plant Deployment" and the WBN2 Corrective Action database found essentially the same or similar issues occurred at WBN2 and BFN1 (i.e., walk downs, 79-14, etc).

Analysis of the Event/Issue

Internal TVA Assessment

This assessment began with an internal TVA review of available documents associated with the WBN2 Project dated from project approval August 2007 to November 2011. This included documents such as the project schedules, assessments, Plan of the Day Packages, Project Review Meeting Packages, Detailed Scoping, Estimating, and Planning (DSEP) Report, presentation to the Operations, Environmental, and Safety committee (OES) dated January 19, 2010, and correspondences pertinent to the WBN2 Project. Once the documents were reviewed, interviews were conducted with selected WBN2 Project personnel. These interviews were then integrated with the document reviews and incorporated into an Event and Causal Factor (E&CF). To perform the analysis, a project timeline was first constructed. This timeline was developed from the review of issues affecting the project. Input was obtained from various sources including a list of project highlights, reports from oversight organizations, and messages from management personnel and others. This timeline then became the basis for the Event and Causal factor (E&CF). After constructing the E&CF, interviews were then held to determine or confirm possible root and contributing causes. The assessment team constructed a detailed timeline of events that was updated during the external verification assessment. *See Figure 1: WBN2 History and Governance Overview.* Relative insights to this issue include management controls that allowed the deviation from the strategic plan shortly after the project began. Before project approval by the TVA Board, TVA contracted with Bechtel to develop an estimate and schedule to complete and start up WBN2. This estimate became the Watts Bar DSEP study. This study provided details for the project execution: schedule, estimates, and risks. In essence, this study became the "road map" or execution plan for the project. Review of this estimate found the initial estimate was flawed. The initial estimate was not a detailed study but an order of magnitude, which was not verified. When verification activities began, they were stopped based on direction from WBN2 Senior Project Manager. This correlates to Executive Management Failure Mode of Strategic Planning Errors - Inadequate Business Plan - Inadequate estimate in that the actual estimate that became the execution plan was flawed.

The strategic plan for the project is contained in the DSEP study. The plan for the project was to complete engineering before beginning construction. In an effort to save project time and money, the two activities were conducted essentially at the same time. This move accelerated the issuance of design packages and activities actually began before the processes to support the activity were established and in place. This correlates to an Executive Management Failure Mode of Strategic Planning Errors – Inadequate Business Plan Execution - Management of the business plan was less than adequate in that the tools and processes were not in place to be successful.

Once the root causes were established, performance indicators were reviewed to determine if they reflected actual performance and, if so, what actions were taken to address the performance shortfalls. This review found KPIs were in place to measure progress but were not effectively used to improve performance. Among these KPIs were Cost Performance Indicator (CPI), Schedule Performance Indicators (SPI), and various completion curves. These PIs are reflected in the WBN2 Plan of the Day and Monthly Management Review Packages as appropriate. Review of these metrics found the project generally failed to meet performance goals. However, even though the indicators reflected performance shortfalls, there were no areas for improvement or corrective actions documented to correct these performance shortfalls. Since performance shortfalls continued to exist, it is concluded that either adjustments were not made or the adjustments made were not effective. Interviews also indicated adjustments were not made by WBN2 Project Management.

During the review of documentation, several issues were identified associated with the control of project scope. The DSEP set the scope of work for the project and therefore it was essential that management maintain control to meet the strategic plan. Interviews confirmed that adequate process measures were not in place to control the scope of work. This lack of control also attributed to losing track of project completion status.

External Verification

Following the conclusion of the internal TVA assessment, an external team with extensive construction industry experience conducted an independent assessment consisting of internal interviews and analysis of information such as weekly contractor invoice data, correspondence between TVA and Bechtel, contracts, audits and various estimates to complete, in addition to the project documentation listed above. The team used a modified version of the McKinsey Investment Readiness Assessment (MIRA) process for final sanction and execution phase projects to ensure the full breadth of project elements were considered in the assessment.

The independent assessment verified and amplified the findings of the TVA internal assessment. The independent assessment determined that WBN2 Project management culture was a key driver of inadequate estimation and ineffective Project management. NGDC Project Management's misunderstanding of project complexity and lack of recent construction experience were key enablers for many of the decisions to cut infrastructure costs and accelerate field labor that have negatively affected the project. WBN2 Project Management also disregarded both the oversight role envisioned by the EPC contract and TVA's corporate strategy for mega-project execution by assuming an active management role in the project. This strained

contractor relations, inhibited Bechtel from executing the project as they felt was most effective, and amplified the impact of the WBN2 Project Management's inexperience.

The independent assessment also determined that the inadequate scope control contributing cause cited in the internal assessment was more precisely a part of the inadequate estimate and Project Management root causes. Lack of a scope control process that conformed to construction industry and TVA standards is one example of many systems that were not fully employed by WBN2 Project Management. Additionally, scope changes in this project were not due to owner decisions to alter programmatic requirements but rather due to an underestimation of the scope that was remaining to complete those requirements at the outset of the project.

Extent of Condition

Even though the extent of this condition is the WBN2 Project, this condition has the possibility of occurring at any large TVA construction site. To address this, the results of this assessment will be shared with the appropriate projects within NGDC (Bellefonte), Fossil Generation Development, and Construction (FGDC), and Nuclear Power Group (NPG).

Previous Similar Events

To determine the existence of any previous similar events, both the TVA and INPO databases were searched. The timeframe for this search was the past three years. The following search criteria were used:

TVA Corrective Action database

- Level A and B PERs were searched since they were the most likely population to have adequate cause information for comparison.

- Project Management D-codes were searched for each plant and Chattanooga Office Complex (COC) to identify any PERs related to major projects that did not meet schedule or budget. In addition, D codes for FPG groups involved in projects were also reviewed.

- Nuclear Support Services D-code was also searched to ensure all potential project or contractor PERs were identified.

- Project D-codes for Nuclear Power Group (NPG) and Fossil Power Group (FPG) Corporate Functional Area Managers (FAMs) were searched since these groups provide G&O to the sites.

- The phrase "Project Management" was searched in the Summary field.

Conclusions

The results of this evaluation were:

Root Cause 1: Ineffective Leadership - Organization and management capabilities misaligned with unique project characteristics.

- WBN2 Project Management did not properly identify the complexity of the project. Management experience from the Browns Ferry Nuclear Unit 1 (BFN1) restart was applied to WBN2. However, the two projects are very different in several areas (site conditions, level of definition, and level of completion). Management's view of the WBN2 restart as maintenance turnaround instead of a major construction project led to discounting the importance of applying construction project planning and execution best practices. WBN2 Project Management discounted early indicators of project overruns and did not seek outside (the project) help to identify sufficient corrective actions for recovery. WBN2 Project Management did not communicate full characterization of project issues outside of the site and TVA did not have an active audit process that would give executive management a view of project health other than what the WBN2 Senior Project Manager provided.

- Consistent with the misidentification of the project complexity and scope, WBN2 Senior Project Management rejected application of Bechtel standard project controls, practices, and contractually defined roles for TVA and Bechtel. During project execution, WBN2 Project Management increasingly shifted from an oversight to a Project Management role, which did not align with the intent of the contract but did align with the underlying cultural bias of TVA. The resulting lack of role clarity strained the interface between contractors and WBN2 Project Management. This condition, combined with the interaction style of some TVA managers, contributed to a lack of collaboration and transparency that inhibited contractors from effectively challenging critical WBN2 Project Management decisions.

- Cultural aspects of the project that discouraged effective dialogue and transparent upward communication of issues amplified gaps in WBN2 Project Management capability. The difficulties between TVA and Bechtel caused, in part, by lack of role clarity, limited collaboration between WBN2 Project Management and Bechtel to address project issues. A culture on site that did not tolerate bad news also contributed to the lack of transparency between contractors and TVA managers. Additionally, WBN2 Project Management's bias towards "showing progress in the field" contributed to decisions to deviate from best practice project planning and sequencing.

Root Cause 2: Inaccurate Estimate - Inadequate understanding of the work to be done led to low initial estimates and impede planning.

- The project was significantly underestimated. DSEP study was, in certain cases, an order of magnitude estimate versus detailed. Walk downs to confirm construction quantities and work scopes were stopped before being completed. Quantities did not accurately reflect the work in the field. The quantities of new construction were overstated and the quantities for replacement work were understated. Unit rates for production were overestimated for the complexity of the work (e.g., density, access and sequencing).

- The level of definition included in the DSEP was inaccurate. The project engineering definition was at best around 5 percent at sanction. Industry standards for a project of this type at sanction are 40-70 percent definition. Based on the level of definition of project at sanction, significant contingencies were warranted. Also, the risk ranging (e.g., hotel load, other misc costs) was not in line with TVA or industry standards.

- The DSEP team was de-staffed before completion of the DSEP by WBN2 Senior Project Manager, causing a loss in core knowledge.

- In addition, the estimate in the DSEP presented a deterministic target and schedule rather than a range of potential outcomes. By focusing on a single target costs and schedule, WBN2 Project Management implicitly assumed a high degree of control over project variability drivers. This mindset contributed not only to an optimistic estimate, but also to an ongoing failure to identify and mitigate the full set of project risks.

- Best practice risk identification and management for mega-projects like WBN2 consider the potential impact of internal and external events across technical definition, project execution, market dynamics, political dynamics and organization. Reviews of available risk registers indicate that WBN2 Project Management limited their consideration of risks during the DSEP to a small set of internally addressable potential events (e.g., hotel load) and were overly optimistic about the degree of control they could exert on the risks considered. This underestimation aligns with both WBN2 Project Management's underestimation of project complexity and its lack of recent construction experience.

Root Cause 3: Management did not execute a robust execution plan or fully utilize available capabilities.

- WBN2 Project Management did not implement construction protocols on the project and instead used maintenance and modification protocols. Management did not establish the upfront planning and infrastructure to support construction activity, resulting in a lack of preparation (i.e., staff) required throughout the project to complete field support activities (e.g., walk downs, work scheduling, packaging of the design, work planning, and field execution).

- The project was managed primarily through financial metrics rather than commodity or system completion KPIs that tracked actual engineering and field progress. WBN2 Project Management curtailed project planning and controls resources in part to improve financial metrics. This severely limited the project's ability to effectively plan work and accurately forecast project progress.

- In addition, the project execution plan did not provide detail in line with industry standards and was not implemented. In an effort to accelerate project completion and possibly save money, decisions were made to deviate from the execution plan. This includes deciding not to complete engineering before construction, use of work orders and not work packages, use of construction work practices, and actually reducing the

quantities and unit rates so that an accelerated 48-month fuel load schedule appeared possible.

- In addition, TVA did not effectively use lessons learned from BFN1 and industry (INPO 08-005). A comparison of the corrective action databases found essentially the same issues.

Contributing Cause 1: Inadequate NGDC / TVA Oversight and Assurance.

External oversight of the project was not sufficient to recognize early warning signs and identify corrective actions beyond those taken by management on the site. As the project continued, WBN2 Project Management, which was initially charged with an oversight role, shifted focus to direct Project Management. This left a void in the oversight role that was exacerbated by a lack of visibility into project status from the outside. Neither the NGDC Project Assurance Organization nor executive oversight from NGDC was effectively used to fill the void. Reports from the Project Assurance Organization gave early warnings but were not acted upon. Project reports did not provide reliable and consistent indicators of project status and were not sufficiently circulated outside the WBN2 Project. The Plan of the Day and Project Review Meeting packages only listed items but failed to note if the issue was a problem and if so, whether any adjustment was made. Review of actual performance found no adjustments were made that had a positive influence.

Extent of Cause

- The root cause of this event was the project had a less than adequate execution plan and did not implement the plan agreed to in the DESP. In an effort to accelerate project completion and possibly save money, decisions were made to deviate from the execution plan and the lessons learned from the industry and Browns Ferry were not effectively used by WBN2 Project Management. This cause is applicable to any large project that would require an execution plan.

- Since NGDC is involved almost exclusively in projects of this type, the extent of cause involved any NGDC project. A corrective action will create details for communicating and incorporating lessons learned. This will carry the expectations for lessons learned from any future projects forward. Corrective action will also be developed to communicate the lessons learned from this issue and communicate it to Sequoyah Steam Generator Replacement, Bellefonte and Clinch River projects. These two actions should address the extent of cause.

Corrective Action Plan

Watts Bar Unit 2 Corrective Actions

The table below outlines corrective **actions that have already been initiated by WBN2 site management** to address the root causes identified in this assessment.

WBN2 Project Management Action Items	Root Cause Correlation		
	Organization misalignment	Inadequate estimate	Project execution
Restructure project organization to increase alignment with a traditional construction implementation organization to focus responsibility and accountability.	✓		
Improve craft morale through improved communications and management focus.	✓		✓
Perform a **comprehensive ETC revision**. Incorporate independent assessment of the external project risks into the final ETC cost and schedule outlook. *ETC development should follow a standard NGDC approach that fulfils TVA-SPP-34.0 Section 3.2.4, Project baseline management.*		✓	
Establish process and oversight improvements, including a "war room," with appropriate infrastructure (TVA, Bechtel, DZ) to monitor and track performance and a forum to review the results for action. *Clarify criteria for requiring a war room in TVA-SPP 34.0.*			✓
Focus a multi-disciplinary team to **improve quality and timing of Planning Documents** in order to provide workable packages and create sufficient backlog of work.			✓
Improve effectiveness of field engineering to minimize craft down time and improve quality of work documents.			✓
Establish independent, integrated schedule and cost monitoring tools to be used routinely for measuring project progress. Link SPI measurement to consistent quantity unit rates. Work activity should be measured against hours based on quantities to be installed rather than craft personnel estimates of task duration. *Earned value management should be consistent with TVA-SPP 34.0.*			✓
Increase transparency by implementing cross functional control tower to track critical KPIs and risks in one place and ensure active risk management processes as the project proceeds. *Fulfills requirements of TVA-SPP 34.0, Section 3.2.11, Project Reporting.*			✓

The table below outlines **further corrective actions that should be undertaken at the WBN2 site** to address the root causes identified in this assessment.

Recommended Action Items	Root Cause Correlation		
	Organization misalignment	Inadequate estimate	Project execution
Initiate regular (monthly) executive sponsor meetings between TVA and Bechtel (one on one session). Roles for executive sponsors should be clearly defined and should include ensuring that TVA and Bechtel corporate leadership are jointly addressing open/ escalated project issues.	✓		
Ensure buy-in of revised cost / schedule across entire WBN2 project through coordinated workshops for TVA and Bechtel senior management with construction and engineering discipline managers and supervisors.	✓	✓	
Streamline work package rebuilds.			✓
Surface productivity measures.			✓
Establish a process to control project scope changes similar to the Change Control Board. *Process should align with COO-SPP 01.2, Change Management and involve the appropriate level change owner within NGDC.*			✓

NGDC and TVA Corrective Actions

The table below outlines corrective **actions that should be undertaken at the NGDC and TVA corporate levels** to address the root causes identified in this assessment.

Recommended Action	Root Cause Correlation		
	Organization misalignment	Inadequate estimate	Project execution
Ensure Bellefonte estimate process incorporates WBN2 root cause learning, business case remains robust, and execution plan incorporates other lessons learned. *Business case development should follow a standard NGDC approach that fulfils TVA-SPP-34.0 Section 3.2.1, Project planning and development.*	✓	✓	✓
Install and **implement an evergreen risk process** across NGDC. *Process should conform to TVA-SPP-34.013, Risk and Contingency Management.*	✓	✓	✓

Recommended Action	Root Cause Correlation		
	Organization misalignment	Inadequate estimate	Project execution
Strengthen the independent Project Assurance Organization by optimizing organizational alignment within in the TVA structure. Organizational mandate should include adequate involvement in stage gate approvals and oversight of construction execution.	✓	✓	✓
Ensure no organizational gaps exist in pivotal roles across NGDC commitments.	✓		
Establish criteria for determining contracting strategy and TVA owner role for various project classifications.	✓		
Conduct an audit of TVA-SPP-34 and other relevant projects procedures to ensure compliance with construction industry best practices.		✓	✓

Effectiveness Review Actions

Approximately 6 months after the actions to prevent recurrence are closed; effectiveness of these corrective actions should be assessed. After the recurrence assessment is completed, periodically scheduled assessments will be required. Attributes of this assessment should include the following, at a minimum:

- Project has an organization and schedule in place that supports completion of the project.
- There is adequate oversight of project schedule and costs.
- A process is in place at other nuclear construction projects for capturing and utilizing lessons learned.

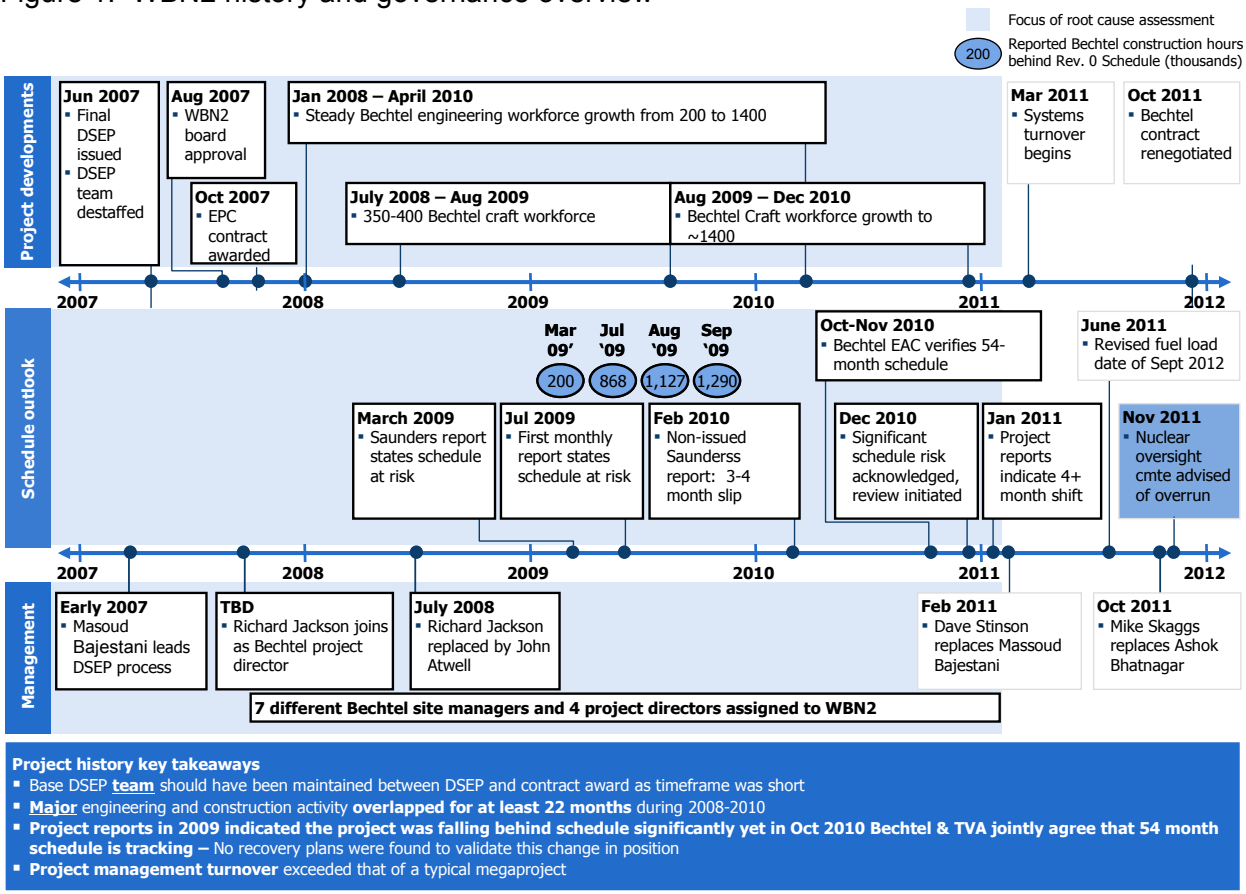
Other Notable Observations

None.

The techniques used to perform the analysis were:

- Event and Causal Factor Chart;
- Hazard Barrier Target Analysis; and
- Modified McKinsey Investment Readiness Index (MIRA) as applied to active construction projects.

Figure 1: WBN2 history and governance overview



SOURCE: Project reports, interviews, Bechtel weekly invoices, team analysis

Section 4

ETC Methodology

Explanation of ETC Process

1. What is the Estimate to Complete (ETC):

   A. The Estimate to Complete (ETC) is the project forecast that provides the budget for all costs for completion of work for the remaining duration of the project. It includes detailed estimates for performance of direct work using known work commodities and estimated unit rates as well as estimates for sub-contractors, non-manual support and material costs. The ETC is added to the current actual cost for the project as of 10/16/11 to derive the Estimate at Completion (EAC), which contains the revised forecast schedule and costs and is presented for TVA Board approval.

2. Approach to Developing the ETC:

   A. Joint effort by TVA Management (Construction Oversight Team, Tiger Team and Project Controls), Bechtel field staff (Supervision, Craft Leads and Project Controls) and Engineering (Field Engineering and Design (as appropriate)).
   B. Used spreadsheets generated and maintained by Project Controls.
   C. Estimate Basis
      1) Started with to go Quantities from the October 16th Quantity and Unit Rate Report (QURR) based on the forecast quantities from the May estimate to complete
         - Construction management, field engineering and Construction Superintendents were tasked with the action of developing the quantities to go.
         - Existing data bases are being validated by walk downs
         - Remaining design changes to be issued were investigated and utilized as a basis
         - Walk downs have been commenced on specific commodities based on magnitude of work to go to validate quantities or assumptions
         - Actual performance was incorporated into assumptions to go for validation
         - Multiple data bases were combined and reconciled

      2) Quantities were reviewed account by account and were categorized as follows:
         a) Firm Basis – Uniquely identified counts, takeoffs, walk-downs of to go quantities.
         b) Formula Basis – Quantities developed by formula, ratio or percentage
         c) Allowance Basis – Quantity allowance developed with assumptions that define the allowance for comparison to actual results.

         Note: Some quantities reflect an increase from the May ETC but were added only to "zero out" negative accounts (over-budget).

      3) Unit rates were reviewed account by account and were evaluated against the following criteria:

         a) Current work processes including Field Engineering and QC inspections.

b) Compared to recent historical and industry standard performance
c) Used QURR 4-week, 8-week and to-date trend data for rate analysis
d) Interview of superintendents
e) Updated to include basis changes for charging practices and account consolidation
f) Based on target Foreman and General Foreman ratios to craft
g) Most assumptions are based on current work process and procedures. Improvement opportunities are being identified in this process.

4) Risk Assessments
   a) Risk assessments performed on items with more than 10K hours of to-go to establish a level of confidence in the estimate prepared by the Team.
   b) Risk assessments performed on a consensus basis with inputs from SMEs

3. Why is this ETC different than past ETC's?

A. Unlike previous efforts, TVA/TVA contractors lead the effort to prepare the ETC:
   1) Work teams were created for each discipline consisting of Bechtel Supervisors, Construction Leads, Engineers (Field and Design), Project Controls, TVA representation, and TVA Oversight Management which owned the effort.
   2) Independent Tiger Team members and TVA Project Controls are leading the preparation effort and providing challenge and experience to improve accuracy and credibility.

B. Multiple and redundant sources (formal and informal databases) used to determine and validate commodity quantities, including WO reviews and some targeted field walk downs to determine work completion status.

C. Basis for direct work commodity estimates of quantities and unit rates documented and challenged by the TVA WBN2 Senior management team.

D. Databases for each commodity are being created to reflect the basis of the quantity.
   1) Database owners and update responsibilities assigned to ensure basis is kept updated to actual completions and to identify new work not in estimate.

E. Identified and estimated the costs of known "to be issued" Engineering scope and included in the ETC.

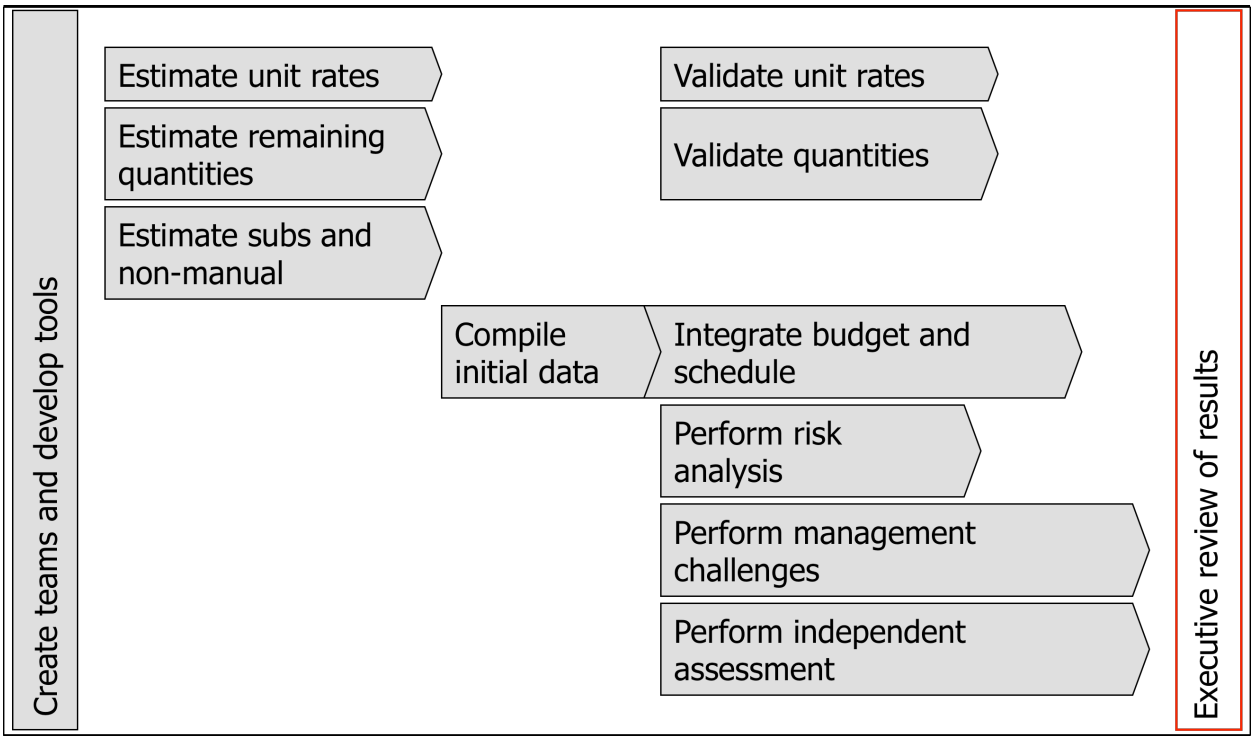
F. Estimates for Sub-Contracts, Support Organizations, non-Manuals and other indirect accounts developed by the Responsible Organization Manager and each separately challenged by WBN Senior Management team

G. Risk ranges established for all unit rates and quantities to reflect confidence levels.
   1) Provides ability to include specific contingency budget needed to achieve a management target.
   2) Risk profiles to be established utilizing Monte Carlo techniques by a consultant

H. The completed estimate will be controlled and re-performed on a quarterly basis

4. Actions being taken to control, monitor, and maintain the basis of the estimate.
   A. Change Control processes put in place to identify and approve new work that was not part of ETC basis (WO growth and new design) or changes to the ETC base (quantities, unit rates, cost estimates, etc)
   B. Action items created in each area to drive performance improvement. Actions will be updated on a weekly basis with the management team and improvements will be measured with specific performance indicators.
   C. Commodity charging and reporting practices revised to more accurately reflect the method in which final work is being completed.
      1) TVA Independent weekly auditing process for quantity reporting and charging practices will be implemented in January, 2012
   D. ETC linked to the work schedule and commodity performance indicators established.
E. Revising scheduling process to support bulk commodity and improved work processes

Process Flow Chart



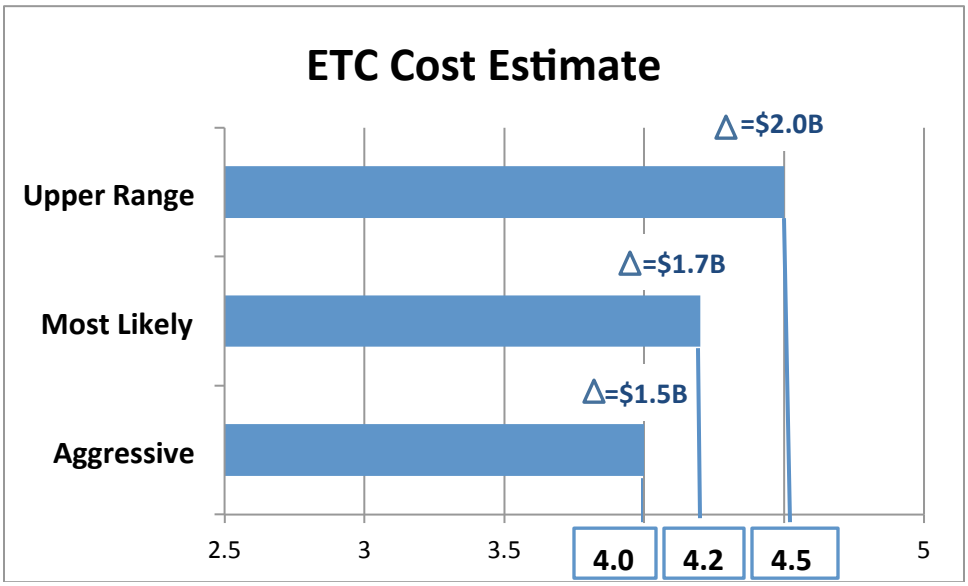
Section 5

ETC Results

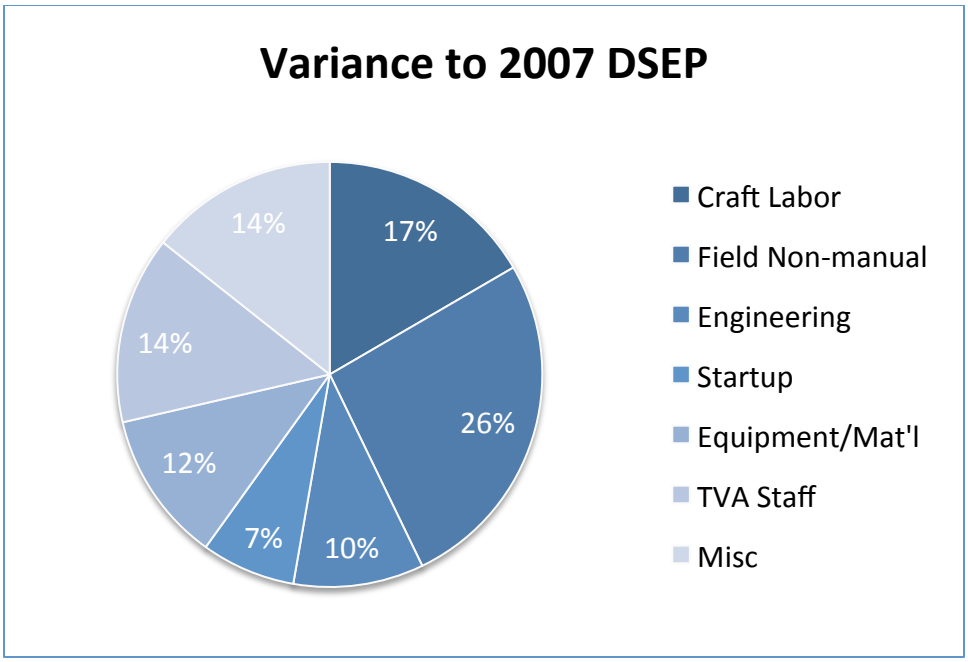
ETC Results

The following set of charts outline the major findings from the ETC. The background information and additional detail can be found in this report in the Schedule Overview and Cost Overview sections.

The new cost estimate and associate risk ranges as determined by the ETC process are as follows:



The chart below gives information comparing the new ETC estimate to the estimate from the DSEP done in 2007. This information divides the increase into categories.



For the Most Likely scenario, the cash flow projection is:

	FY12 ($M)	FY13 ($M)	FY14 ($M)	FY15 ($M)	FY16 ($M)
Most Likely	**500**	**500**	**500**	**500**	**116**

The schedule that corresponds to the cash flow above is:

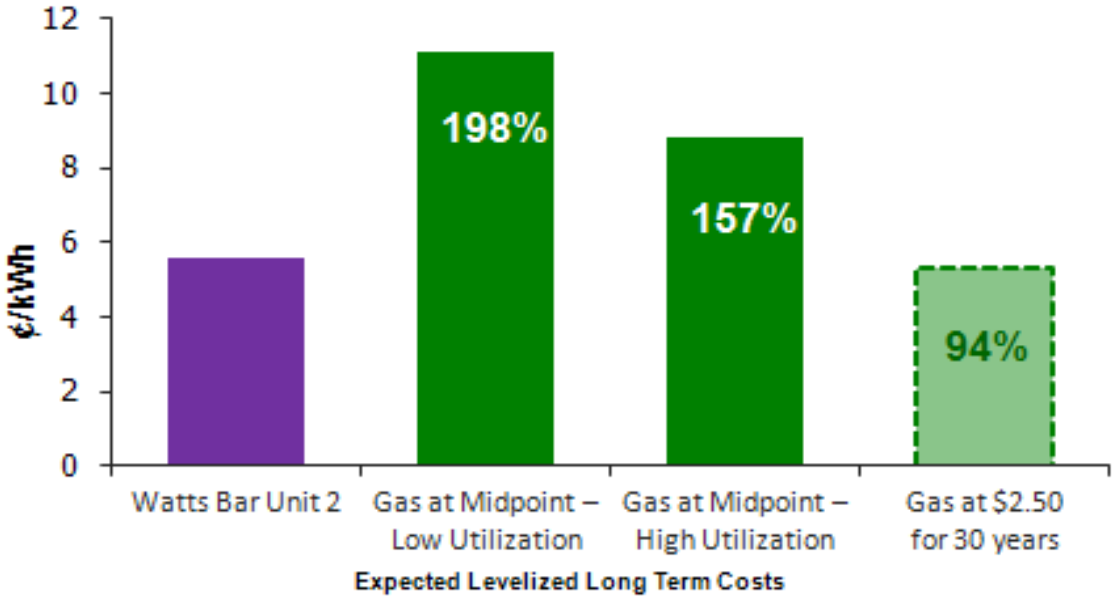
	Fuel Load	Initial Criticality	Commercial Operation
Most Likely	**Jun. 2015**	**Sept. 2015**	**Dec. 2015**

Section 6

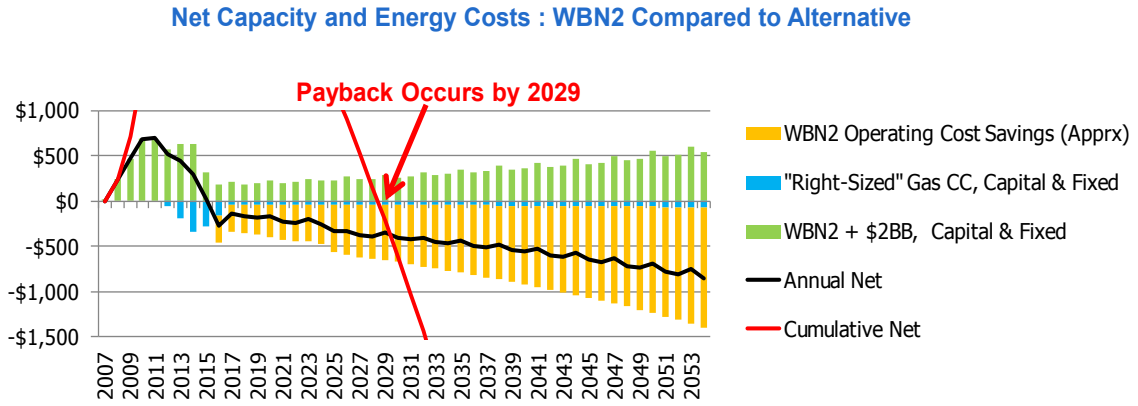
Project Comparison

Cost Analysis

Watts Bar Unit 2 cost to complete versus building new gas plants

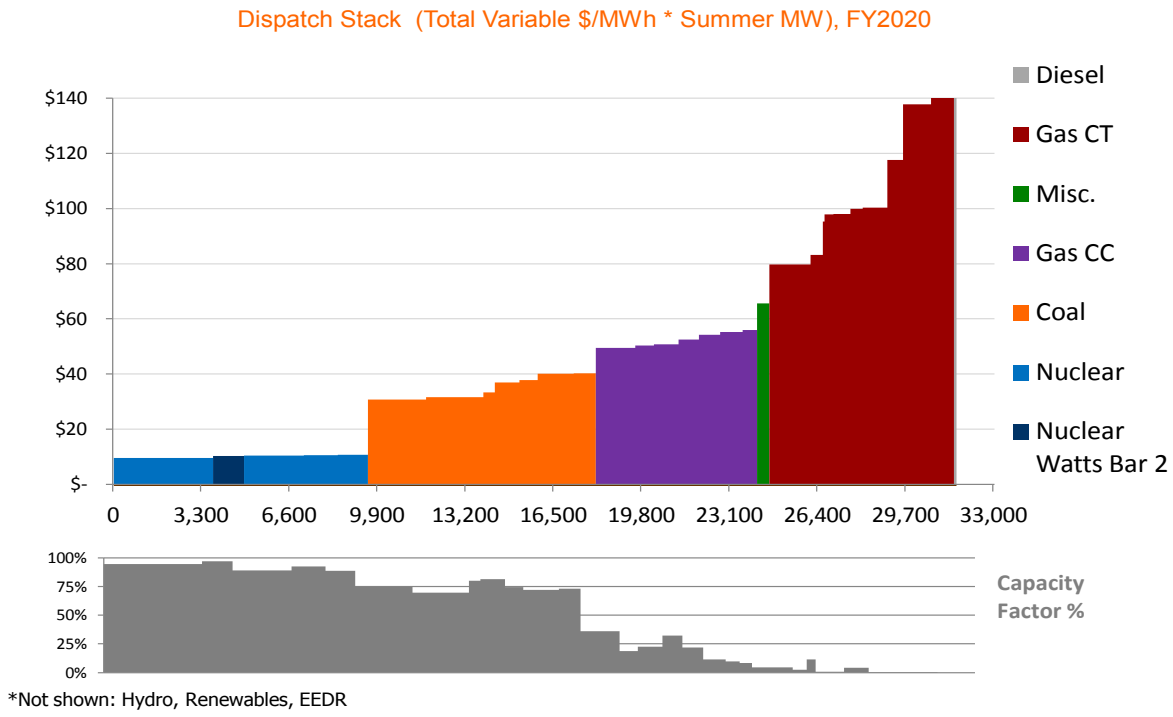


Total Capital Investment Pay Back - Expected Within 14 Years of In-Service Date



- After accounting for all construction costs, including sunk costs, and netting of all Watts Bar 2 fixed and variable operating costs against TVA marginal supply costs as well as replacement capacity costs, WBN2 will recover its construction costs by 2029, and WBN2 will provide decades of low cost, clean energy after that recovery occurs

Nuclear Generation Serves Baseload Needs



*Not shown: Hydro, Renewables, EEDR

Section 7

Schedule Overview

WBN-2 Schedule Development

This document describes the basis and methodology utilized in development of the WBN-2 schedule reforecast associated with the ETC (Estimate to Complete). **The data used to develop the new forecast shown in this report was accurate as of 03/08/2012. Although the distributions of the man-hours change daily as estimated work gets planned into work orders, the total forecast of 3,195,089 man-hours has not changed as of 5/9/12.** This schedule in the new forecast was developed after the ETC basis for commodities and unit rates were defined and overall resource requirements established. While the ETC does reflect the total manpower and cost estimate for WBN 2 project completion the new forecast is based on the remaining craft man-hours leading up to and including testing and startup activities. Scheduled man-hours do not include supervision, indirect support and other "hotel" loaded cost.

Scope Definition:

The scope basis used for schedule development is aligned with the man-hour and cost estimates associated with direct craft work, testing and startup established in the ETC. The total estimated craft work scope was broken down into four categories which include:

Category	Scheduled Man-hours
Currently identified scheduled work orders	1,772,739
Startup Support Craft Hours	460,000
Estimated growth	591,149
Expected Breakage	371,201
Total Forecast	3,195,089*

* 16 percent is subtracted from ETC direct craft estimates to remove supervision hours for schedule development.

Category Descriptions:

- Currently identified work orders – This is the scope of work that is reflected in the estimates for work orders that currently exist. This scope represents 56 percent of the ETC estimated craft man-hours remaining to complete the project.
- Estimated Growth – This category is applicable to the scheduling process only since the ETC has the total scope included. Inclusion of the growth category is required to balance the ETC estimate with the schedule scope. Estimates in this category were quantified through the ETC estimating process but have not yet had work orders generated and estimated. This scope represents 18.5 percent of the ETC estimated craft man-hours remaining.

- Expected Breakage - Breakage is defined as work that was not in the original construction completion scope or intention but is being added due to discovery in the field. This does not include expanded design scope or rework. This category represents 11 percent of the remaining ETC estimated craft man-hours. The 11 percent expected breakage was determined through a historical review of previous plant startup's and experience at WBN on system having completed the turnover process.

Once a total estimated breakage amount was determined a structured process was developed to determine the expected breakage for each system weighted against the total breakage estimate. The potential for breakage increases with system size, complexity and the window of time until completion. To relate these factors a review of remaining work on each system was performed. Work types were considered and ranked including work orders, design change documents and PER's. A formula was developed to correlate the work type and scope to system size and complexity. This formula was applied to the remaining systems with expected breakage distribution of the total estimate as follows:

- Breakage Greater than 9 percent - Top 3 systems (062-Chemical & Volume Control, 063-Safety Injection, 068-Reactor Coolant) will see a potential 6 to 12 week turnover impact.
- Breakage Between 5 percent and 9 percent - 2 systems (070-Component Cooling Water and 03B-Aux Feedwater) in this group will see a potential 6 to 8 week impact to turnover.
- Breakage Between 2 percent and 5 percent - 9 systems in this group with a potential turnover impact of 3 to 6 weeks.
- Breakage Between 0.85 percent and 2 percent - 13 systems in this group with a potential impact to turnover of 2 weeks or less.
- Breakage Less than 0.85 percent - 46 systems in this group with no impact to turnover from breakage expected.

As described in the Schedule Structure section of this document the transition window has been designed to mitigate the expected impact on system turnovers by expected breakage.

Startup Test Schedule Definition

The startup test schedule has progressed from a generic logic with standard timeframes for system turnover, component testing, flushing and preoperational acceptance testing to a schedule with sequence and logic tailored for each specific system. The initial component testing matrix, developed by the system engineer and approved by the discipline lead, defines the component testing scope. These tests are typical for components across system boundaries and include such test as control circuit checks, uncouple run and coupled runs for pumps. There is total estimate of 10,000 component tests to perform including calibrations.

Standard unit rate test times were developed for component test. Examples of these unit rate times are: megger checks 8 hrs, time delay relay calibrations 8 hrs, pump functional test 5 hrs, power transformer test 40 hrs.

Based on these unit rate times there is an estimated 73,000 test hours and with an estimate of 2.5 men per test which results in approximately 182,000 man-hours of craft time associated with component testing. All identified component tests have had unit rates determined and individually loaded into the project schedule. Due to the scope of system turnovers to date the component tests unit rates have not been fully validated. A risk contingency is included in the ETC due to the incomplete validation.

To determine the adequacy of the startup test duration an industry review of historical plant startup timeframes was performed. Based on this, it was determined that a typical startup

program would take 18 months. The WBN-2 startup test window is currently scheduled for 14 months. The basis for the 14 months is:

- The initial WBN 2 startup estimate was 12 months due to the common systems not needing to be tested.
- An additional three months was added to the test window due to the impact of working in conjunction with an operating unit WBN 1.
- By performing emergency core cooling flow testing prior to hydro allows the startup test schedule to be performed in 14 months.

Component testing will be critical to the startup program up to open vessel testing, after that point the limitation on control room activities, instrument rack access, plant maneuvers, and access limitations during ILRT will be the critical to the startup program.

Schedule Structure

The traditional method for developing schedule logic was used which starts at the end, commercial operation, and works backward through the startup logic, system testing, system turnover and finally bulk work. Reviews were completed with the startup test organization to validate the sequence and timeframes for major test and startup evolutions.

The critical aspect of schedule logic development is establishing the prerequisites for system turnover from construction to the startup test process for initial component testing. To accomplish this, detail reviews were performed for each system with the responsible startup test engineer to validate that all of the existing work required for the system being review was correctly tied to that system. This process will continue as each new work order generated will be reviewed by the engineer and coded in a controlled WITEL database which scheduling uses as a basis for adding scope/logic to a specific system.

A transition (turnover) window was established for each system. This window is a minimum of three months in duration and is schedule to allow completion of bulk work to complete on each system prior to progressing into the turnover window.. The turnover window will be focused on final system walk downs, breakage resolution, construction testing and work document closure. The man-hours estimated for expected breakage on each system are scheduled during this three month timeframe.

A bulk work window has been established and is scheduled to complete prior to the transition window for each system. This window is designed to allow maximum efficiency in the organization and sequencing of work. During this period the SPI calculation target will continue to be based on a weekly forecast for schedule progress but, the window for acceptable performance will be four weeks. Simply stated, we will establish a target for each week in schedule hours to be earned but allow credit to be given if the hours earned were scheduled anywhere within the upcoming four week window. This will allow a margin of schedule flexibility without negatively impacting the ability to monitor and prioritize activities as they become critical to complete the bulk work on a given system to support the turnover. System logic will be maintained during this window to support allow focus on specific work activities as necessary.

Schedule Development Method and Basis

The basis for the schedule reforecast included the existing schedule scope composed of 12,473 open work orders and an additional 19,714 support, testing and startup activities. There is 1,772,739 craft man-hours associated with this basis.

Activities were developed for each system to accommodate both the time required and the 371,201 man-hours of expected breakage. The breakage was distributed to each system based on the calculation described earlier and further broken down to estimates for each craft per system.

The 591,149 man-hours of growth include scope from designs remaining to be issued and walk down results. These man-hours were broken down to the craft level. The growth man-hours for each craft were incorporated into their existing scheduled activities to allow the maximum flexibility in distribution during resource leveling.

Distribution of scheduled man-hours over time (leveling) was performed on pipefitters, electricians and instrument fitters as these are the critical resources associated with project completion. The desired end state is to distribute resources in an effective manner maximizing the number available for each of the critical craft while remaining within budget. Additionally, the distribution should not result in any one craft impacting project completion significantly more than the others. All of the targeted objectives were achieved in this scheduling effort.

The target schedule including all of the expected growth scope has been established for reference and monitoring. The day to day production schedule integrity was maintained including the original baseline work activity estimates and will continue to be used to manage production. This will allow continuous monitoring of scope increases associated with growth or breakage including validation of scope change assumptions.

Implementation Plan

WBN-2 has implemented the bulk work phase of the schedule as of Jan 23, 2012. As described earlier, this window will allow work to be performed in the most efficient manner (by area, elevation, room, etc.). All work activities will continue to be logically tied to the system turnover milestones and constrained to support the approved system waterfall. This method will provide the ability to monitor work activities in the bulk work window and apply priority as required tosupport the system waterfall. This window will be controlled by the construction manager.

An additional concept included in development of the schedule is the identification of a transition window between construction bulk work and system turnover for testing. This strategy has not been implemented in previous system turnover efforts resulting in significant work activities continuing up to and impacting turnover dates. This window is established based on the system waterfall and will start on a system by system basis approximately three months prior to system turnover. The three months window duration will allow time for the worst case breakage estimate to be completed without impact to system turnover. During this timeframe the work completion walk downs, breakage repair and closeout activities needed to meet turnover requirements will be completed. This window will be controlled by the turnover manager.

At the completion of the turnover window the system will be available to start component testing through startup testing. The testing window will be controlled by the startup manager.

Monitoring & Oversight

SPI
Schedule monitoring will continue to be reported on a weekly basis with daily oversight and resolution of issues being performed though “war room” staff and meetings. During the bulk work phase the window for SPI will be broadened from one week to a four week window. This will allow a substitution of equal man-hours for a like commodity (hangers, cable) within the four week window to be included in the SPI calculation.

As systems transition from the bulk work window into the turnover window the criteria for SPI will be reduced to a one week window along with normal schedule adherence criteria applied and continue at this level through turnover to Operations.The SPI will be monitored against the CPI for project total as well as at the craft level

Estimated Growth
Daily monitoring work orders and man-hour estimates generated to eliminate the estimated growth margin is being performed. Both overall margin as well as specific craft work activities estimate increases or additions are reviewed and challenged. A daily metric depicting the margin and changes to it is issued each work day.

Expected Breakage
A controlled review process has been established which includes a review of all new work orders with an identification of those meeting the criteria for breakage. When a breakage work order is identified, it is coded in the work order tracking system (MAXIMO) and that information is transferred to the project schedule. Once in the project schedule a manpower estimate is developed allowing monitoring of the both the remaining estimate for breakage on a system basis and through the cost accounting we are tracking who is charging time to the breakage account. Using these two methods will provide both the ability to monitor what has been used from the breakage accounts and what the remaining identified scope.

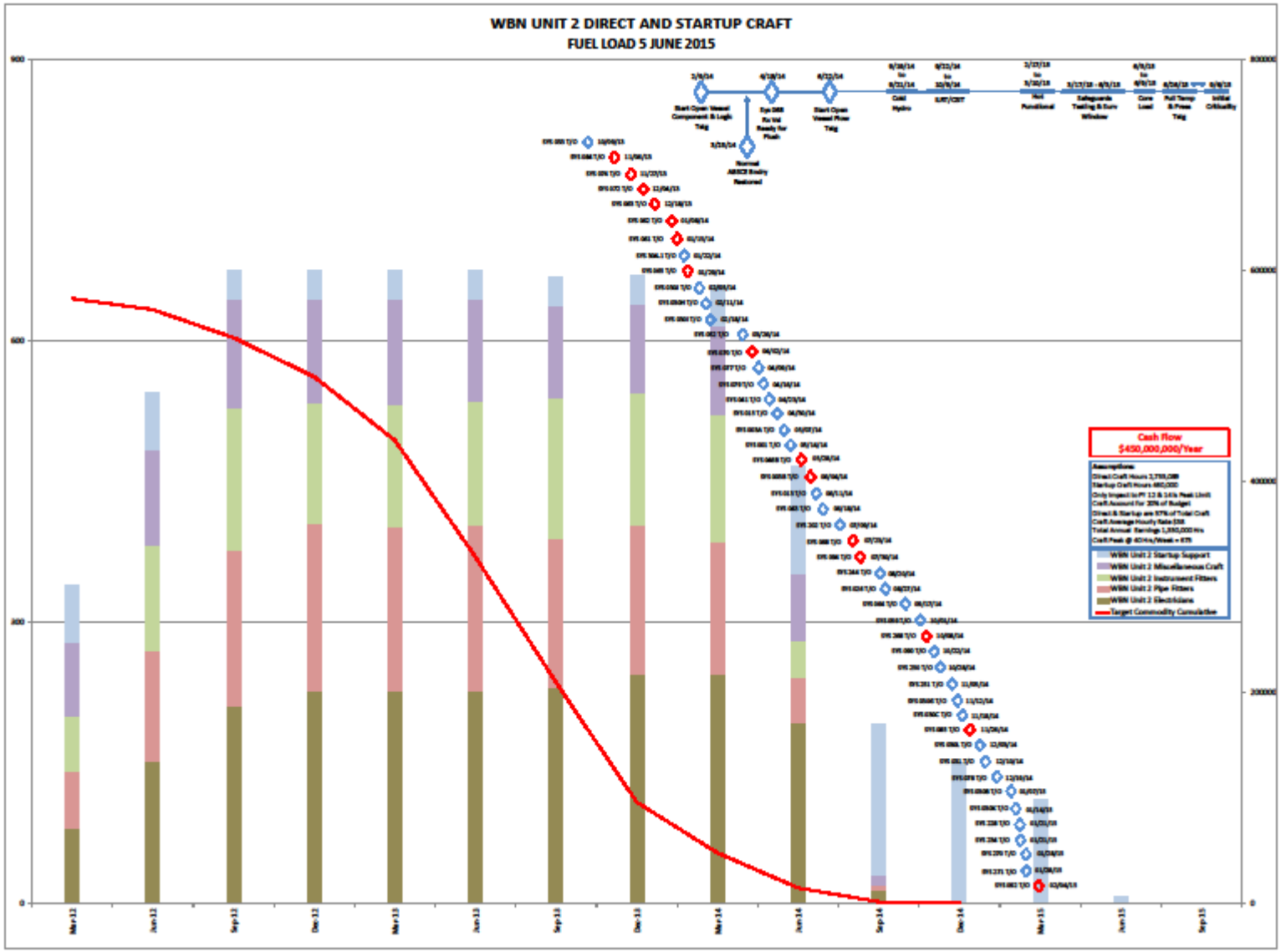
The SPI will be monitored against the CPI for project total as well as at the craft level.

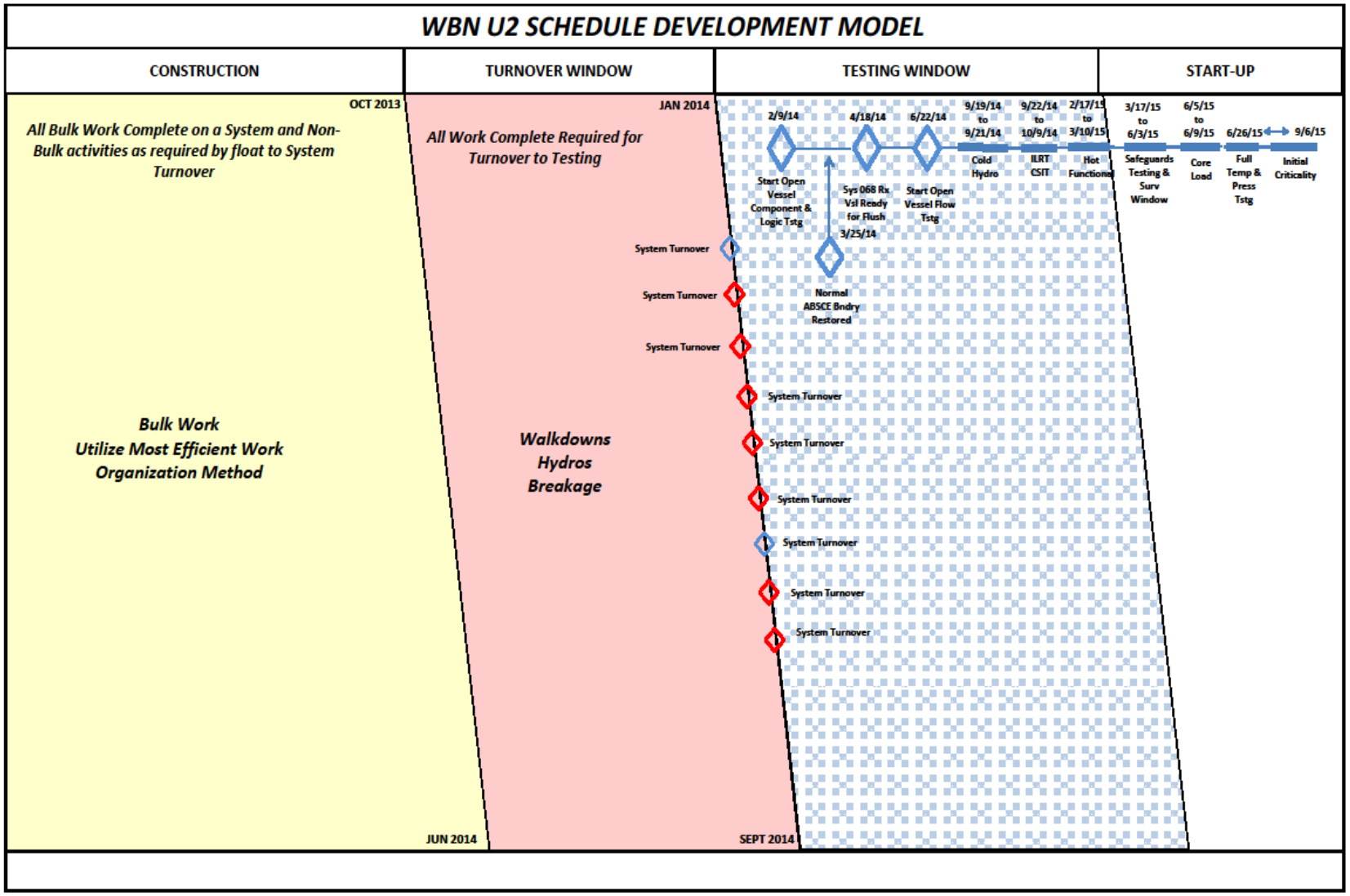
Daily Issued Monitoring Metrics Include:

SPI
Scheduled man-hours earned compared to targeted for each craft
Scheduled man-hours reported complete but not in the target for completion this week
Work activities with increases in man-hours
New work orders generated in previous 24 hours
Schedule productivity for each superintendent
Activities scheduled in previous 24 hours that did not work as planned
Scheduled man-hours for upcoming 3 weeks for each craft.
Total schedule scope analysis (changes in estimated growth or expected breakage)

Weekly Issued Monitoring Metrics Include:

All daily metrics are rolled up to a weekly summary
Weekly schedule adherence by organization and craft
CPI
Commodity Curves


WBN UNIT 2 DIRECT AND STARTUP CRAFT
FUEL LOAD 5 JUNE 2015
Cash Flow
$450,000,000/Year
WBN Unit 2 Startup Support
WBN Unit 2 Miscellaneous Craft
WBN Unit 2 Instrument Fitters
WBN Unit 2 Pipe Fitters
WBN Unit 2 Electricians
Target Commodity Cumulative
Mar-12
Jun-12
Sep-12
Dec-12
Mar-13
Jun-13
Sep-13
Dec-13
Mar-14
Jun-14
Sep-14
Dec-14
Mar-15
Jun-15
Sep-15


WBN U2 SCHEDULE DEVELOPMENT MODEL
CONSTRUCTION
TURNOVER WINDOW
TESTING WINDOW
START-UP
OCT 2013
JAN 2014
All Bulk Work Complete on a System and Non-Bulk activities as required by float to System Turnover
All Work Complete Required for Turnover to Testing
Bulk Work
Utilize Most Efficient Work Organization Method
Walkdowns
Hydros
Breakage
JUN 2014
SEPT 2014
2/9/14
Start Open Vessel Component & Logic Tstg
4/18/14
Sys 068 Rx Vsl Ready for Flush
3/25/14
Normal ABSCE Bndry Restored
6/22/14
Start Open Vessel Flow Tstg
9/19/14 to 9/21/14
Cold Hydro
9/22/14 to 10/9/14
ILRT CSIT
2/17/15 to 3/10/15
Hot Functional
3/17/15 to 6/3/15
Safeguards Testing & Surv Window
6/5/15 to 6/9/15
Core Load
6/26/15
Full Temp & Press Tstg
9/6/15
Initial Criticality
System Turnover
System Turnover
System Turnover
System Turnover
System Turnover
System Turnover
System Turnover
System Turnover
System Turnover

Section 8

Project/Licensing Risk Overview

Project / Licensing Risk Assessments

Risks assessments were performed on Construction risks and Licensing / Project Risks. The following describes the process used for each and the results of the assessments.

Construction Risks

Risk assessments were conducted on the proposed funding and schedules for completion of the WBN2 project. The assessment included 3 categories:

1. Completion of direct work commodity accounts
2. Non-direct work accounts (support, startup, materials, sub-contracts, etc)
3. Projects to address Licensing Issues.

1. Direct Work Commodity accounts: The accuracy of commodity estimates (quantities and unit rates) were assessed during development of this ETC in order to provide a recommendation for contingency based on uncertainties. The following process was utilized to establish the ranges of uncertainty.

- Risk assessments were performed on commodities that contained more than 10K hours "to-go" in order to establish a level of confidence in the estimate prepared by the Team.
- Risk assessments performed via a series of team meetings by discipline with inputs from SMEs to gain a consensus.
- Unit Rates and Quantities were assessed for 3 confidence levels to develop the risk table:
    - **Low**: The lowest unit rate or quantity the team believes can be used and still have a chance (10% probability) to make the unit rate or quantity
    - **Most Likely**: The unit rate or quantity the team believes can be used and have an equal chance of being under run or over run (50 percent probability). This is normally the goal of an estimate, a reasonable mid-point value.
    - **High:** The unit rate or quantity the team believes can be used and almost always (90 percent probability) would be under run.

  The attached spreadsheets (Attachment 1) reflect the values for each commodity that were used in the modeling.

2. Non-Direct Accounts: The accuracy of estimates was assessed during development of this ETC in order to provide a recommendation for contingency based on uncertainties. The following process was utilized to establish the ranges of uncertainty.

- Risk assessments performed via a series of team meetings with inputs from SMEs to gain a consensus on the scope and accuracy.
- Each account was assessed for 3 confidence levels (most likely and bounding) to develop the account ranges.

Attachment 2 reflects the ranges established and used to determine contingency for non-direct accounts.

3. Projects addressing Licensing Issues: The accuracy of estimates was assessed during development of this ETC in order to provide a recommendation for contingency

based on uncertainties. The following process was utilized to establish the ranges of uncertainty.

- Risk assessments performed with inputs from Licensing and the Key Senior Management team to gain a consensus on the scope and accuracy.
- Each project was assessed to determine the probability of occurrence, timing and cost range of values.

Analysis:

- Established distribution profile in percentages associating % contingency needed versus risk level
- Distribution profiles were evaluated using industry standard models and methods for establishing risks and contingencies.
- Schedule impacts were included in each area to ensure costs associated with project delays are incorporated into the assessment and recommendation..

Conclusion for Construction Risk Assessment and Contingency

The analysis of these ranges for commodity completion, non-direct work accounts and inclusion of certain Licensing Projects resulted in contingency funding recommendations as reflected on the attached funding spreadsheet (Attachment 3). The report from HighBridge Inc. (Attachment 4) reflects the modeling results that support contingency funding.

Licensing / Project Risks

A risk register was developed using the input from Licensing and the Key Station Management team. Each risk item was assessed to determine the probability of occurrence, timing and cost range of values.

Section 9

Performance Improvement Plan

In addition to the Corrective Actions discussed in the Cause Analysis section of this report, the following initiatives are being taken to address improvement opportunities in increasing production and efficiency. Each of these initiatives has a detailed plan of actions that are being discussed and progressed with the WBN Management team weekly. These are not inclusive of all actions and additional actions will be added and tracked as new initiatives are identified.

Electrical

1. Electrical ICARD's data base updating and process changes and Legacy Work Package Walk downs
    A. WBN2 Electrical Organization has over 500 Legacy Work Packages that require walking down for status of commodities. These packages and ICARDs do not convey the actual condition of the installation. This action plan will be to establish process path for walk down, ICARDs updating, production ICARDs and for a establishment of a team for review of the ICARDs data base for the purpose of updating the complete system to reflect actual installations in WBN2. This will allow a greater accuracy on ETC for the future. This plan also includes replanning of the Legacy Packages, closure of Legacy packages and implementation of replanned or regenerated (new) packages for ease of installation.
2. Electrical Conduit Installations Unit Rate
    A. WBN2 Electrical Organization present ETC for conduit is at 27,000. Unit Rate at present is 4hr/lf. Industry and TVA recommended is 2.5 hr/lf. Reduction of the Unit Rate will bring closure to risk.
3. Electrical Conduit Supports Installation Unit Rate
    A. WBN2 Electrical Organization present ETC for conduit is at 27,000. Unit Rate at present is 30 hours each support. Industry and TVA recommended is 25 hours each. Reduction of the Unit Rate will bring closure to risk. WBN2 present process for support credit includes anytime a support is used (even if previously installed, that the support UR and MH are charged. Review/control required to eliminate this practice and to place controls/process in place for one time only credit/charge on supports)
4. Commodity Bulk Work
    A. WBN2 Electrical Organization with present progress and the use of the System Turnover Completion Scheduling process will not be able to achieve completion of commodities in the required timeframe of the WBN schedule. To allow for better productivity, efficiency, reduction of Unit Rates and commodity completion, post the Legacy package WO walkdown Milestones. The schedules and work packages must reflect installations that are scheduled with approximately a 4 week rolling construction schedule and area/room considerations made when scheduling this work. If areas or rooms are reviewed for all possible work, then the installations can be reviewed to implement the most efficient use of space, coordination issues and hardware installations, which then allows review of the Unit Rates for reduction if possible.
5. Cable installations Unit Rate Reduction
    A. WBN2 Electrical Organization has approximately 255,000 (305K @ 90%) feet of cable to install. This commodity at present has a Unit Rate of 0.75 hr/LF. Industry and TVA recommended is 0.2 -0.4. The goal is a reduction to provide a closure on the risk to ETC.

Mechanical Piping and Hangers

6. Work Order Closure
    A. There are a significant number of work orders that are reported field work complete, but require additional work (Documentation correction and / or physical work) to put into closure. Work orders previously assigned to Night Shift have been turned over to Day Shift to Complete/ Close. it is recommended that a separate group be set-up within the pipe support group to correct, complete, and close these work orders.

7. QC Support / Certifications (Common issue for all disciplines)
    A. During analysis of the cause for increased unit rates (affecting all disciplines), it was found that there were reports of excessive delays during performance of work activities involving QC Inspections. There appear to be significant opportunities for improvement in the staffing, utilization and coordination/communication with QC, including better management to avoid rejections. This action plan is intended to address that opportunity.

8. Minimize Temporary Support Requirements
    A. There are 77 temporary supports required by EDCR to maintain the ABSCE Boundary, for systems 3, 62, and 63 (The team reviewed the systems with largest number of EDCR required temporary's. i.e. @ 70%). These supports are required to be full capacity supports and often require more fabrication/erection time than the Modification required for the Permanent support.

9. Revise Procedures
    A. Revise procedures 1206 and 3401 to reduce the amount of paperwork and redundant signatures.

10. Develop a 4-6 week, 90 day schedule/ Bulk Construction/Complete WO Walk downs
    A. The current scheduling and work management philosophy for systems turnover does not allow the flexibility needed for completion of remaining bulk work in an efficient fashion. Develop a 4-6 week schedule based on presently known system waterfall. Establish our WO walk down to be driven by team of Planner, Field Engineer, Superintendant and Craft Supervisor

HVAC

11. CRDM FANS
    A. Installation of the CRDM fans is restrained by timing for Polar Crane availability. Each fan weighs approx. 4500 lbs. . Need plans and contingencies for material handling and rigging.

12. SPIDER HANGERS construction
    A. The fabrication and installation of complex HVAC SUPPORTS 197-4000, 197-4001, 197-4002, & 197-4003 are estimated at 7000 mhrs / hanger. Opportunities to reduce the scope and improve the man-hours thru elimination of some welds and scheduling to optimize lessons learned.

13. Develop system to track duct span progress.

A. Tracking by spans does not allow enough granularities to adequately monitor progress to the schedule. Each span has a fixed number of mods with difficulty levels determined. Take the budgeted hours for each mod and divide by the total budgeted hours for all mods in that span to determine the % completes. Each mod will be broken down into categories from task start to task completion with each category being weighted for a total of 100% of the mod budgeted hour. Will be tracked by data base.

14. WORK SPACE RESERVATION/HVAC SCHEDULING STRATEGY SEQUENCE
    A. Work is complicated by interferences from other work groups. There is no current system to designate space reservation so that possible interferences are identified and prevented. This action plan develops and implements a space reservation program.

15. LCC coil replacement.
    A. LCC Coil unit changeout requires the removal of plant equipment and re-install after changeout. Changing out all cooling coils on all 4 LCC units is required in a very congested area. This plan identifies the interferences in advance and optimizes the installation plan with increased Field Engineering and Supervision planning.

Instrumentation and Controls

16. 2 to 1 taper of welds
    A. The use of 2-1 taper increase the time required to make a socket weld by approximately 150%. The requirement for utilization of 2-1 welds has been applied generically, and there appears to be opportunity to reduce the amount of 2 to 1 tapered welds.

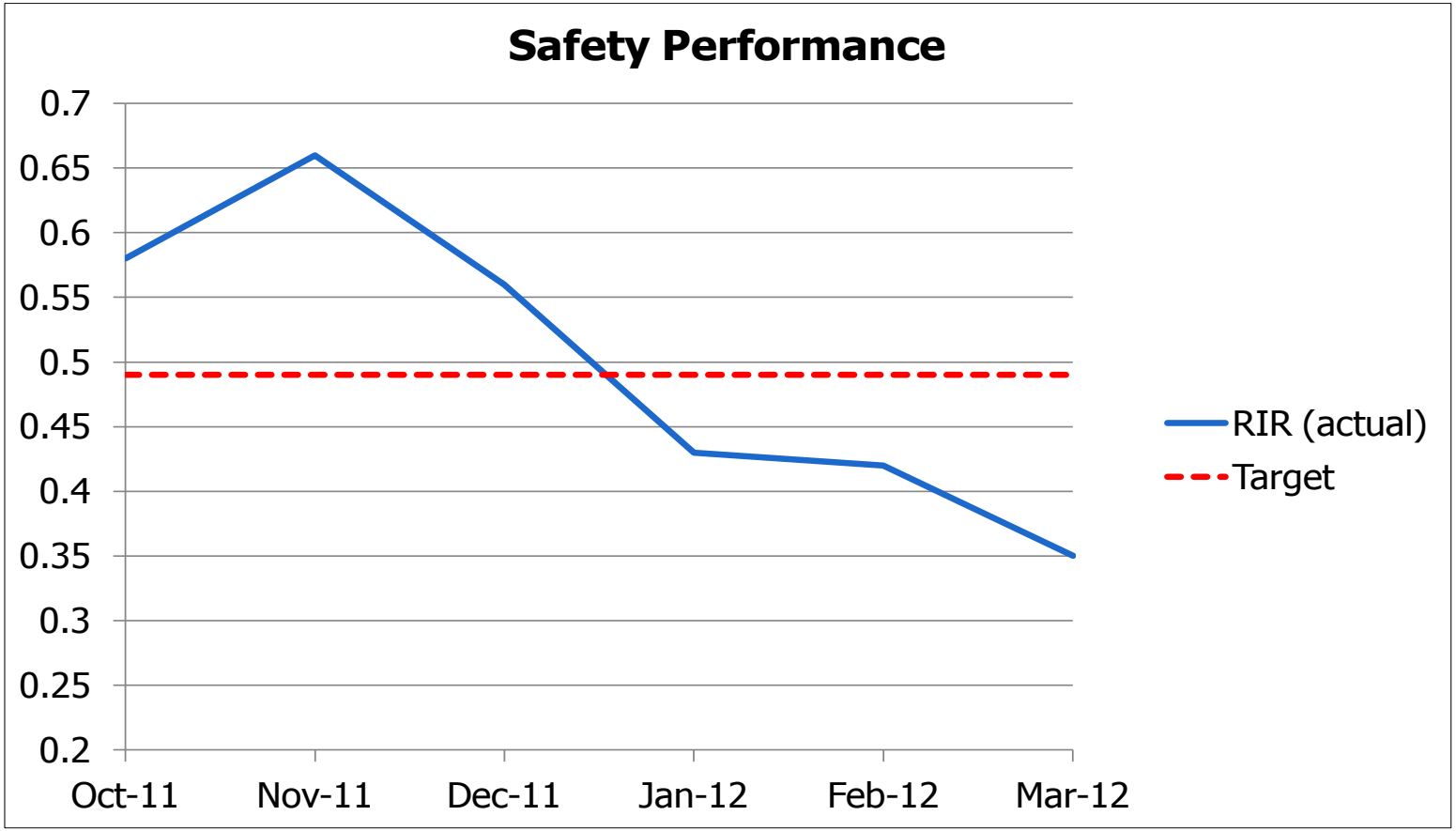
17. Investigate Possibilities of utilizing Dry Fit Pipe
    A. Some piping was installed (dry-fit) during the original construction on U2. The current plan requires that all of this be removed and replaced. There is opportunity to utilize much of this previously installed piping with some research to find material heat numbers in contract files (traceability). Investigate utilizing more of the Dry Fit Pipe in the field.

18. Complete I & C WO Walk downs for inscheduling activities
    A. To complete the Inscheduling WO walk downs. There are 145 WO to be walked down, four craftsmen and two FE's are performing the task at this time. To be driven by team of Planner, FE, Supt. and Craft Supt.

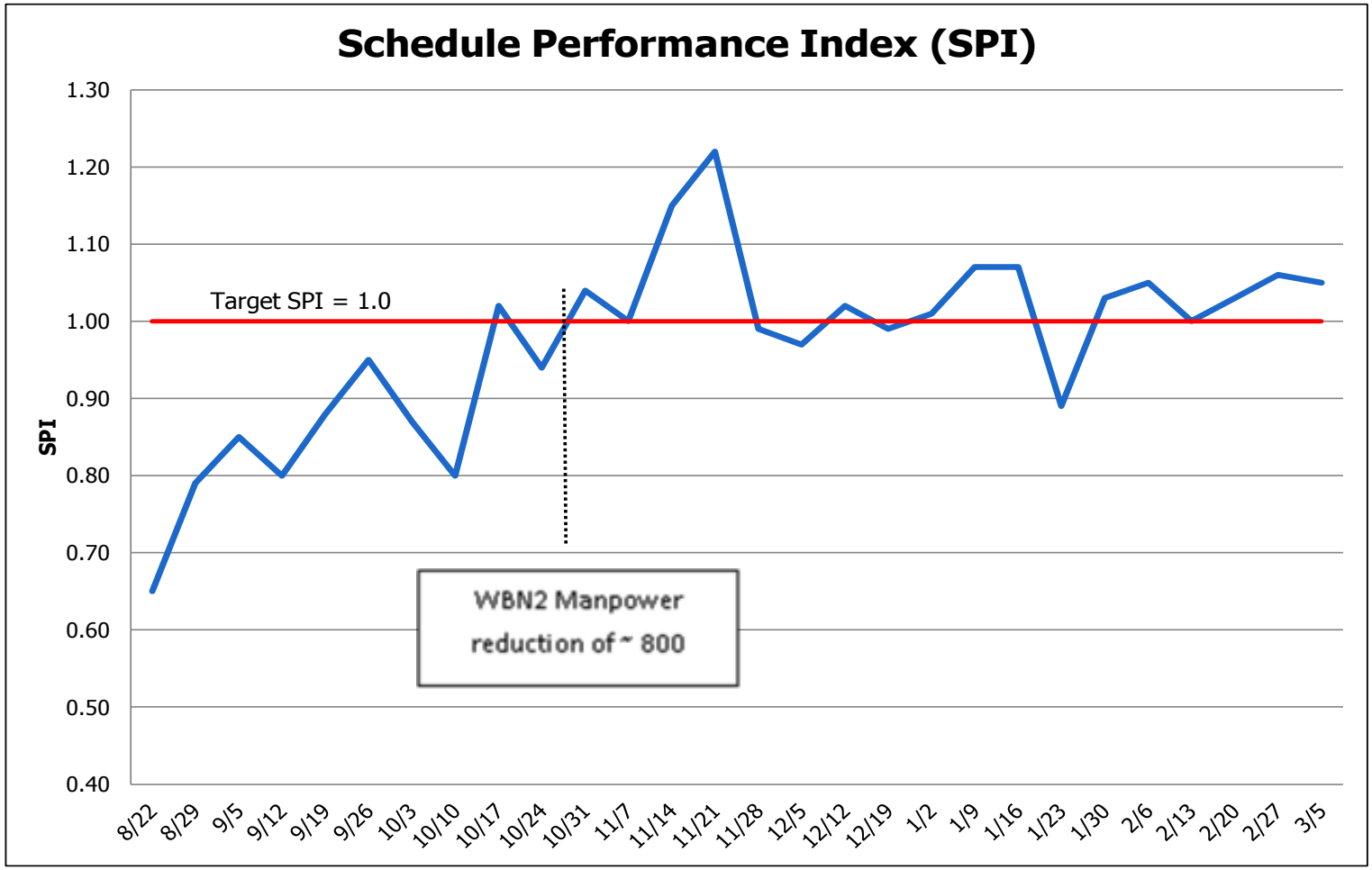
19. Evaluate and improve the process for orbital welding
    A. The current unit rate for orbital welding is trending extremely high at 15, with the expected at 6 hours. Streamline process.

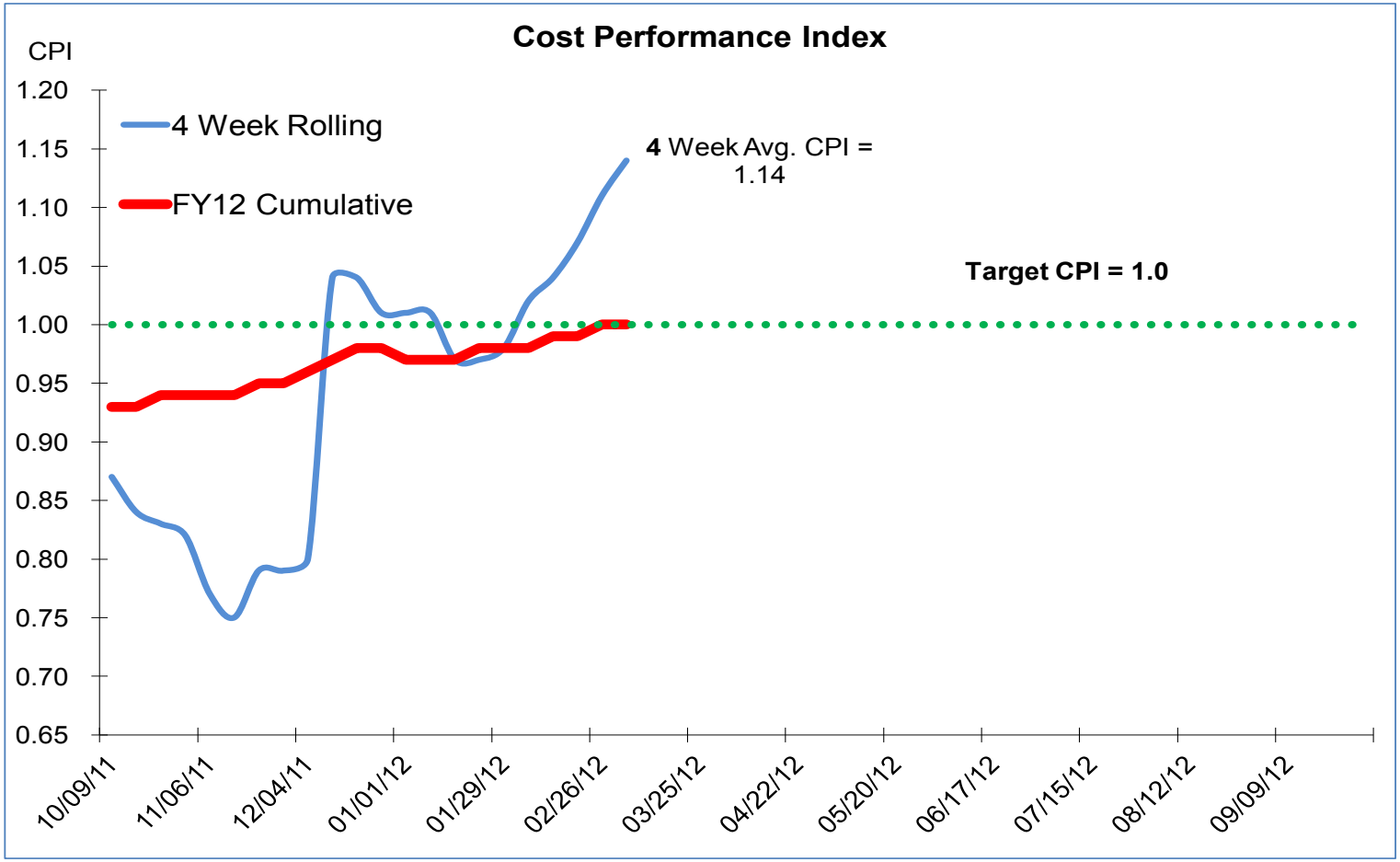
20. Revise Procedures
    A. Evaluate all procedures and data sheets required for work order's and identify opportunities to reduce unnecessary documentation for project improvement.

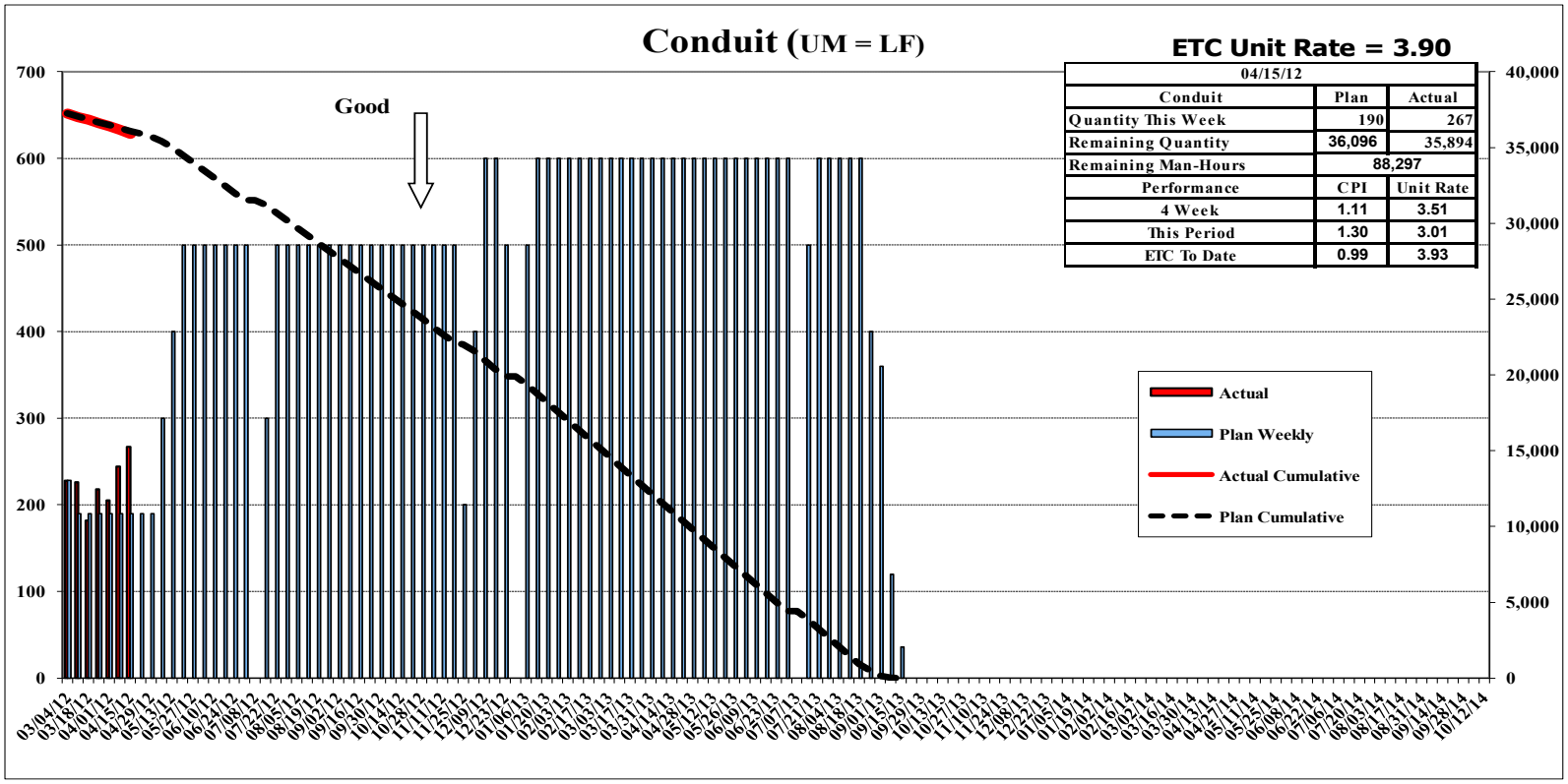
Project Status Report

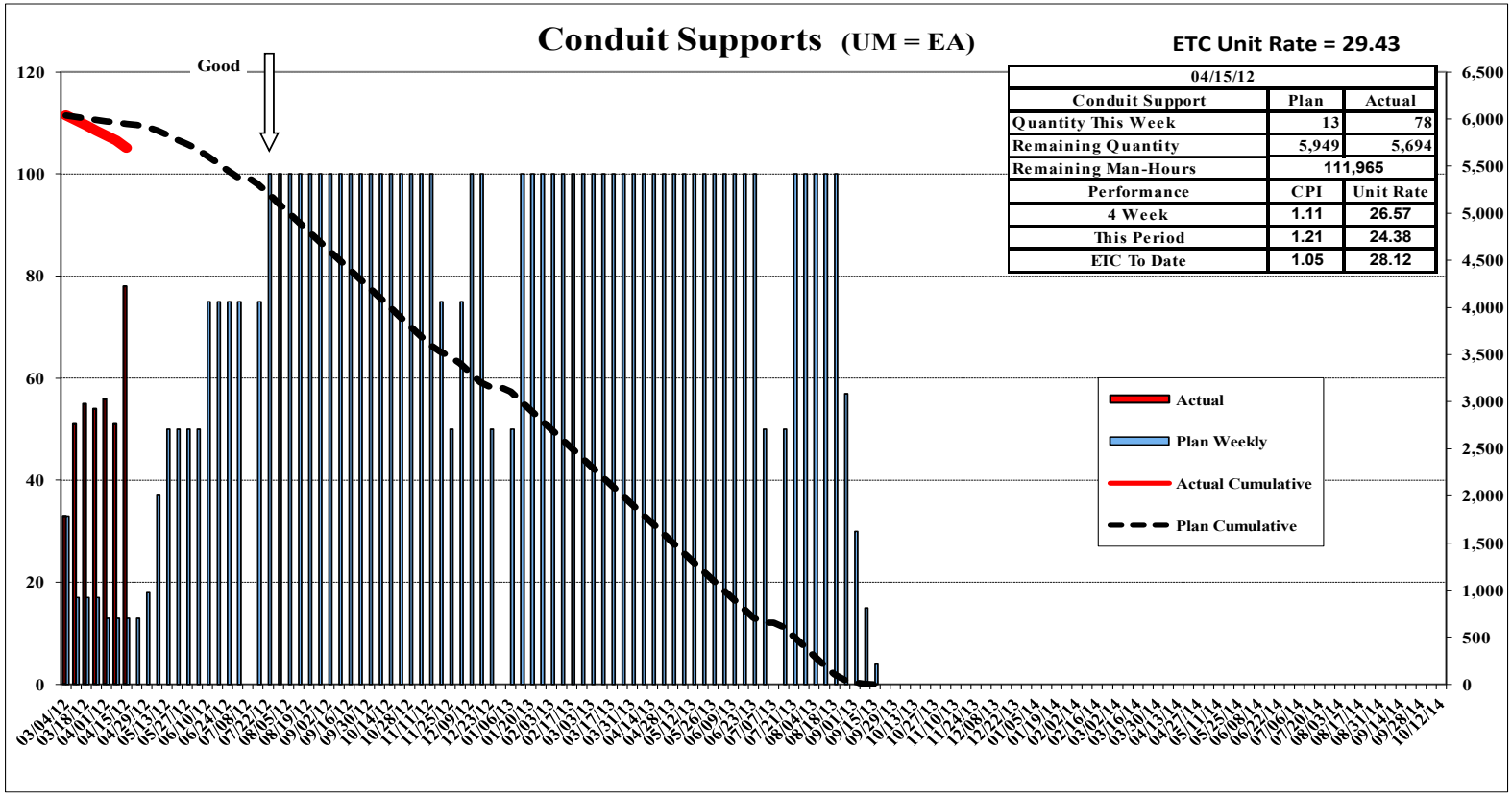


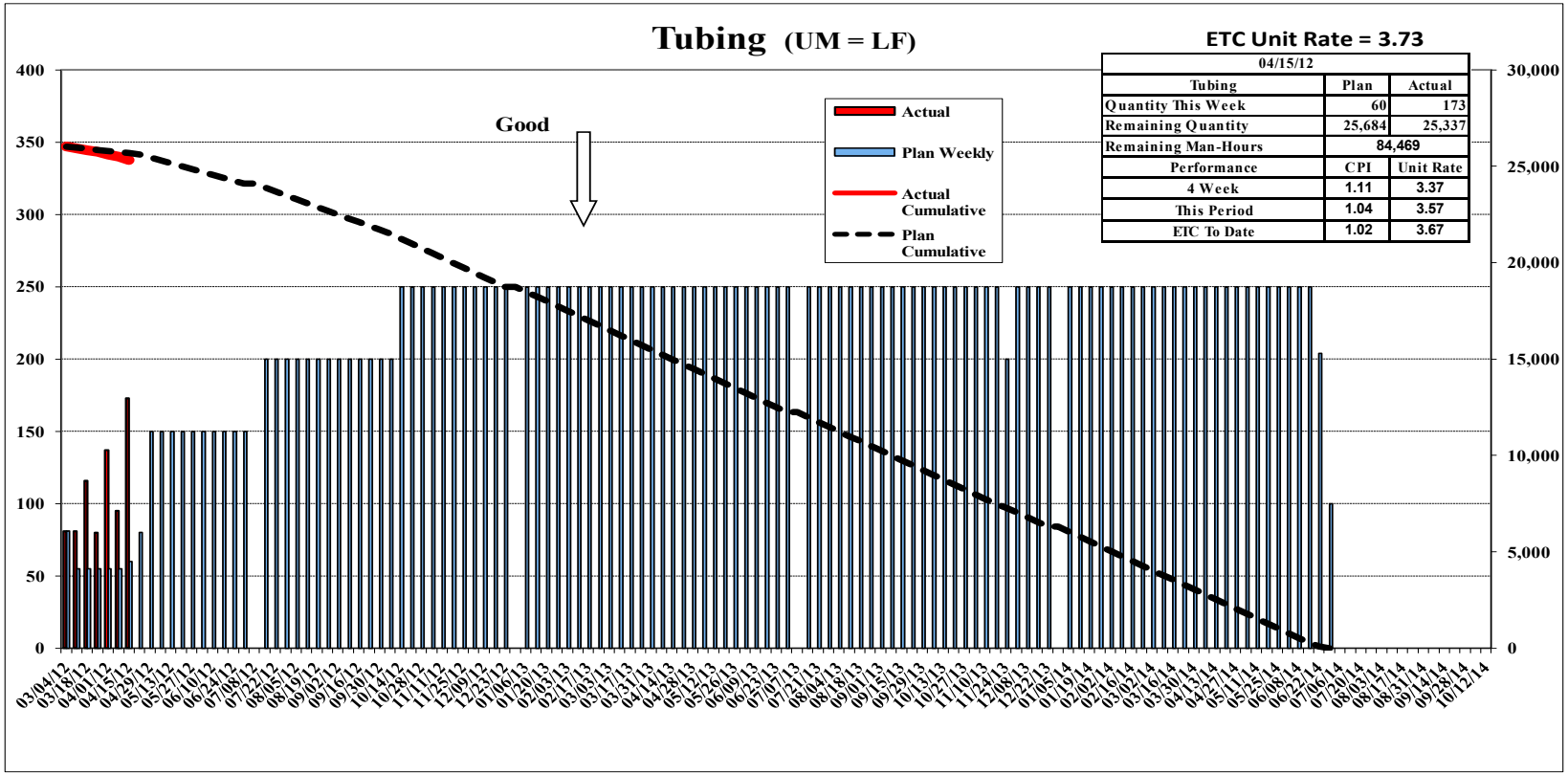
	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Acceptance %	98.1%	98.5%	97.6%	98.1%	97.6%	97.5%	98.1%	96.5%	97.0%	97.0%	96.5%	97.9%



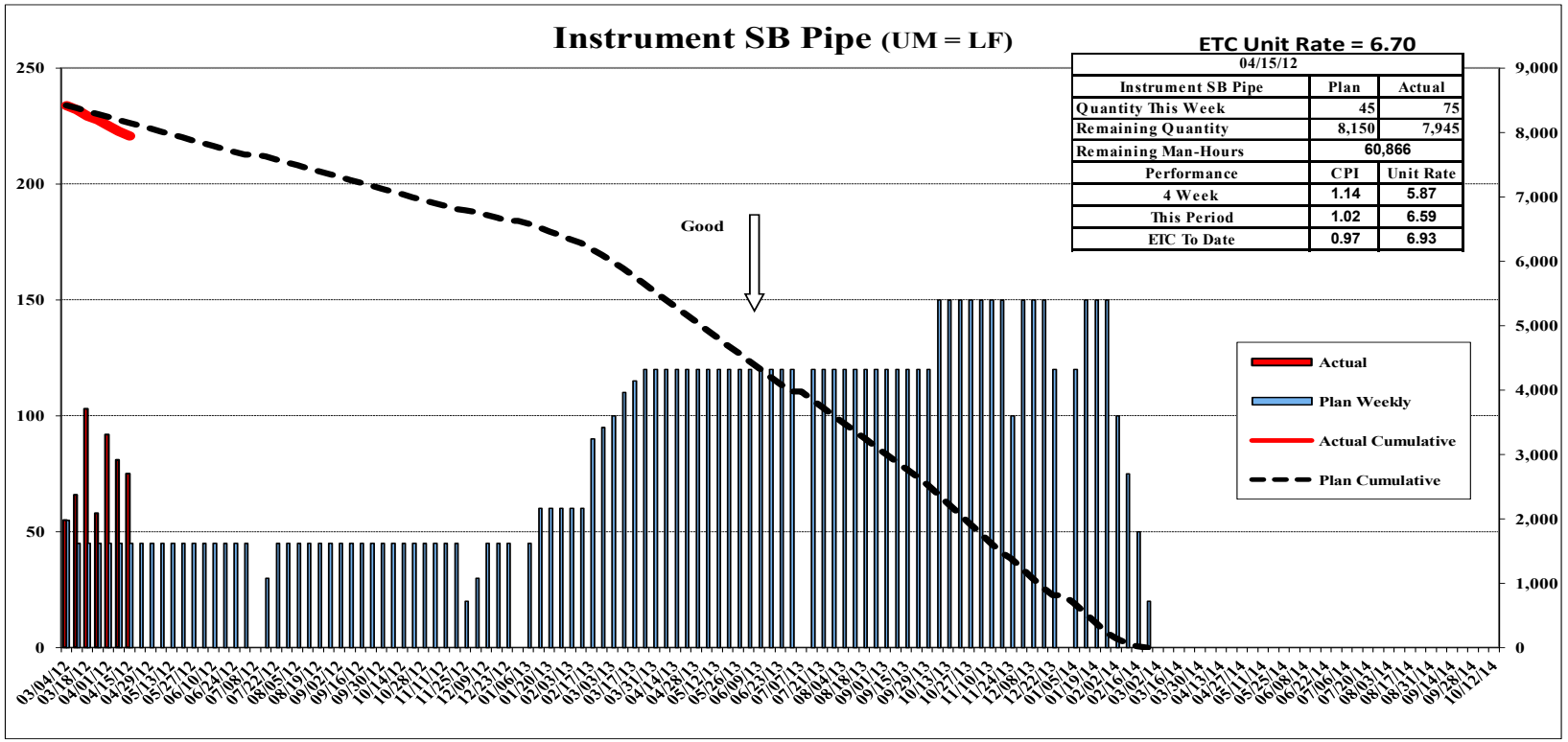


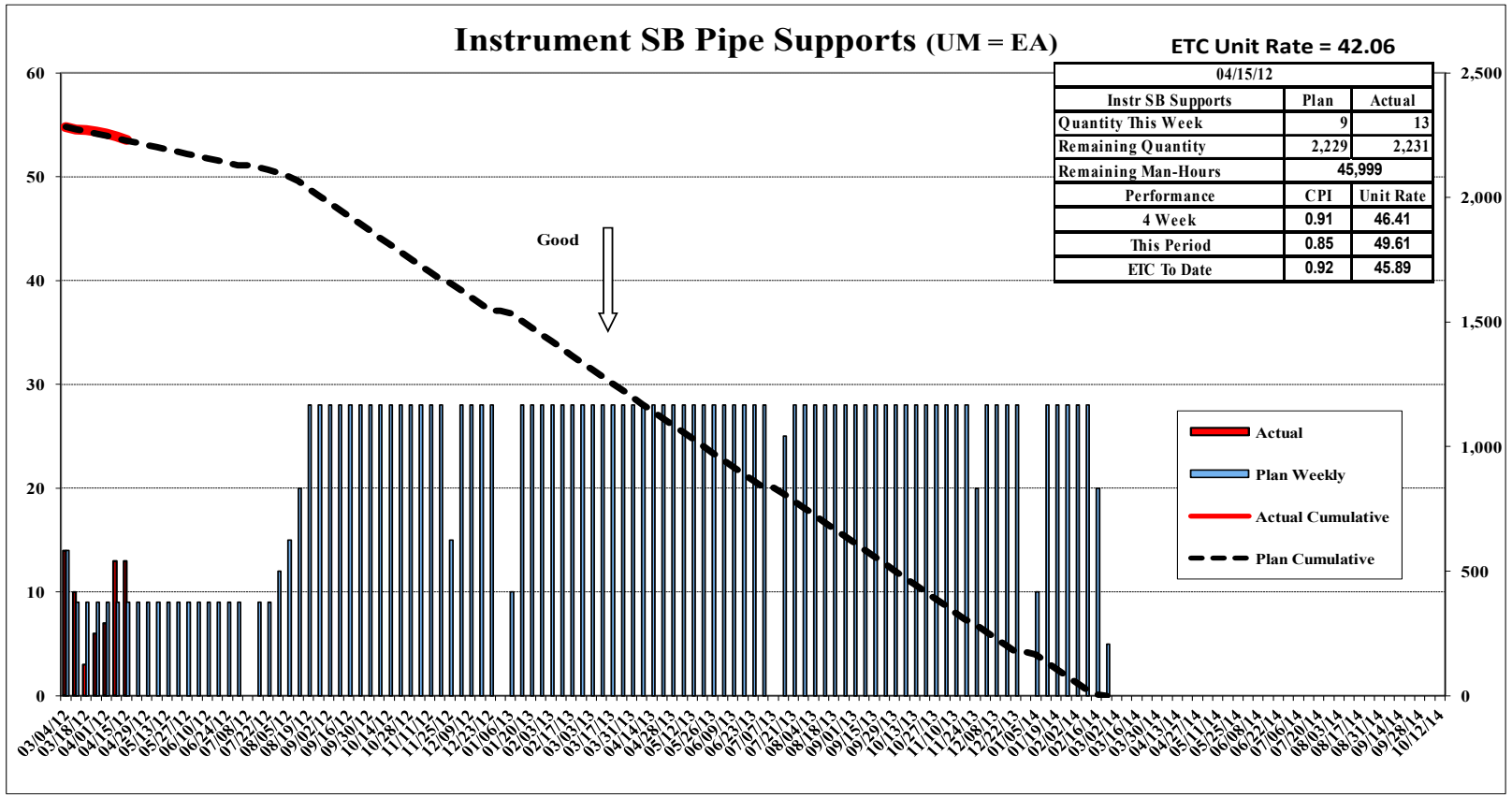


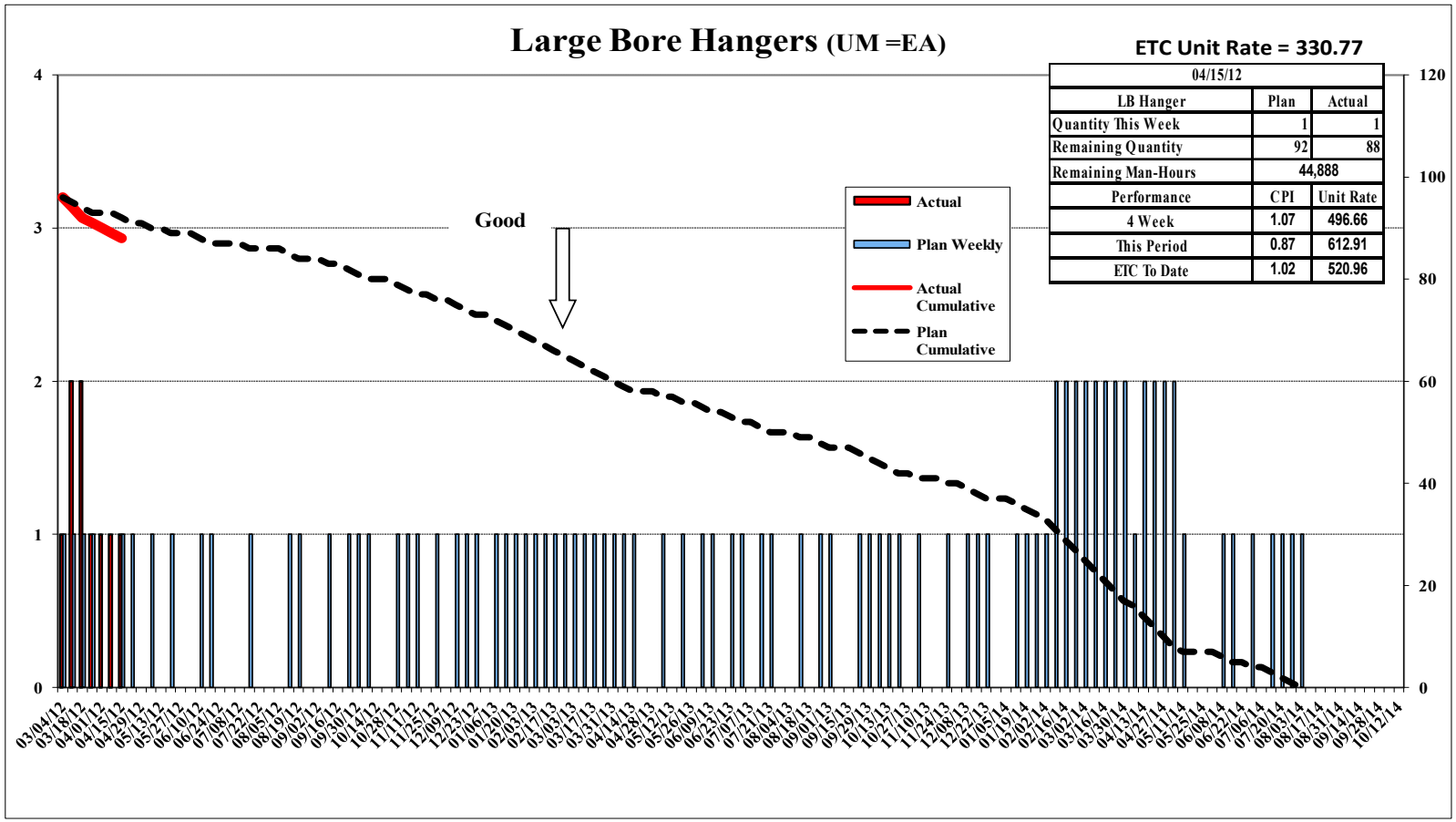


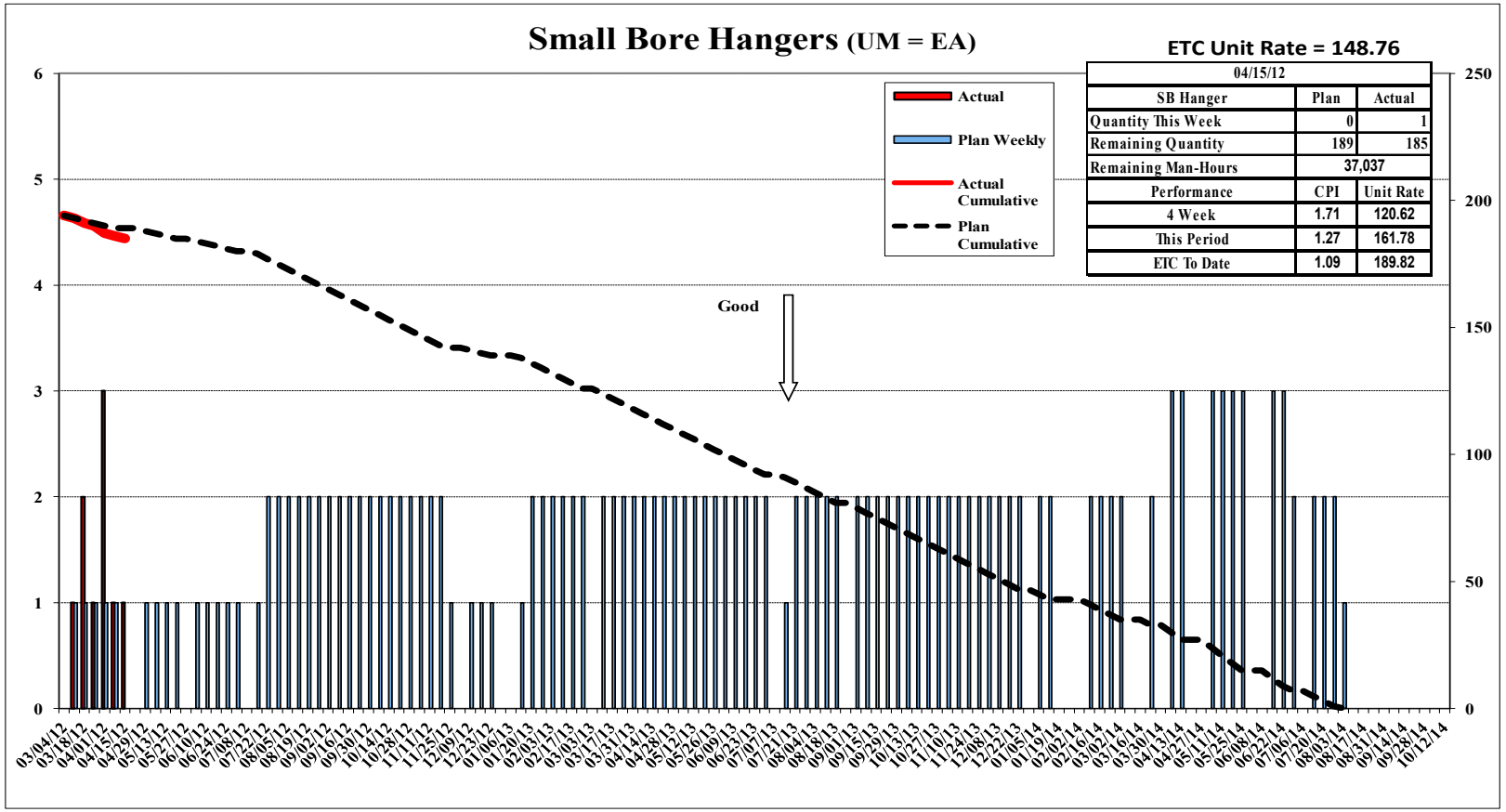


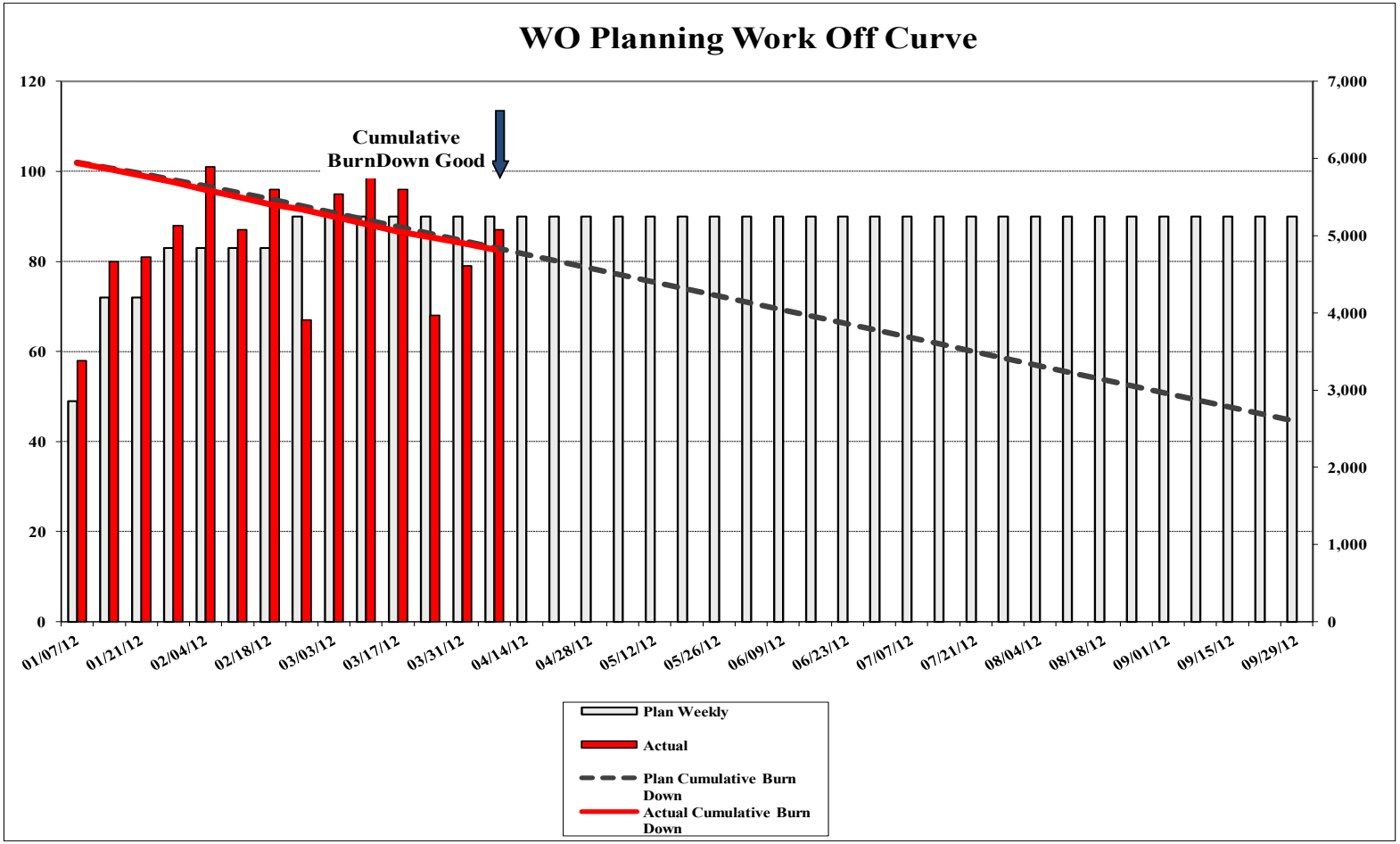
04/15/12		
Tubing	Plan	Actual
Quantity This Week	60	173
Remaining Quantity	25,684	25,337
Remaining Man-Hours	84,469	
Performance	CPI	Unit Rate
4 Week	1.11	3.37
This Period	1.04	3.57
ETC To Date	1.02	3.67











Section 10

Summary

The WBN2 Project was experiencing cost overruns and schedule delays. A new management team was put on the project and began to implement an improvement plan. This plan consisted of:

- Defining the problem
- Performing a cause analysis
- Developing a rigorous corrective action plan
- Developing a new estimate for project completion
- Developing project oversight and monitoring tools to track performance improvement

The new project estimate was compared to the cost of new build gas. The analysis demonstrated that completing WBN2 at the new estimate is a good value for the ratepayers.

The corrective action plan put in place has resulted in demonstrated improved project performance.