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Office of River Protection  
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P.O. Box 450, MSIN H6-60  
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CCN: 132848

MAR 31 2006

Dear Mr. Schepens:

**CONTRACT NO. DE-AC27-01RV14136 – REPORT OF EXTERNAL REVIEW TEAM FOR THE HANFORD TANK WASTE TREATMENT AND IMMOBILIZATION PLANT - FINAL REPORT TITLED: “COMPREHENSIVE REVIEW OF THE HANFORD WASTE TREATMENT PLANT ESTIMATE AT COMPLETION”**

On behalf of Tom Hash, Chairman of the Board of Bechtel National, Inc. the report of the External Review Team (ERT) is attached in accordance with the commitment made to Secretary Bodman. Please note that this is the final report.

In November of 2005, the ERT was assembled with recognized experts from the Engineering & Construction Industry and Academia who have demonstrated expertise in the design, construction, operation, project management, and cost estimating of Nuclear and Chemical Processing Plants. The 16-member team was comprised of individuals from outside Bechtel including most major Department of Energy (DOE) suppliers and competitors of Bechtel as well as retired Bechtel engineers. The talent brought to bear for this type of cost and schedule review is unprecedented in the DOE complex.

The ERT's charter was to challenge the cost and schedule estimate produced by the Hanford Tank Waste Treatment and Immobilization Plant (WTP) project in December of 2005 (which assumed fiscal year 2006 funding at \$626 million) through a thorough and critical review. The ERT assessed the scope of the project, the contract requirements, the management execution plan, the project schedule, the cost estimate including contractor contingency, and performed an analysis of risks outside the current scope of work.

The ERT concluded that the execution plan for the contract scope of work, the estimating methodology and the estimate itself were generally valid and defensible and achieve an 80 percent confidence level as measured by standard industry criteria. However, to provide a higher confidence estimate, the ERT made several recommendations focused on increasing allowances for the possibility of future economic inflation, the availability of a skilled workforce to operate the WTP, and to provide more conservatism to address future uncertainties in the remaining work scope.

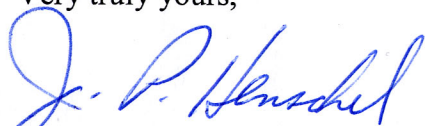
The ERT also made several recommendations to incorporate risks presently outside the scope of work that have been captured in the Technical and Programmatic Risk Analysis (TPRA). Examples include the impacts associated with the reduction in fiscal year 2006 funding from \$626 million to \$490 million, operational enhancements recommended by the External Flowsheet Review Team, and new regulations recently included in the WTP contract. Further, the ERT recommends that the DOE increase the TPRA allowance by another \$1.0 billion to address future "unknown unknowns" and that a more proactive risk management program be initiated to identify and manage these risks.

In total, the ERT concludes that incorporation of all ERT recommendations would increase the December estimate (including TPRA, but not including fee) from \$10.5 billion to \$11.3 billion and would extend the schedule by an additional 18-24 months. However, due to the project's annual funding constraint, the ERT's \$11.3 billion estimate may not have included sufficient allowance for the total impact of transferring items from TPRA into the scope of work since TPRA is not funded. This will need further analysis that will be conducted during the completion of the May, 2006 Estimate At Complete (EAC) which will be based on fiscal year 2006 funding of \$490 million and \$690 million thereafter.

We are taking immediate action and working with DOE to establish the appropriate path forward to include the ERT recommendations in the May EAC. This collaboration is essential since actions to incorporate many of the ERT recommendations require guidance and decisions by DOE. It is also our plan to retain representatives from the ERT to provide validation of the WTP project team's plans and actions to incorporate the ERT findings.

This review has identified important issues that must be addressed in future cost estimates to assure the total program is managed within a high-confidence realistic cost and schedule baseline. This review is a key milestone to assure the success of the WTP.

Very truly yours,



J. P. Henschel  
Project Director

CMA/tjm

Attachment - Comprehensive Review of the Hanford Waste Treatment Plant Estimate at Completion





# **Comprehensive Review of the Hanford Waste Treatment Plant Estimate at Completion**

**Assessment Conducted by an Independent  
Team of External Experts**

**March 2006**

**Chartered by the Hanford Waste Treatment  
and Immobilization Plant Project  
at the Direction of the US Department of Energy  
Office of Environmental Management  
Washington, DC 20585**

# Comprehensive Review of the Hanford Tank Waste Treatment and Immobilization Plant Estimate at Completion

Assessment Conducted by an  
Independent Team of External Experts

March 2006



## Executive Summary

Following an August 2005 corporate commitment to the Secretary of Energy, Bechtel National, Inc. chartered a team of industry experts to review the technical, cost, and schedule aspects of the Waste Treatment and Immobilization Plant (WTP) project. This summary reflects the observations and recommendations of the EAC Review Team (ERT), comprised of six senior industry consultants, six retired Bechtel employees, one current Bechtel employee, three employees of Bechtel's competitors, and one academic.

ERT was charged with conducting a comprehensive review and analysis of WTP's cost and schedule baselines. The target of the review was the "Total WTP Project Estimate at Completion," issued 30 December 2005. This "626 EAC" is based on funding of \$626 million in FY2006, continuing thereafter at 690 million constant dollars per year. The 626 EAC is a step toward the 490 EAC scheduled for delivery in May 2006. Reflecting lower FY2006 funding and segmented into caps for five individual facilities, the 490 EAC is expected to become WTP's revised performance measurement baseline.

ERT was to assess and comment on the:

- Efficacy of the project execution plan underlying the 626 EAC.
- Credibility of the estimate and schedule.
- Overall confidence level of the 626 EAC.

From this assessment ERT concludes:

1. The base 626 EAC, including contingency associated with Bechtel's contract scope and contract-compliant project execution plan, is generally defensible and achieves an 80 percent confidence level by standard industry criteria. However:
  - Technical and Programmatic Risk Assessment (TPRA) did not address the "unknown unknowns" associated with so-called "pioneer process plants."
  - Without consideration of these unknowns, the aggregate of base EAC plus TPRA is closer to a 50 percent confidence level.
2. DOE would be prudent to recognize unknowns in TPRA by including in the EAC:
  - An additional \$1 billion to bring the entire 626 forecast (EAC + TPRA) to an 80 percent confidence level.
  - A schedule extension of 18 to 24 months to reflect current funding limitations.
3. The 626 EAC would be more credible if a) adjusted for certain recommendations in this report, and b) backstopped by more proactive risk management.

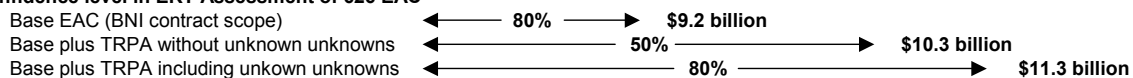
ERT recommends:

1. Increasing the EAC (including TPRA) to \$11.3 billion (excluding BNI fee) to incorporate "unknown unknowns" and raise the confidence level to 80 percent.
2. Extending the schedule for completion of hot commissioning to the fourth quarter of fiscal year 2018 to account for the effect of funding limitations.
3. Strengthening contract management and risk management to build project credibility.
4. Modifying the start-up and commissioning personnel strategy to provide for a) hiring and training personnel with the intent of transferring them to the permanent operating staff, b) increasing the staff to meet the full facility operating requirements, and c) developing operating and maintenance procedures and training programs tailored for a pool of candidates with varying experience levels.

### Summary Cost Analysis 626 EAC Plus ERT Recommendations

| Cost in \$ millions                | BNI Contract |               | TPRA    |                 |                  | Total         |
|------------------------------------|--------------|---------------|---------|-----------------|------------------|---------------|
|                                    | EAC (1)      | Mgm't Reserve | Program | BNI Managed (2) | Unknown Unknowns |               |
| <b>December 2005 EAC (626 EAC)</b> | 7,736        | 1,041         | 1,760   | 0               |                  | <b>10,537</b> |
| ERT Recommended Adjustments        | 233          | 145           | -1,174  | 540             |                  | -256          |
| Rand study implication             |              |               |         |                 | 1,000            | 1,000         |
| <b>ERT Assessment of 626 EAC</b>   | 7,969        | 1,186         | 586     | 540             | 1,000            | 11,281        |
| <b>Say .....</b>                   |              |               |         |                 |                  | <b>11,300</b> |

**Confidence level in ERT Assessment of 626 EAC**



Note 1: Excludes Contractor fee

Note 2: Value of those risks ERT recommends be managed by Contractor. ERT does not judge whether the included items are inside or outside of Contractor scope

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- Appendix E – External Review Team Process Detailed Flow Diagrams
- Appendix F – Operational Readiness, A Long Term Strategic Approach

## Acronyms and Abbreviations

|                  |   |
|------------------|---|
| BNI              | Bechtel National, Inc                                     |
| BecRAC           | Bechtel Risk And Contingency                              |
| BETK             | Bechtel Estimating Tool Kit                               |
| BNI              | Bechtel National, Inc                                     |
| BOF              | Balance Of Facility                                       |
| BSII             | Bechtel Systems And Infrastructure, Inc.                  |
| C&T              | Commissioning And Testing                                 |
| CADD             | Computer Aided Drafting And Design                        |
| COCO             | Cost & Commitment   |
| DCS              | Distributed Control System                                |
| DOE              | Department Of Energy                                      |
| DOE-HQ           | Department Of Energy - Headquarters                       |
| DWPF             | Defense Waste Processing Facility                         |
| EAC <sup>1</sup> | Estimate At Completion                                    |
| EPA              | Environmental Protection Agency                           |
| EPC              | Engineering, Procurement, And Construction                |
| EPCC             | Engineering, Procurement, Construction, and Commissioning |
| EPPR             | Engineering Progress And Performance Report               |
| ERT              | EAC External Review Team                                  |
| ETC              | Estimate To Completion                                    |
| EVMS             | Earned Value Management System                            |
| FCCM             | Facilities Capital Cost Of Money                          |
| FMR              | Field Material Requisition                                |
| G&A              | General and Administrative                                |
| HLW              | High Level Waste  |
| HPAV             | Hydrogen In Piping And Ancillary Vessels                  |
| IFC              | Issued For Construction                                   |
| LAB              | Laboratory  |
| LAW              | Low Activity Waste  |
| M&SC             | Material And Subcontract Cost                             |
| M&TE             | Measuring And Testing Equipment                           |
| ORR              | Operational Readiness Review                              |
| P&ID             | Piping And Instrumentation Diagram                        |
| PIP              | Project Implementation Plan                               |
| PT               | Pretreatment Facility                                     |
| PO               | Purchase Order  |
| QDP              | Quantity Development Packages                             |
| QURR             | Quantity Unit Rate Report                                 |
| RGM              | Revised Ground Motion                                     |
| SU               | Start-Up  |
| TPRA             | Technical And Programmatic Risk Assessment                |
| USACE            | United States Army Corp Of Engineers                      |
| WBS              | Work Breakdown Structure                                  |
| WGI              | Washington Group International                            |
| WTP              | Waste Treatment And Immobilization Plant                  |

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<sup>1</sup> 626 EAC: Completed in December 2005 based on assumption of \$626 million funding in FY2006 and \$690 million per year thereafter.

490 EAC: To be completed in May 2006 based on \$490 million funding in FY2006, with subcaps on five individual facility line items. Assumes \$690 million per year thereafter.



## 1.0 Background

### *The Project*

In December 2000, Bechtel National, Inc. (BNI) was awarded a contract to design, build, and commission the Waste Treatment and Immobilization Project (WTP) to immobilize highly radioactive waste stored in underground tanks at the Department of Energy (DOE) Hanford Site near Richland, Washington. The estimate for the contract scope as defined at that time was in the order of \$4 billion, and Congress had authorized funding at \$690 million per year in year 2000 constant dollars.

WTP is first-of-a-kind in terms of its size (roughly equivalent to two 1,000 megawatt nuclear power units) and scale (about four times more throughput of high level waste than the Defense Waste Processing Facility at Savannah River, a waste vitrification plant built in the 1980s). One of the WTP goals is to meet regulatory milestones agreed by the DOE, the Environmental Protection Agency (EPA) and the State of Washington. The milestones pertain to both the WTP construction progress and the WTP mission progress (e.g. complete hot commissioning by December 2011, clean up 10 percent of Hanford tank waste by mass and 25 percent of waste by radioactivity by 2018).

### *Current Forecast Evolution*

In February 2005, DOE asked BNI to: (1) continue with an Estimate at Completion (EAC) exercise then in progress to determine how quickly the plant could be completed absent funding constraints (“Scenario A”), and (2) evaluate the cost and schedule to conform to an annual \$690 million funding constraint (“Scenario B”). These estimates were to:

- Incorporate all known emerging design evolution (including pulse jet mixer pumps, ultra-filtration, revised seismic criteria).
- Update quantities resulting from progress in design.
- Re-evaluate productivity and pricing based on experience.
- Update contingency used.
- Re-evaluate contingency at a higher confidence level than had been previously reflected in BNI’s management reserve.

The EAC delivered to DOE in April 2005 concluded:

- Scenario A forecast cost without fee or Technical and Programmatic Risk Assessment of \$7.721 billion with completion of hot commissioning in September 2013.
- Scenario B forecast cost (without fee or TPRA) of \$7.994 billion with completion of hot commissioning in January 2015.

DOE engaged the U.S. Army Corps of Engineers to review BNI’s April 2005 estimates. While the Corps advised DOE it could not provide a comprehensive review based on limited information in certain high impact cost and schedule areas, it indicated the estimates had not fully included potential cost growth.

On 18 August 2005, DOE directed BNI to re-submit a comprehensive EAC while setting funding limits of \$626 million in FY 2006 and \$690 million per year thereafter (termed the “626 EAC”). In December 2005, BNI submitted the 626 EAC forecasting a cost (excluding fee and TPRA) of \$8.777 billion with completion of hot commissioning in November 2016. TPRA was evaluated at an additional \$1.76 billion.

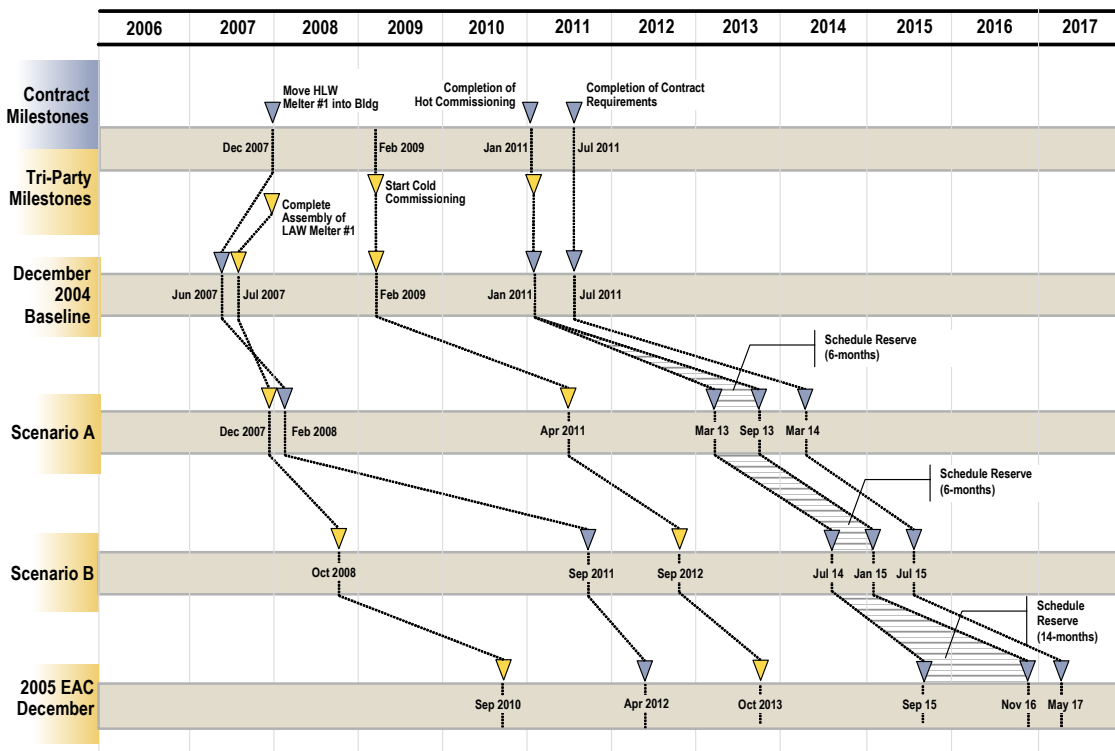
The cost and schedule EAC histories from December 2000 to December 2005 are displayed in Figures 1-1 and 1-2, respectively.

Figure 1-1 Estimate at Completion History (Cost)

| Estimate at Completion History (\$ millions) |                       |                 |                 |                 |                   |                 |                 |                 |                 |                   |
|--|-----------------------|-----------------|-----------------|-----------------|-------------------|-----------------|-----------------|-----------------|-----------------|-------------------|
| All figures are escalated                    |                       | Contract        |                 |                 | Mar 2003          |                 | August 2005     | April 2005      | Dec 2005        | Dec 2005          |
| WBS  | Facility              | December 2001   | April 2001      | May 2002        | Contract Baseline | July 2004 EAC*  | TPMB*           | EAC*            | EAC             | EAC w/ allocation |
| 1.01   | Pretreatment          | 840             | 1,019           | 947             | 939               | 887             | 1,058           | 1,666           | 1,637           | 3,169             |
| 1.02   | Low Activity Waste    | 575             | 623             | 664             | 573               | 561             | 557             | 623             | 654             | 1,192             |
| 1.03   | High Level Waste      | 623             | 681             | 682             | 806               | 773             | 777             | 1,036           | 1,067           | 2,076             |
| 1.05   | Balance of Facilities | 202             | 246             | 271             | 295               | 269             | 268             | 340             | 350             | 682               |
| 1.06   | Analytical Laboratory | In Pretreat     | In Pretreat     | 199             | 204               | 186             | 194             | 206             | 237             | 421               |
| 1.08   | Plant Wide EPCC       | In Facilities   | In Facilities   | 1,457           | 1,457             | 1,574           | 1,620           | 2,365           | 2,623           | Allocated Above   |
| 1.90   | Shared Services       | 1,227           | 1,457           | 1,728           | 582               | 587             | 566             | 775             | 973             | Allocated Above   |
| <b>Subtotal Estimate at Completion</b>       |                       | <b>\$ 3,465</b> | <b>\$ 4,026</b> | <b>\$ 4,492</b> | <b>\$ 4,856</b>   | <b>\$ 4,837</b> | <b>\$ 5,039</b> | <b>\$ 7,011</b> | <b>\$ 7,540</b> | <b>\$ 7,540</b>   |
| Potential Trends/Late Adjustments            |                       |                 |                 |                 |                   | 208             | NA              | 284             | 196             | 196               |
| <b>Total Estimate at Completion</b>          |                       | <b>\$ 3,465</b> | <b>\$ 4,026</b> | <b>\$ 4,492</b> | <b>\$ 4,856</b>   | <b>\$ 5,045</b> | <b>\$ 5,039</b> | <b>\$ 7,294</b> | <b>\$ 7,736</b> | <b>\$ 7,736</b>   |
| Management Reserve                           |                       | 500             | 350             | 300             | 550               | 422             | 367             | 700             | 1,041           | 1,041             |
| <b>Total Forecast at Completion**</b>        |                       | <b>\$ 3,965</b> | <b>\$ 4,376</b> | <b>4,792</b>    | <b>\$ 5,406</b>   | <b>\$ 5,467</b> | <b>\$ 5,406</b> | <b>\$ 7,994</b> | <b>\$ 8,777</b> | <b>\$ 8,777</b>   |

\* Per DOE-ORP direction, EACs were not funding constrained  
 \*\* Does not include TPRA allowance or fee

Figure 1-2 Estimate at Completion History (Schedule)



*Engagement of External Expert Review Teams*

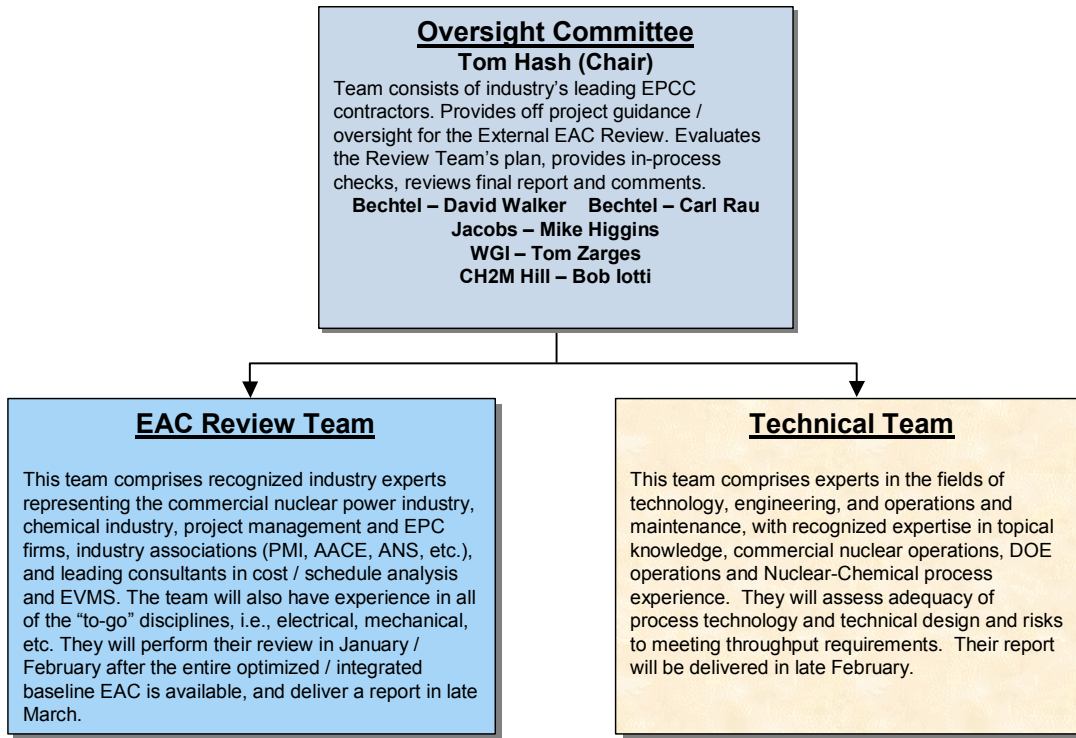
In addition to providing direction to re-submit the EAC, DOE’s 18 August 2005 letter noted BNI’s 8 August 2005 corporate commitment to the Secretary of Energy to perform an independent project review by industry experts. It directed BNI to conduct: (1) a comprehensive review and analysis of the technical baseline focusing on the functionality of WTP process systems, and (2) a comprehensive review and analysis of the cost and schedule baselines.

In October 2005, BNI commissioned an External Flowsheet Review Team (EFRT) and an EAC Review Team (ERT). Names, affiliations, and summary resumes of the ERT are provided in Appendix A.

The EFRT and ERT reported to an Oversight Committee as shown in Figure 1-3. This committee evaluated both review team plans, provided in-process checks, and reviewed the reports.



**Figure 1-3 Review Team Summary Criteria, Charters, and Reporting Relationships**



*ERT Charter and Scope*

BNI chartered the ERT to:

- Provide a demonstrably objective review of the EAC by:
  - Employing a diverse, independent team of experts.
  - Utilizing resources internal and external to BNI.
- Provide DOE confidence in the EAC, by considering:
  - Basis (scope, contract, execution strategy, schedule).
  - Development Methodology.
  - Results.
  - Funding Compliance.
- Provide a balanced perspective of factors including risks.
- Provide recommendations to help restore project credibility.

The ERT mobilized in November 2005 to develop its organization and plan. The ERT defined the scope to include:

- Assessing the validity and achievability of the overall cost estimate and schedule baseline including:
  - Scope definition and execution strategy.
  - Forecast basis and assumptions.
  - Forecast methodology.
  - Quantification.
  - Schedule logic and sensitivity analysis.
  - Forecast of cost.
  - Risk and contingency analysis.
- Delivering a report providing an evaluation of:
  - Efficacy of project execution plan.
  - Credibility of the estimate and schedule.
  - Overall confidence level of the EAC.

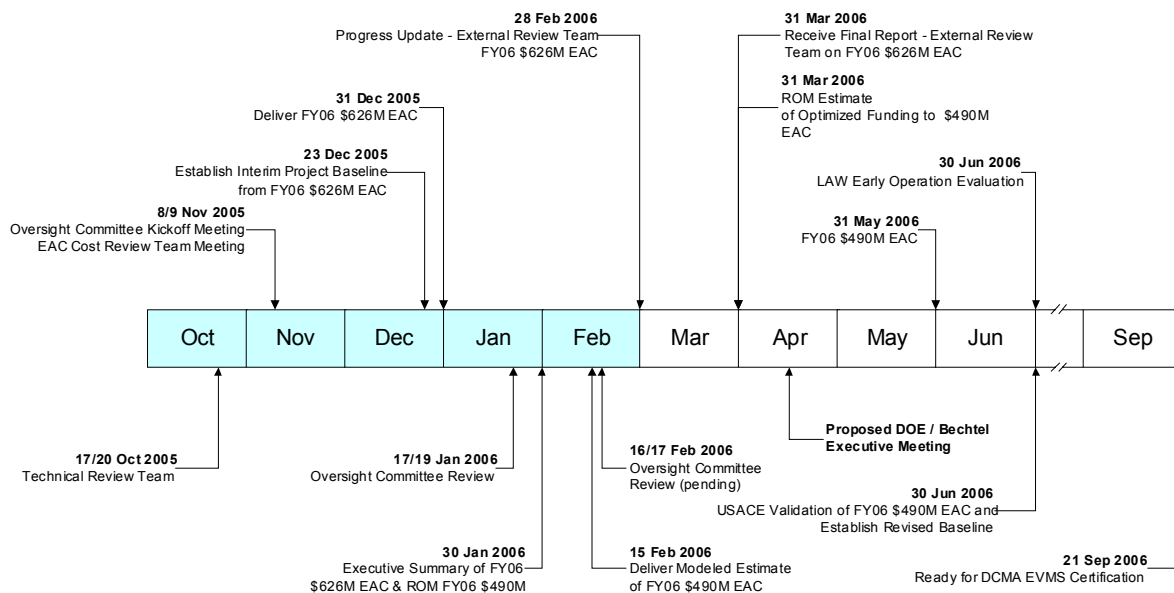
Scope was defined as not including:

- A comprehensive formal management assessment.
- 100 percent drill down into details of the estimate.
- An independent estimate.
- Identifying and quantifying technical risk.
- Root cause analysis of past performance problems.
- Optimization of cost and schedule.
- Consideration of potential contract modification.

### Review Target

The ERT reviewed the 626 EAC delivered by BNI in December 2005. This EAC is but one step along the way to developing the next EAC as illustrated in Figure 1-4. The next EAC will be based on line item budgets for five individual facilities funded in the aggregate of \$490 million in FY 2006 and \$690 million per year thereafter (termed the 490 EAC). The 490 EAC will incorporate results of the ERT and EFRT and will be validated by the U.S. Army Corps of Engineers.

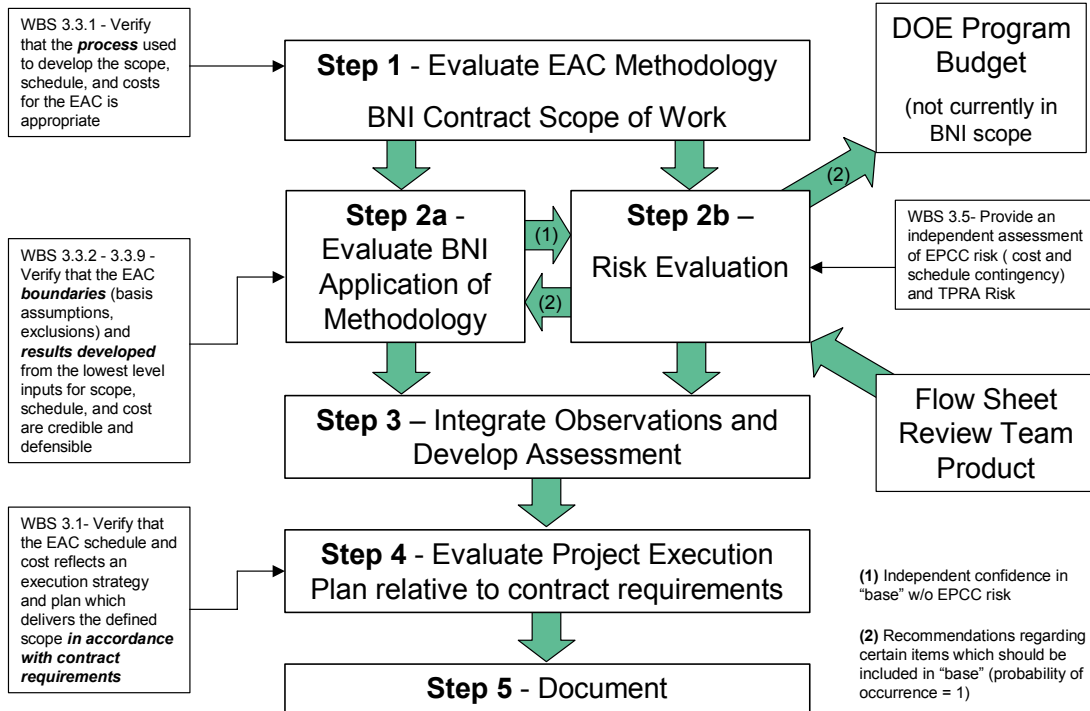
**Figure 1-4 Summary of WTP 626 EAC and 490 EAC Development Process**



ERT validated the 626 EAC forecasting process and discipline, the underlying forecast bases and the associated risk analyses. While the review was conducted on the 626 EAC (based on a plan which will not be implemented), there is merit in targeting it for review, because its underlying development processes and supporting analyses will be carried over in large degree to the 490 EAC.

ERT accomplished its objective through an organization of sub-teams (shown in Appendix B), applying methodologies described in individual report sections which are organized by the review Work Breakdown Structures (WBS). It followed the process displayed in Figure 1-5:

Figure 1-5 Summary of ERT Review Process



The process is further elaborated in Appendix D, which correlates documents reviewed with this report's WBS.

## 2.0 Key Observations, Conclusions, and Recommendations

Many specific observations, conclusions and recommendations are included in the body of this report. However, several are especially worthy of consideration by BNI when completing the 490 EAC:

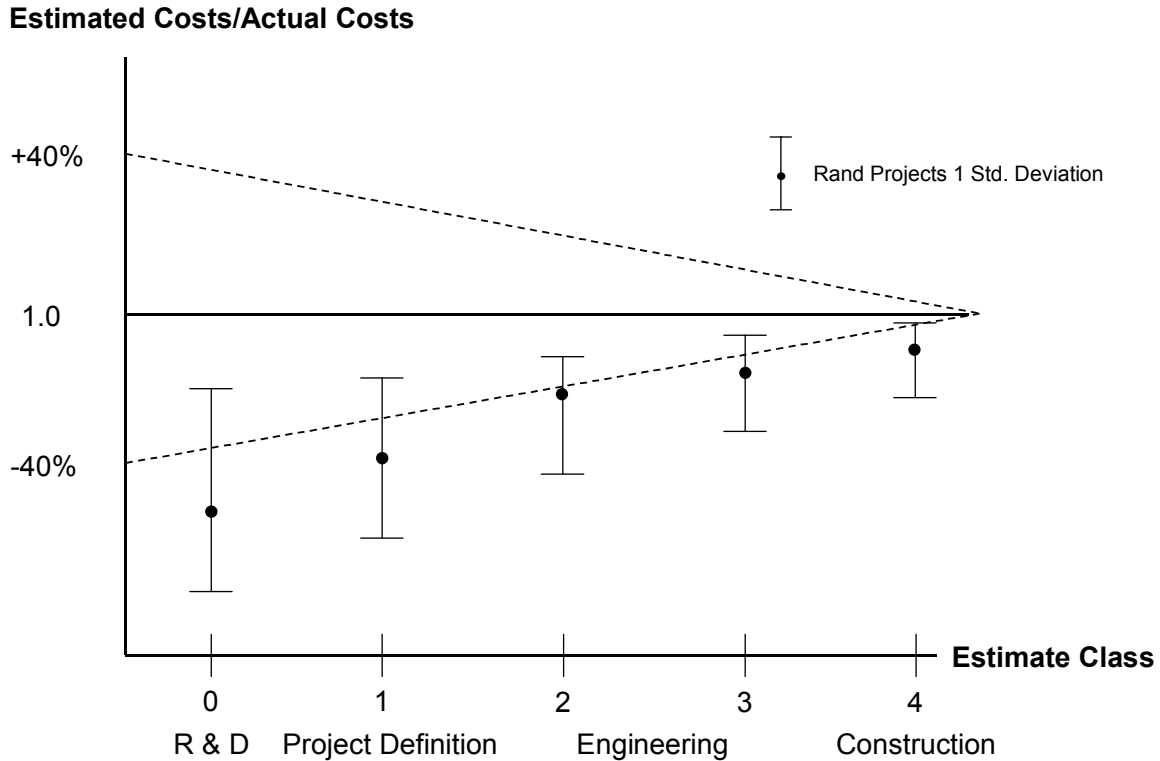
### *Observations*

1. Bechtel procedures and guidelines for preparing forecasts of cost and schedule are well documented, are consistent with best industry practice, and were appropriately applied to the scope of work included in Bechtel's contract when developing the 626 EAC.
2. The enormous amount of information included in the EAC has integrity and can be traced from the lowest levels of input detail to the summaries.
3. DOE has not changed the scope of the contract (Section C) since Mod 29 (April 2003). The contract statement of work does not reflect all work included in the 626 EAC.
4. DOE and Bechtel recognize the entire risk management program needs significant strengthening.
  - The TPRA program has focused primarily on technical risk tracking and mitigation. Programmatic risks (e.g. regulatory risks, funding uncertainty, new DOE management requirements) were either not recognized or not incorporated until late 2005. (The December 2005 Risk Report added \$1.2 billion in potential programmatic risk.) Most programmatic risks were merely identified as exclusions in previous EACs and not quantified.
  - With the notable exceptions of seismic (known but not carried as a risk; total impact of \$700 million to \$900 million) and Pulse Jet Mixers (carried as a risk but with schedule impact un-evaluated; total cost impact \$200 million to \$300 million), technical risk has been managed reasonably well in terms of identification and mitigation.
  - By contract, TPRA "lives" outside the EAC (and therefore is not considered in funding-driven schedule projections).
  - While TPRA incorporates line item risks identified today, "unknown unknowns" have not been considered. As demonstrated by a detailed study by the Rand Corporation, pioneer process plants display a pattern of initial underestimation of capital costs and growth of cost over time.<sup>2</sup> WTP is a nuclear/chemical pioneer process plant that clearly exhibits this phenomenon. This is illustrated in Figure 2-1 below, which is adapted from the Rand study. The figure depicts cost estimating accuracy for conventional construction projects at different project development stages, and illustrates the cost growth experience for 44 pioneer process projects. Those plants, which had first-of-kind technology, exhibited substantially more cost growth than conventional projects. The WTP experience is in line with other pioneer process plants. History thus shows that unknown factors may lead to a significant underestimate of project costs despite careful estimating procedures.

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<sup>2</sup> *Understanding Cost Growth and Performance Shortfalls in Pioneer Process Plants*, Prepared by Rand Corporation for the U.S. Department of Energy, September 1981.

Figure 2-1 Pioneer Process Plant Costs



5. The current Start-up and Commissioning Execution Plan is unrealistic due to the significant schedule extension and the projected shortages of qualified personnel in 8 to 10 years given the changing demographics in the nuclear industry. Commercial nuclear plant operators are retiring and utilities are competing for qualified personnel.
6. In compliance with the contract, BNI’s Start-up and Commissioning Plan stops short of the planning required to take WTP into long-term operation. In particular, it does not account for training programs and incentives that will be needed to attract qualified plant operators.

*Conclusions*

1. BNI’s cost forecast for work in its contract-compliant execution plan achieves an 80 percent confidence level, but its project-wide 626 EAC, including TPRA and the “unknown unknowns” common to pioneer process plants, achieves a confidence level of only about 50 percent.
2. It would be prudent for DOE to recognize the “unknown unknowns” in TPRA by including:
  - An additional \$1 billion to bring the entire 626 EAC (including TPRA) to an 80 percent confidence level.
  - A schedule extension of 18 to 24 months in view of current funding limitations.
3. A strong contract management and risk management program will help build the credibility of this and future EACs.
4. Post-commissioning planning must be undertaken soon to ensure successful operation of WTP.
5. The 626 EAC would represent a valid contract cost and schedule baseline with adjustments reflected in the following conclusions:



A. Forecast boundaries (i.e. the basis, assumptions, inclusions and exclusions) are well drawn and credible but for one significant exception: assumed availability and qualifications of start-up and commissioning personnel.

B. Cost

- The ERT recommendation to modify the graded approach to commissioning (tailored training/procedures), if accepted, will add \$130 million. This avoids sequential commissioning and multiple operational readiness review risk currently valued in TPRA at \$465 million. It will also save approximately \$110 million in the operations phase.
- Escalation may be understated by \$110 million.

C. Schedule

- The schedule (without consideration of TPRA) covers the defined scope and execution strategies within the right time frames to support a November 2016 completion of hot commissioning.
- The funding-driven EPC (i.e. pre-start up and commissioning) schedule is not optimized nor is it based on a fully resource loaded, critical path analysis. There may be an opportunity to shorten the schedule by six to nine months.
- While the component testing portion of the start-up and commissioning schedule is too aggressive, the overall duration from start of testing to completion of hot commissioning is achievable. A staged finish of facilities (e.g. earlier LAW) would improve the situation.

D. Cost Contingency

- The general cost contingency of \$812 million should be increased to \$982 million.
- Modeling anomalies, when corrected, would reduce both cost and schedule contingency, but these reductions are offset by ERT judgment that Bechtel's confidence is overstated.

E. Schedule Contingency

- The 14 month contingency can be reduced by 3 months with associated savings of \$24 million in time-related costs.

F. TPRA (in addition to conclusion 2)

- TPRA is a consideration outside the bounded cost and schedule forecast detail.
- Reviews by ERT, DOE, and Bechtel suggest that transfers within the TPRA register and, in certain cases, from the TPRA register to Base EAC cost, are required to assign risk items to the party best positioned to manage them.
- The TPRA line item allowance included for External Flowsheet Review Team results is sufficient to accommodate those recommendations planned for implementation.
- By contract, TPRA "lives" outside the EAC and therefore the annual funding cap. Any risk that cannot be fully mitigated must be taken into the project's scope and execution plan. Without a) additional funding, b) adjustment to (reduction of) project scope or c) relaxation of administrative constraints (e.g. small business set-asides), schedule impact cannot be mitigated.

The cost summary of these conclusions is shown in Figure 2-2. Line item detail of Figure 2-2 costs can be found in Appendix C.

**Figure 2-2 Summary Cost Analysis**

**EAC 626 Plus ERT Recommendations**

| Cost in \$ millions                | BNI Contract |               | TPRA    |                                    | Total         |
|------------------------------------|--------------|---------------|---------|------------------------------------|---------------|
|                                    | EAC (1)      | Mgm't Reserve | Program | BNI Managed (2) / Unknown Unknowns |               |
| <b>December 2005 EAC (626 EAC)</b> | 7,736        | 1,041         | 1,760   | 0                                  | <b>10,537</b> |
| ERT Recommended Adjustments        | 233          | 145           | -1,174  | 540                                | -256          |
| Rand study implication             |              |               |         | 1,000                              | 1,000         |
| <b>ERT Assessment of 626 EAC</b>   | 7,969        | 1,186         | 586     | 540                                | 11,281        |
| <b>Say</b> .....                   |              |               |         |                                    | <b>11,300</b> |

**Confidence level in ERT Assessment of 626 EAC**

|   |         |                |
|---|---------|----------------|
| Base EAC (BNI contract scope)             | ← 80% → | \$9.2 billion  |
| Base plus TRPA without unknown unknowns   | ← 50% → | \$10.3 billion |
| Base plus TRPA including unknown unknowns | ← 80% → | \$11.3 billion |

Note 1: Excludes Contractor fee

Note 2: Value of those risks ERT recommends be managed by Contractor. ERT does not judge whether the included items are inside or outside of Contractor scope

*Recommendations*

1. Increase the EAC to \$11.3 billion to raise the confidence level of the cost estimate to 80 percent.
2. Extend completion of the schedule for hot commissioning to 4<sup>th</sup> quarter 2018 to account for the impact of added cost due to annual funding limitations.
3. Strengthen contract management and risk management through current planning efforts by DOE and Bechtel:
  - To minimize cost and schedule growth, DOE must assume a strong leadership role by
    - Assigning risks and mitigation responsibilities to the party best able to control them.
    - Making timely contract modifications as necessary to support these assignments.
    - Being an active participant in risk mitigation.
    - Seeking funding beyond annual cap levels as necessary to fund TPRA contingencies.
  - Bechtel must improve its support to DOE with
    - Proactive risk identification and quantification.
    - Analysis for decision making, including documenting the consequences of delayed decision making.
    - Adequately staffed contract administration to achieve necessary contract modifications in a timely manner.
4. Modify the Start-up and Commissioning Personnel Strategy as proposed in Appendix F. DOE should immediately invoke the post-commissioning services clause in the contract and direct Bechtel to revise its execution plan.
  - Hire test and commissioning personnel with the intent of transferring them to the permanent operating staff when hot commissioning is successfully completed.
  - Develop operating and maintenance procedures and training programs tailored for candidates with varying experience levels, given the limited availability of highly experienced workers.

### **3.0 Detailed Observations and Conclusions**

The ERT organized the WBS so its evaluation tasks could translate directly into sections of this report. Each ERT task team identified the objective of its respective task along with a work plan that defined the methodology for the evaluation, documents to be reviewed, and prospective interviews. Because several tasks in the WBS were subsequently combined or deleted after the work plans were developed, some gaps appear in the report numbering.

*Note on methodology:* Unless otherwise specified, team members interviewed appropriate WTP staff and reviewed project documents pursuant to each task outlined in this report. Appendix B summarizes the people ERT interviewed. Appendix D summarizes documents ERT reviewed.

### 3.1 Baseline Components

The baseline components reviewed include the contract scope, schedule, and cost.

#### 3.1.1 Baseline Scope

##### *Objective*

Validate that the scope (technical basis, exclusions, qualifications, and assumptions) used as the basis of the EAC is consistent with contract technical requirements.

##### *Methodology*

- Reviewed scope quantity definition.
- Reviewed estimate logic for non-designed scope.
- Reviewed status of the design.
- Reviewed project's assessment of major and potential issues noted by the EFRT's flowsheet review.
- Reviewed project's list of boundary statements.

##### *Observations*

- The scope used as the basis of the EAC was consistent with the contract. The list of assumptions, qualifications and exclusions was appropriate for the project (see WBS 3.3.9). The project scope, including the scope of services technical basis, quantities, equipment and appropriate boundary statements, was established and measured using standard BNI procedures and tools.
- The technical basis of the design used for the EAC appears to be valid, subject to the conclusions of the EFRT. The EFRT's flowsheet review identified one flaw, 17 major issues and 13 potential issues. These issues have been captured as a TPRA line item in the EAC.
- BNI has tools to ensure the EAC is consistent with the scope. These tools include the following:
  - Work Breakdown Structure to define and assign contract scope.
  - Management Assessments and Quality Assurance oversight/audits tracking commitments to the customer through the Recommendation and Issues Tracking System.
  - Corrective Action Reports and Non-Conformance Reports.
  - Deliverables Tracking Log.
  - Permitting requirements tracking database.
  - Regulatory Safety Issues databases including:
    - Authorization Basis Amendment Requests.
    - Decisions to Deviate.
    - Design Change Notices.
    - Conditions of Acceptance.
    - Safety Evaluation Request.
    - Configuration Control Procedures.

##### *Conclusion*

The scope used to develop the EAC is consistent with contract requirements; however, as noted in Section 3.1.3, the EAC includes scope direction that is not yet reflected in the contract.

### 3.1.2 Baseline Execution Plan

The ERT divided the Execution Plan into the EPC and the commissioning phases.

#### 3.1.2.1 Project Execution Strategy: EPC

##### *Objective*

Determine if the BNI Project Execution Plan is reflected in the EAC.

##### *Observations*

- BNI's Project Execution Plan is called the Project Implementation Plan. In response to the contractual requirement to prepare a Project Execution Plan, BNI prepared a Project Implementation Plan (PIP). The PIP was first issued on 9 January 2002 and revised twice. Even though the PIP has not been updated since November 2004, the project has implemented a Project Execution Strategy to accommodate changes to project direction (funding limitation and changes in scope such as new seismic criteria) since 2004.
- The PIP is a comprehensive plan covering all aspects of accomplishing the project objectives. The PIP contains a summary and 21 sections that address Project Implementation Plan Overview, Project Background, Project Description, Fundamental Project Drivers, Project Organization, Project Management, Process Operations, Research and Technology, Engineering, Acquisition Services, Contracts, Construction, Commissioning and Training, Environmental and Nuclear Safety, Quality Assurance, Human Resources, Business Services, Project Controls, Information Systems and Technology, Project Administrative Services, and Risk Management.
- The PIP not being updated has no real impact on the EAC, since the EAC is based on the Project Execution Strategy.

##### *Conclusion*

The 626 EAC reflects the adjusted Project Execution Strategy.



### 3.1.2.2 Commissioning Execution Strategy and Plan

#### *Objective*

Verify that the EAC reflects an execution strategy and plan that deliver the defined scope in accordance with contract requirements for the start-up and commissioning portion of the work.

#### *Methodology*

- Compared information collected from WTP to industry data and standards as well as ERT experiences associated with start-up, testing, and commissioning.

#### *Observations*

- The BNI commissioning execution strategy is well documented in suitable detail for this stage of the program. The commissioning execution strategy and plan is described in the following documents: WTP Integrated Commissioning Strategy Whitepaper, Commissioning Plan “A,” WTP Commissioning Plan Part “B,” and the Project Implementation Plan. The commissioning strategy covers five core areas: facility operations, testing, maintenance, facility procedures and training.
- The execution approach can be considered sound and proven. The key execution approaches in each functional area, outlined in the Project Implementation Plan, are consistent with best practices utilized in the nuclear utility industry.
- Commissioning and Testing (C&T) basis of estimate documents used as input to the 2005 EAC are consistent with the execution strategy. Site Document 24590-WTP-PL-OP-05-002, Rev. A, WTP Commissioning Plan “Part B.” meets the objectives of the contract and defines the WTP organization, tests, and procedures for commissioning each of the major facilities and supporting facilities. Contract requirements were included in the basic rationale for developing the execution strategy and schedule.

#### *Conclusion*

The execution strategy and plan meet contract requirements and were consistently utilized while developing the 626 EAC.

### 3.1.3 Baseline Contract Terms and Conditions

#### *Objective*

Determine if the terms and conditions of the BNI – DOE contract are properly addressed in the EAC.

#### *Observations*

- BNI rigorously attempts to comply with all contract requirements. BNI has developed a matrix of every contract requirement, has a plan to comply with each, and makes diligent efforts to that end, even if it does not always succeed in achieving full compliance (e.g. small business subcontracting).
- DOE has not changed the scope of the contract (Section C) since Mod 29. While modifications to the contract have occurred for funding and other administrative changes, the contract has not been updated to incorporate key technical changes (such as revised ground motion) that have occurred over the last year. BNI is in an awkward situation: the work has been authorized by letter, but the two parties have not agreed upon the scope or the price. DOE and BNI are not effectively controlling and managing the contract change process. Forty scope changes with a value of about \$1.7 billion are included in the EAC but are not reflected in contract modifications.
- The incentives in the contract function as “behavior drivers.” Even with incentive fees built into the contract to motivate contractor performance, most of the cost risk still falls on the government. Therefore, the government’s challenge is to manage the scope of work to the available funding, and the contractor’s challenge is to limit its work to what is in the scope or to bring out-of-scope work into the contract. The tension between DOE’s effort to control the scope and BNI’s efforts to protect its commercial position has consumed inordinate time and energy. Finding appropriate ways to minimize contracting barriers would help BNI focus on accomplishing design, construction, and commissioning of the WTP.

#### *Conclusions*

- The contract Statement of Work does not reflect all work in the 626 EAC. DOE and BNI need to resolve the outstanding scope changes expeditiously. Some changes are partially included in actual costs expended, some changes are included in the EAC, and some changes are included in the TPRA allowance.

### 3.1.4 Baseline Schedule

#### *Objective*

Validate the consistency of the overall project schedule for scope, contract technical requirements, and project execution strategy.

#### *Methodology*

- Assessed the applicability of the schedule basis to the Project Execution Strategy.

#### *Observations*

- The scope of the project schedule encompasses the complete project including integration of all phases throughout the life of the project.
- The schedule reflects the execution strategy described in the EAC basis and supports hot commissioning in November 2016. BNI has done a good job of identifying the changes to high level project milestones that have occurred since contract inception.
- The schedule reflects a “stretch-out” to accommodate funding constraints. While BNI’s schedule strategy does not specifically follow DOE’s directive to place priority on the progression of the LAB and Low Activity Waste (LAW) facility, BNI’s decision to curtail them for two years while focusing on completing the design of the Pretreatment (PT) and High Level Waste (HLW) facilities appears to be a reasonable way to expedite the WTP.

#### *Conclusion*

The project schedule is consistent with the contract scope, technical requirements, and supports the current execution strategy.

### 3.1.5 Baseline EAC Costs

#### *Objective*

Validate that the costs reflected in the EAC are consistent with contract statement of work, technical requirements, and execution strategy.

#### *Methodology*

- Reviewed each section of this report for conclusions and recommendations.
- Interviewed authors of each section to obtain clarification and to determine compliance with all project technical requirements, Statement of Work, and project execution strategy.

#### *Observations*

- The scope and pricing definition for the project is well developed. BNI indicates that engineering is 68 percent complete, acquisition is 44 percent complete, and construction is 28 percent complete. Computer models and databases provide extensive details that have been utilized in the development of EAC costs. The detailed scope definition supports segregation of costs to various levels and summaries for review, analysis, and reporting purposes. The schedule detail activities are job-hour loaded and reflect progress to date.
- Extensive reviews have been performed within the project management team, BNI functional management staff, and various external and independent review teams. These reviews increase confidence that the EAC methodologies and basis are appropriate for the project.
- BNI's cost basis includes management functions for integration with and/or oversight of relevant external interfaces. The WTP contractor is performing the requirements of the contract including integration of activities with DOE, other stakeholders, and regulators. As an integral part of the estimate, the EAC includes cost and schedule considerations for management functions, tasks, products, and deliverables necessary to accomplish the contract scope.
- The EAC reflects the execution strategy, which is sound and well developed for the scope. The execution plan will need to be modified for future funding limitations and budget segregation requirements.
- BNI has implemented the requirements of the current contract with respect to cost management. Project control tools and programs are in place to monitor both progress and performance of budget costs and schedule as required in contract Section C.6, Standard 1. The scope, estimate, and schedule are integrated using hierarchical coding structures to identify the work, responsibilities, and resources required to accomplish the work scope. These structures are defined with control accounts consisting of Work Breakdown Structure (WBS), Organization Breakdown Structure (OBS), and Resource Breakdown Structure. Together with project procedures, plans, and management staff, the EAC is sufficiently developed to provide basis for baseline definition, progress, and performance monitoring for the life of the project.
- BNI identified the basis of risks for cost estimating purposes. Risks associated with the overall program have been identified and quantified by the project team and supplemented with other independent reviews by a Red Team, EFRT, USACE, Burns & Roe, and DOE. Estimates have been made of risk within the scope of the contract (EPCC), TPRA risk items managed by the contractor, and TPRA risk managed by DOE or other regulatory entities.

#### *Conclusion*

The scope of work, cost bases, and schedule used as the basis of the EAC are valid and appropriate for the project needs. The data are sufficiently detailed and are consistent with the technical requirements, contract statement of work, and the execution strategy.

### 3.2 Not Used

### 3.3 EAC Validity

The ERT reviewed both the processes used to develop the 626 EAC and assessed whether these processes were appropriately applied and yielded credible EAC amounts.

#### 3.3.1 Forecast Process

The ERT evaluated the forecast process in terms of quantities, schedule, cost, and technical bases.

##### 3.3.1.1 Forecast Process: Quantities

###### *Objective*

Validate the methodology and results in the 626 EAC for quantification of equipment and bulk commodities for permanent plant construction.

###### *Methodology*

- Reviewed the Quantity Development Packages (QDP) for each commodity, identifying the methods and basis of bulk commodity quantities in the EAC.
- Determined appropriateness of the estimating methods to quantify the final as-built scope.

###### *Observations*

- The quantity basis reflected in the EAC is defined by the status of design, which is very detailed. The ERT's review process concentrated on areas that may not be fully designed at this stage.
- For bulk commodities that are not yet detailed by the issued design, such as electrical and instrumentation, the WTP team spent great effort to develop detail quantities based on considerations that will eventually be incorporated in the final design.
- QDP commodity reports were prepared for all major commodities and provide acceptable basis for the quantities reflected in the EAC.

###### *Conclusions*

- The quantity basis reflected in the EAC is supported by the design model as well as other databases such as set-route, Intools, and Component Information System.
- The methodology for quantity development is valid for equipment and bulk commodities and appropriate for the WTP project.
- The resultant EAC quantities are considered appropriate for the project scope. Some allowances for finalization of project design may be appropriate and should be added in the direct accounts.
- The process used to develop EAC quantities is valid.

###### *Recommendations*

- Opportunities exist to simplify future estimating efforts without sacrificing the accuracy of the results by establishing project specific sampling, ratios, or other parametric data.
- Re-visit the decision to delete all "design growth allowances" from the EAC. Reassess an appropriate allowance, depending on the extent that the quantities are based on actual WTP experience or use of generic parameters.
- After inclusion of appropriate quantities for design growth, re-evaluate the EPCC contingency cost assessment of confidence levels assigned to the quantities for an 80 percent probability of cost under-run.



### 3.3.1.2 Forecast Process: Schedule

#### *Objective*

Verify that the process used to develop the project schedule for the EAC is valid to produce a schedule that is complete, accurate and achievable, with appropriate levels of resource loading. (The implementation of the process to produce the project schedule is addressed with WBS 3.3.4.1 and 3.3.4.2)

#### *Methodology*

- Reviewed the schedule tools that BNI used for schedule development.
- Reviewed the application of the schedule tools to the project.

#### *Observations*

- BNI used an appropriate scheduling tool for WTP. The project schedule is based in Primavera, which enables management and resource loading of large schedule databases.
- The project schedule contains an excessive level of detail. In an effort to restore credibility to the project, the WTP team produced a Level 4 schedule with 41,000 activities and milestones (of which approximately 24,000 are open and 17,000 are complete). This level of detail makes the schedule unwieldy and does not appreciably improve its accuracy. A scheduling process using a “rolling wave” concept that progressively provides more detail as time goes on would support the EAC development more effectively.
- The WTP project schedule contains “late constraints” to reflect the impacts of limited funding, limiting the ability to effectively evaluate float. For purposes of calculating float, the schedule contains six late finish milestones: Engineering Transition to Construction, Construction Completion for each of the four major facilities, and Contract Completion. This convention allows continued start-finish analysis of downstream activities. As the schedule is presently developed, many activity durations must be re-evaluated and adjusted to reflect scenario changes. The schedule used for the 626 EAC is effectively a one-time schedule that will require significant modification for strategy changes.
- The WTP project schedule, while partially resource loaded, is not cost loaded. However, Primavera schedules interface with the Cobra software for time related cost data. The schedule provides the basis for calculation of EAC costs that are time related, such as escalation.

#### *Conclusion*

- The schedule process, while unwieldy due to the extensive detail, provides the appropriate data for the 626 EAC. The current schedule is basically a one-time schedule for the 626 EAC and will require extensive changes for different schedule strategies.

#### *Recommendation*

- BNI would benefit from a summary level schedule that could be manipulated more easily to assess changed scenarios for funding, schedule, and strategy. Such a schedule would enable BNI to respond more quickly to DOE’s changing requirements and provide the grounding for the detailed schedule.

### 3.3.1.3 Forecast Process: Cost Basis (excluding TPRA issues)

#### *Objective*

Verify that the process used to develop the project forecast basis for costs in the EAC (materials, subcontracts, equipment and labor) is complete, accurate, and achievable with appropriate level of supporting detail.

#### *Methodology*

- Reviewed the procedures and process used by WTP in preparing the 626 EAC.
- Drilled down in an individual account from the base quantity to the cost included in the EAC to verify the validity of the process.
- Reviewed BNI's standard procedures for preparing project forecasts.

#### *Observations*

- The methods used by the WTP team allowed for the development of an accurate assessment of the cost at the completion. The forecast used a combination of approaches including: 1) actual costs to-date plus an estimate of costs to complete, and 2) estimating the total cost at completion and then deducting the to-date actual resulting in a calculated to-go cost. The EAC also addresses time-related costs.
- The EAC cost estimate complies with the contract and meets the requirement for the WTP EAC.
- The EAC methodology is consistent with BNI standards.
- The WTP team quantified the key program level parameters for the development of the EAC costs and incorporated actual costs through 25 September 2005, known escalation rates, and late adjustments. Benchmarking of similar projects was utilized to validate reasonableness.
- Detailed cost estimates were prepared by the responsible departments for all of the cost elements.
- WTP conducted an extensive review process on the EAC including:
  - Internal quality control checks.
  - Area reviews of the functional department inputs.
  - Functional representatives from Bechtel Systems and Infrastructure (BSII) central functions.
  - Senior members from other projects performed vertical and horizontal slice reviews.
  - Management Red Team Review.

#### *Conclusion*

The process used to develop the project forecast cost basis in the EAC follows both BNI standards and industry best practices for the preparation of cost estimates including an appropriate level of detail and supporting documentation.

### 3.3.2 Technical Basis

The ERT addressed the technical basis that underlies the design separately for the engineering, procurement, construction, and start-up/commissioning phases for the project.

#### 3.3.2.1 Technical Basis: Engineering, Procurement, and Construction

##### *Objective*

Establish the maturity and stability of the technical basis for engineering, procurement, and construction that underlies the scope and quantification of the 626 EAC.

##### *Methodology*

- Reviewed the status of the design.
- Reviewed the results of EFRT's flowsheet review.
- Reviewed the WTP team's assessment of the EFRT's flowsheet review.
- Assessed the potential for change to the technical basis (EAC risk).

##### *Observations*

- The project has a formal process to verify that the design complies with the design basis documents. This procedure includes:
  - Criteria reviews by all designers.
  - Integrated safety management reviews.
  - Design reviews.
  - Team Reviews.
- Technical issues associated with the design have been validated by research, testing, and modeling.
- The project design is mature and stable with the exception of those issues raised by EFRT, as illustrated with the high percent complete of engineering. The project has reviewed all of the issues identified by the EFRT and has developed an action plan to resolve them.
- The technical basis for the development of EPC quantities uses an established and appropriate technique. The method uses detailed lists, design percent complete, historical production rates, and costs to determine the EAC.
- The method used to determine the engineering and procurement hours and cost is sound and consistent with industry practices. The method uses detailed lists of engineering deliverables and historical data for production rates. The design then progressed by performing appropriate research and testing and modeling. All major decisions have been made and design is now about 68 percent complete.
- The method used to determine the commodities quantities and cost is sound and consistent with industry practices. All major commodities are modeled on 3D CADD models, which can be used to accurately determine commodity quantities.

##### *Conclusion*

- The technical basis for the design is generally well established. The technical basis is supported by research and testing, the level of completion of the design, and the level of 3D modeling. Additionally, the design is based on DOE approved basis of design documents.
- The substantial percent complete in engineering and modeling allows for a significant amount of commodities to be extracted from the model and limits the need to estimate commodity quantities. Additionally, the historic data enables accurate estimates of engineering, procurement, and construction scope and schedule. The project has evaluated the major and potential issues and estimated values are included in the EAC (in contingency and TPRA).
- Issues remain, including RGM, HPAV, and those identified by the EFRT that could significantly affect the design.

### 3.3.2.2 Technical Basis: Start-up and Commissioning

#### *Objective*

Verify that the start-up and commissioning scope used as the basis of the EAC is consistent with contract requirements and execution strategy.

#### *Methodology*

- Reviewed contract requirements applicable to start-up and commissioning.
- Reviewed the commissioning program execution strategy.
- Reviewed the start-up and commissioning test schedule and assumptions used in schedule development for reasonableness and consistency with the start-up and commissioning Basis of Estimate documents and resultant EAC.
- Reviewed the EFRT draft report to evaluate potential impacts to the test program.

#### *Observations*

- The Start-up and Commissioning Plan meets contract requirements. It specifically spells out individual contract requirements and describes how contract compliance will be achieved.
- The basis of the Start-up and Commissioning Plan and execution strategy is sound. The plan logic mirrors that of a typical nuclear utility plant start-up, testing progress from least complicated to most complicated.
- Potential technical risk associated with first-of-a-kind equipment has been anticipated. Analysis of the risk supports the \$86 million management reserve and six months of schedule contingency.
- Resolution of the EFRT review issues, developed subsequent to the 626 EAC, is progressing. Many issues identified by the EFRT (line plugging, erosion, ultra-filter flux area, remote testing, and others) may have a significant impact on the commissioning cost and schedule.

#### *Conclusion*

- The start-up and commissioning logic to be used by the WTP is sound and meets contractual requirements.
- The EAC appropriately reflects the scope of the commissioning plan. The probability of successful test sequencing using this logic is high.

### 3.3.3 Not Used

### 3.3.4 Schedule Basis

The ERT evaluated the schedule basis separately for EPC and Start-up/Commissioning as described in the following sections.

#### 3.3.4.1 Schedule Basis: EPC

##### *Objective*

Verify that the schedule developed for the EPC activities followed a valid process (evaluated in Section 3.3.1.2) and is complete, has a reasonable critical path, and achievable with appropriate resource loading.

##### *Methodology*

- Examined the WTP schedule, including its logic, durations, float computations and utilization, and work methods.
- Reviewed engineering release, fabrication and delivery rates, and installation curves for bulk commodities.

##### *Observations*

- The project schedule is based in Primavera and has extensive depth (24,000 open activities and milestones) and detail to support the remainder of the WTP project.
- The WTP schedule is constrained by funding limits. The constraints imposed on this project necessitate work stoppages on the LAW Building and the LAB, which are reflected in the schedule.
- The schedule does not have a critical path through the entire project. It has critical paths for each of the individual facilities and uses the concept of “significant path” to connect those facilities. Some of the activities on the significant path have very extended durations reflecting mapping from lower level control tools and include constrained starts due to funding.
- The Primavera schedule is not fully resource-loaded, but the Cobra software applies costs to the resources that are leveled in Primavera.
- The Construction/Start-up interface logic is incomplete. However, the level of logic applied to this interface is typical of the current stage of construction and usually migrates to a systems completion approach later in the construction phase.
- Procurements are included in the schedule, although in such detail that BNI staff assistance was required for us to identify them.
- The time relationship between engineering activities and their related construction activities is very long, reflecting the funding limitations applied to construction.
- The EPC schedule was developed from the detailed and reasonable list of engineering deliverables.

##### *Conclusions*

- The schedule developed for the EPC activities contains critical paths that are reasonable and achievable for the facilities on an individual basis. While there is no overarching critical path for the entire WTP facility, early start dates can be determined by analysis of the “significant paths.”
- Electrical commodity curves, showing lead of engineering release over construction installation and construction installation over predecessor commodities, indicate a potential to improve the EPC schedule by six to nine months.
- The WTP facility Level 4 schedules are too detailed in the out years (2011-2015). One activity, scheduled to occur in 2011, has 20 days of duration. This type of micro-scheduling creates excessive detail, which in turn leads to confusion, requires extra project controls effort to maintain, precludes quick “what if” scenario analysis, and may create a false sense of accuracy.
- The funding constraints on the WTP have impeded work, especially on the LAW and LAB buildings. Reducing some of the excessive durations and float will relieve some of these constraints. This will improve confidence in the project schedule, and improve the risk levels assigned in the schedule contingency analysis.

### 3.3.4.2 Schedule Basis: Start-up and Commissioning

#### *Objective*

Verify that the process for scheduling start-up and commissioning activities has resulted in a schedule that is complete, reflects a reasonable critical path, and is achievable with appropriate resource loading.

#### *Methodology*

- Reviewed the start-up phase component and Primavera test schedules to understand test sequencing and test completion rates with primary focus on system test completions.
- Compared expected system test completion rates to system test completion rates achieved in the commercial nuclear power industry.
- Reviewed the commissioning test schedules to understand integrated test sequencing, test durations, test failure contingencies, and transition between test phases.
- Reviewed the WTP contract to understand contract specified operational requirements, test requirements, and process test acceptance criteria.

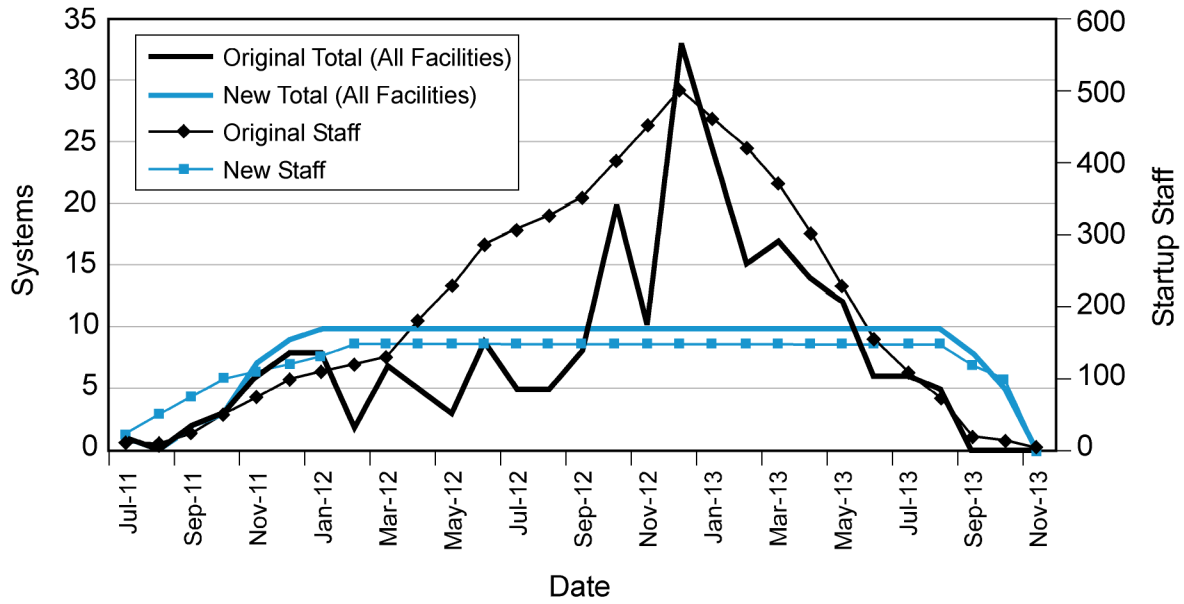
#### *Observations*

- The WTP start-up and commissioning schedule was developed through a logical sequencing of five distinct test phases:
  - *Component Testing* to ensure each component meets performance requirements.
  - *System Testing* to ensure each system functions as designed, and applicable acceptance criteria are met.
  - *Water flow testing* to verify that the integrated systems at each facility meet design and functional requirements under simulated operating conditions.
  - *Cold commissioning* to verify that each facility will meet design requirements using non-radioactive simulated feed.
  - *Hot commissioning* to demonstrate the capability of WTP facilities to separate radioactive waste into Low Activity and High Level streams followed by vitrification of each type of waste.
- The level of component and system testing is extremely high, far exceeding the in process testing experienced during nuclear power plant Start-ups (as shown in Figure 3-1). Test support organizations, such as engineering and quality assurance, may have difficulty providing the needed support. These levels will be appropriately reduced when the start-up schedule is refined.
- Scheduled test durations are conservative for water flow runs, cold commissioning, and hot commissioning.

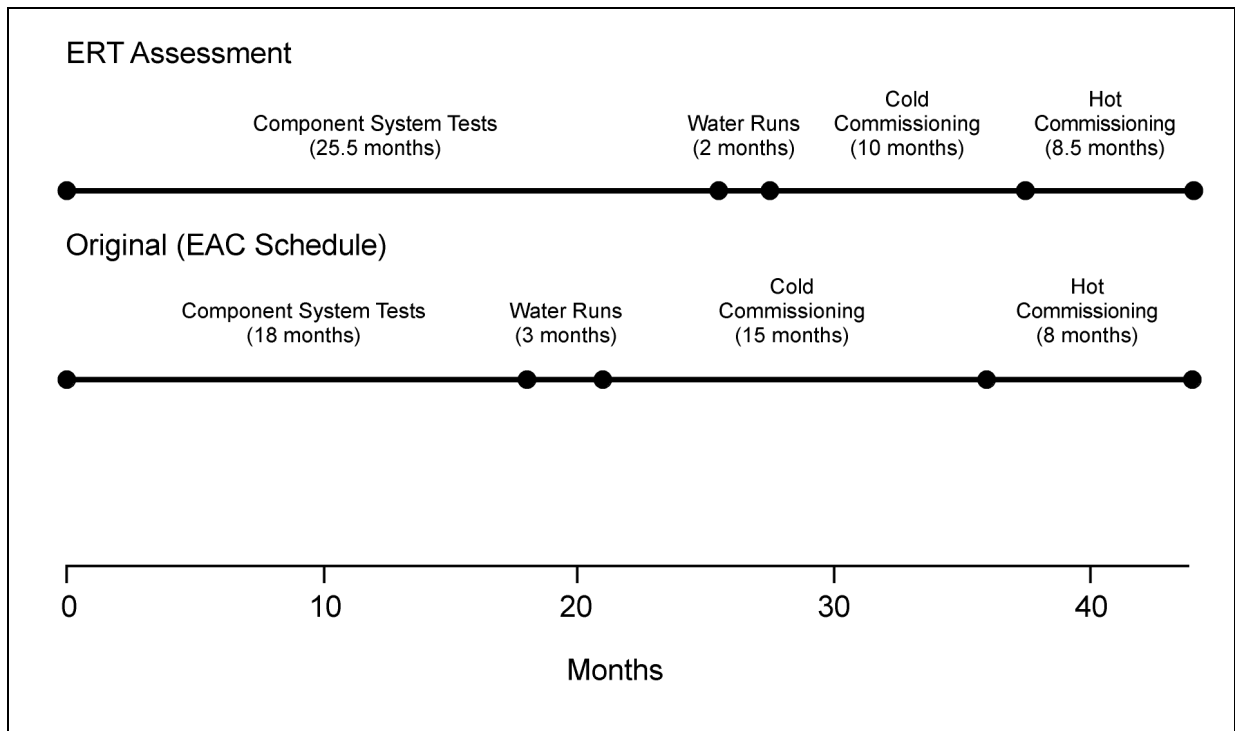
#### *Conclusions*

- The total planned project test duration with contingency is more than adequate to complete all required testing.
- Given the very aggressive test completion rate and expected system and equipment problems, the proposed component and system test phase schedule will not be met.
- The probability of meeting schedule is high for the water flow tests.
- The probability of meeting schedule is high for the cold commissioning test phase.
- The probability of meeting schedule is high for the hot commissioning test phase.
- The overall duration from start of testing to completion of hot commission is achievable, as shown in Figure 3-2.

**Figure 3-1 System Test Completions**



**Figure 3-2 Test Schedule for 3 Major WTP Facilities**





### 3.3.5 Job Hour Basis

The ERT evaluated job hour bases for construction, engineering, and start-up as described in the following subsections.

#### 3.3.5.1 Construction Job Hour Basis

Construction job hours include direct craft, craft indirects, and field non-manual as described in the following subsections.

##### 3.3.5.1.1 Construction Job Hour Basis: Direct Craft

###### *Objective*

Verify the process used for estimating the craft direct job hours and confirm the reasonableness of job hour estimates, unit rates, and productivity factors.

###### *Methodology*

- Determined the credibility of the job hours, unit rates, and productivity factors.
- Compared to-go unit rate performance against reference projects.
- Conducted sample unit rate analysis using a drill-down approach on selected specific issues that represented significant to-go scope or appeared to be questionable. The approach included a determination of the consistency of definitions and completeness of cost components.

###### *Observations*

- In general, the piping and electrical unit rates were optimistic when compared to benchmark data and to-date performance. The ERT selected piping and electrical commodities for review because they represent the majority of the to-go scope, have the greatest degree of complexity, and contain the greatest risk. The WTP project recognizes the risk associated with piping and electrical unit rates and included significant contingency in the EAC.
- The ERT conducted high-level review of other accounts and found no significant concerns. The resulting EAC appears to be adequate to cover the direct craft job hour scope.
- Bechtel corporate management has reviewed and concurred with the direct craft job hour estimates, which adds credibility to the results.

###### *Conclusion*

The ERT confirmed that the job hour estimates, unit rates, and productivity factors are reasonable and adequate to complete the project. The ERT has reflected its observations regarding piping and electrical unit rates as confidence inputs to its contingency evaluation.

### 3.3.5.1.2 Job Hour Basis: Indirect Craft

#### *Objective*

Verify the process used for estimating the craft indirect job hours and confirm the reasonableness of job hour estimates for the to-go scope.

#### *Methodology*

- Determined the credibility of the job hours, unit rates, and productivity factors.
- Compared to-go unit rate performance against reference projects.
- Conducted sample unit rate analysis using a drill-down approach on selected specific issues that represented significant to-go scope or appeared to be questionable. The approach included a determination of the consistency of definitions and completeness of cost components.

#### *Observations*

The to-go indirect craft labor appears low when compared with project experience and reference benchmark data. The to-date ratio to direct job hours is 41 percent and the to-go ratio is 24 percent for an overall EAC ratio of 28 percent.

#### *Conclusion*

Although ERT has high confidence for the process used in the development of the to-go indirect craft job hours, ERT concluded that the resultant EAC job hours are not adequate to complete the project. The ERT recommends that in the 490 EAC BNI should revise the ratio of indirect craft labor relative to direct craft labor for the to-go ratio to be 30 percent, which is a cost impact of roughly \$40 million (800,000 hours). This should occur after resolution of the direct job hour accounts. The ERT has reflected its observations as a direct adjustment in its contingency evaluation.

### 3.3.5.1.3 Job Hour Basis: Field Non-Manual

#### *Objective*

Verify the process used for estimating the field non-manual job hours and confirm the reasonableness of job hour estimates for the to-go scope.

#### *Methodology*

- Reviewed the job hours, unit rates, and productivity factors.
- Compared to-go unit rate performance against reference projects.
- Conducted sample unit rate analysis using a drill-down approach on selected specific issues that represented significant to-go scope or appeared to be questionable. The approach included a determination of the consistency of definitions and completeness of cost components.
- Reviewed field non-manual hours relative to total craft hours for the to-date and to-go scope. The approach included a determination of the consistency of definitions and completeness of cost components.

#### *Observations*

- The process and methodologies for estimating field non-manual job hour scope are consistent with BNI standards and are appropriate for the WTP Project. BNI functional management has reviewed and concurred with the field non-manual job hour estimates, and this review adds credibility to the results. In addition, the project incorporated the Red Team comments as a late adjustment item, which brought the estimate more in line with the appropriate benchmarks.
- The to-go field non-manual job hours are low when compared to the to-date performance and reference benchmark data, as noted during Red Team reviews.

#### *Conclusion*

The ERT has high confidence in the process used in the development of the to-go field non-manual job hours and the resulting staffing plan in the EAC. The increased to-go field non-manual job hours resulting from the Red Team recommendation (included as late adjustment in the 626 EAC) are necessary to complete the project.

### 3.3.5.2 Job Hour Basis: Engineering and Home Office

#### *Objective*

Establish the reasonableness of Engineering and Home Office job hours.

#### *Methodology*

- Reviewed estimates and staffing plans.
- Reviewed oversight and functional management involvement.
- Reviewed the use of historical data.

#### *Observations*

- The method used to develop the job hour basis for engineering design, start-up support, and home office support is technically sound and follows standard industry practice. WTP developed a detailed list of deliverables, reviewed percent complete, identified planned and potential revisions, and applied historical data to the individual items. The initial list of deliverables (drawings, data sheets, specification, etc.) was developed from the list inherited from the previous contractor. This list was reviewed and modified by BNI personnel including the chief engineer and each discipline. When the list was complete, the hour estimate was developed by the chief engineer and each discipline using data from other BNI projects. The schedule was force-fit based on the end date of the project. The staffing levels were then developed from the schedule and hours estimate.
- To-go hours were based on progress to date. Standard BNI tools are used for engineering, procurement, and construction. The project has formal procedures to define percent complete for engineering based on development of the deliverables or the issuance of bid packages or contracts. Additionally, checklists were used to re-evaluate engineering deliverables for planned revisions.
- The development of department hours for the EAC received a significant level of management review. The involvement of the manager of engineering, chief engineers, and their support staffs in the development of EAC began around September/October 2004. There were three estimate phases: ETC – WTP Management, the April 2005 EAC, and the 626 EAC. The chief engineers provided oversight for development of the ETC.
- The scope of the ETC encompassed the appropriate considerations.
  - Identified to-go scope by engineering discipline.
  - Included design deliverables and engineering procurement activities.
  - Estimated to-go hours by IFC (Revision 0) and anticipated revisions.
  - Estimated number of revisions and unit rates based on history.
  - Developed discipline-specific to-go job hour summaries and unit rates.
  - Identified inter-discipline drivers/gaps multi-discipline review sessions.
  - Adjusted ETC and identified reduction opportunities.
  - Developed bottoms-up estimates with focus on the Pareto Principle (80/20).
  - Defined “level of effort support to” functions (construction, startup, and commissioning).
  - Provided rough order of magnitude estimates for RGM and HPAV.

#### *Conclusion*

The job hour basis for engineering and other departments is reasonable and well documented and was developed using appropriate data from other jobs as well as to-date experience.

### 3.3.5.3 Job Hour Basis: Start-up and Commissioning

#### *Objective*

Determine confidence in the methodology and assumptions used in the start-up and commissioning job hour estimates and staffing levels of the EAC.

#### *Methodology*

- Reviewed background documents and formulated questions and areas of concern.
- Received briefings and additional backup materials from appropriate project personnel.
- Compared information received to industry data and standards as well as ERT experiences.

#### *Observations*

- The C&T staffing required to support the development of procedures, development and implementation of training, maintenance, and all functions that support and include operations, will peak at approximately 800 personnel.
- The Project has developed a recruiting strategy to select personnel that have previous Operating and Maintenance experience, either from the Navy nuclear program, commercial nuclear utility industry, or other nuclear facilities within the U.S.
- The training program developed by the Project is well thought out with an appropriate amount of classroom training as well as on-the-job-training for both Operations and Maintenance personnel.
- The Project used a “graded” approach by classifying training modules based on their complexity, risk, and frequency in operating a system. The ERT believes this approach has validity, and concurs that the estimated hours are reasonable to get the procedures through final approval.
- The start-up testing group has a greater staffing demand as the component and system testing period is much shorter.
- Recruiting and training WTP operators and maintenance personnel will be very challenging. The Project plans to recruit the majority of their operators and maintenance personnel within about an eighteen-month window (approximately 25-30 persons per month). The nuclear industry currently has difficulties finding experienced replacements for personnel retiring or changing jobs. At the time, WTP will need their staff, the nuclear utility industry will be near a crisis level in replacing experienced personnel that joined the nuclear industry in the 1970s and early 1980s.
- The current staffing plan assumes the WTP staff level will peak at hot commissioning and drop to a token few shortly after the hot demonstration runs are completed. This adds an additional challenge, as the recruiting will be for a short-term assignment rather than a long-term career opportunity.

#### *Conclusion*

- Job hours for start-up and commissioning are probably understated. Recruitment of the WTP operating and maintenance staff cannot be accomplished within the time frame currently proposed by the project. Industry resources will be critically short at that time and a longer time will be required to recruit and train the staff. The probability of recruiting a substantial number of the staff with nuclear experience is very low, given both the industry demand as well as the short term of the engagement. Therefore, taking credit for the experience factor in the development of procedures, training programs for maintenance and operations and the simplicity of training and procedure details is not a credible assumption.
- To meet its personnel needs, WTP will need to begin staffing at least two years earlier than planned, work with community colleges to develop new talent, and create incentives to retain those hired for the duration of the assignment.

### 3.3.6 Labor Cost Basis

The ERT evaluated labor cost bases for craft, field non-manual, engineering, and start-up as described in the following subsections.

#### 3.3.6.1 Labor Cost Basis: Craft

##### *Objective*

Validate the methodology and results in 626 EAC for craft labor composite cost per hour and resultant labor cost.

##### *Methodology*

- Reviewed the source documents of individual craft bulletins obtained from Labor Relations.
- Reviewed the worksheet model built by construction Project Controls personnel for calculation of the composite labor cost per hour for each category of work. The worksheet covered the development of the composite labor cost per hour for all the direct accounts as well as the distributable craft accounts.
- Reviewed the basis for all the inherent assumptions.

##### *Observations*

- The worksheet model is a logical process for developing the composite craft labor cost per hour. The model accounts for all cost components in the correct sequence to generate an overall cost per hour by category of work.
- The EAC to-go escalation rates for craft labor are considered compatible with the to-date experience. As a separate exercise, actual craft wage bulletins were evaluated for the past three years to compare the escalation to-date relative to the to-go projections.
- Labor costs have a chance of being higher if the assumed high percentage of apprentice utilization is not achieved. Labor costs have a chance of being lower if the percentages of overtime and second shift is less than assumed.

##### *Conclusions*

- The process of developing the labor cost is valid for the EAC. The extension of craft hours to craft labor cost is performed correctly. The percentages utilized for future escalation of craft labor costs are considered appropriate.
- Overall, the resultant labor cost is reasonable for the estimated craft hours.

### 3.3.6.2 Labor Cost Basis: Field Non-Manual

#### *Objective*

Validate the methodology and results in 626 EAC for field non-manual labor composite cost per hour and resultant labor cost.

#### *Methodology*

- Reviewed payroll data for actual salary paid for each salary classification and application of the forward pricing rates for payroll additives, overheads and General and Administrative (G&A), including Facilities Capital Cost of Money (FCCM) charges.
- Reviewed the mix of BNI salary grades within salary classifications for the to-go scope.
- Reviewed the non-manual staffing plans and salary classifications for each position.
- Compared the actual composite costs per hour to the composite rates utilized in the EAC.

#### *Observations*

- The process is logical and all the factors were applied in the correct manner.
- BNI's application of current actual salaries includes an inherent assumption that the to-go mix of individual salaries is similar to the current mix. After consulting with WTP project control personnel, the ERT concurs that reasonable assumptions were made for the 626 EAC.

#### *Conclusion*

The process and results of developing the field non-manual to-go composite cost per hour are valid for the EAC. The extension of to-go non-manual hours for to-go labor cost is performed correctly. EAC summaries for field non-manual labor cost are valid and reasonable. The to-go composite rates are based on current experience.

### 3.3.6.3 Labor Cost Basis: Engineering and Other Departments

#### *Objective*

Validate the methodology and results in 626 EAC for Engineering and other departments labor composite cost per hour and resultant labor cost for both BNI and WGI personnel.

#### *Methodology*

- Reviewed payroll data by department, for actual salary paid by salary classification and application of the FY05 forward pricing rates for payroll additives, overheads and G&A, including FCCM charges.
- Reviewed the mix of BNI salary grades within each salary classification as appropriate for the to-go scope.
- Reviewed the staffing plans by department and salary classifications for each position.
- Compared the composite costs per hour based on actual salary data to the composite rates utilized in the EAC.
- Validated the process of extending the estimated hours to-go by the to-go composite cost per hour and of summarizing to various EAC sections.

#### *Observations*

- The process is logical and all the factors were applied in the correct manner.
- BNI's application of current actual salaries includes an inherent assumption that the to-go mix of individual salaries is similar to the current mix. The actual data also included overtime, liability, and workers compensation costs. ERT concurs that reasonable assumptions were made for the 626 EAC.

#### *Conclusion*

The process for developing the labor cost and the resulting values are valid for the EAC. The extension of non-manual hours to labor cost is performed correctly. EAC summaries of engineering and other department costs are valid. The to-go composite rates are based on current experience.

### 3.3.6.4 Labor Cost Basis: Start-up and Commissioning

#### *Objective*

Validate the methodology and results in the 626 EAC for Start-up and Commissioning labor composite cost per hour and the extended labor cost for both BNI and WGI personnel.

#### *Methodology*

- Reviewed the basis and methodology used in the development of the EAC composite cost per hour.
- Reviewed payroll data by department, for actual salary paid by salary classification, and application of the forward pricing rates for payroll additives, overheads and G&A including FCCM charges.
- Reviewed the staffing plans and salary classifications for each position. Reviewed the mix of BNI and WGI salary grades within each salary classification as appropriate for the to-go scope.
- Compared the composite costs per hour based on actual salary data (where available) to the composite rates utilized in the EAC.
- Validated the process of extending the estimated hours to-go by the to-go composite cost per hour and summarization to various EAC reporting sections.

#### *Observations*

- The process is logical and all the factors were applied in the correct manner.
- For WGI personnel, due to confidentiality of the rate basis, composite rates per hour were provided. These rates have been reviewed by the Defense Contract Audit Agency (DCAA) for validity.
- The conversion of start-up hours to staffing levels needs to consider the extended work week that is typically worked during plant start-up activities. The EAC assumes a normal 40 hour work week for start-up activities.
- The composite cost per hour for Start-up personnel is considered low by approximately \$10.00 per hour. The EAC assumes that adequate supply of experienced personnel will be available to staff this project on a regular 40-hour work week and without payment of per-diem rates. No allowance for signing bonuses or salary uplifts has been included to attract this experienced staff. This gap has been considered in the ERT contingency assessment.
- The EAC includes reduced effort for procedure writing and the amount of training required for the personnel based on the assumed skill set, education, and experience level for the operations staff. Based on the ERT's comments in Sections 3.3.4.2 Schedule Basis and 3.3.5.3 Job Hour Basis, BNI needs to re-evaluate this assumption and adjust costs accordingly.

#### *Conclusions*

- The process of developing the labor cost should be revisited for the 490 EAC. The extension of department hours to labor cost is performed correctly; however, the limited amount of actual cost history for start-up personnel should not be used as the starting point for calculations. Estimates should model anticipated factors such as salary guidelines, overtime, and extended work weeks.
- The ERT estimates that the start-up and commissioning costs for the contract are understated by roughly \$130 million. The estimate includes the understated labor hours discussed in Section 3.3.5.3, as well as labor rates necessary to attract personnel with the required skill set for operations.



### 3.3.7 Material and Subcontract (M&SC) Cost Basis

The ERT evaluated material and subcontract costs for direct costs, indirect costs, and Start-up/Commissioning as described in the following subsections.

#### 3.3.7.1 Material and Subcontract Pricing Basis: Directs

##### *Objective*

- Validate the methodology for pricing of permanent plant equipment and bulk commodities.
- Confirm that the appropriate BNI corporate procedures are being followed.
- Validate prices in the EAC cost summaries and confirm their reasonableness.

##### *Methodology*

- Reviewed the BETK estimate details for pricing basis of awarded and un-awarded scope.
- Selected major equipment items for detail review of pricing basis.
- Reviewed equipment pricing basis for vendor representatives, spare parts, design costs, testing or documentation requirements, bonuses/liquidated damages and other common cost items for final as-built EAC.
- Reviewed estimate of backcharges.
- Reviewed project's commitment to small businesses and minority owned companies.
- Reviewed bulk commodity composite unit price development.
- Validated the process of extending the quantity and unit price for equipment, material, and subcontracted items.
- Verified EAC to-date costs match accounting data.

##### *Observations*

- BNI used an appropriate process to price permanent plant equipment and bulk commodities.
  - Equipment and bulk commodities were priced appropriately, except for allowance for escalation to the forecast cutoff date, backcharges, and field material requisitions.
    - The escalation from date of a commitment to current EAC cut off date was omitted from the EAC. The magnitude of the omission is approximately \$10 million. It is addressed in Section 3.3.8 (Escalation Basis).
    - Allowances for uncollectible backcharges may be understated in the EAC. The project is currently re-evaluating the procedure to resolve vendor site access for any remedy actions.
    - The to-date cost for field material requisitions (FMRs) relating to permanent plant materials is just over \$9 million. This includes \$2 million that has been included in the 626 EAC. The balance of the to-date and all of the to-go FMRs will be addressed in the 490 EAC.
  - The EAC cost basis for the melters is valid for the project scope, including allowances for seismic modifications.
  - WTP pricing per linear foot for electrical raceway bulk commodities was in all cases less than the values for new nuclear generation plants currently being estimated.
  - Vendor representatives' costs are included in multiple areas of the EAC. The estimate of more than \$16 million was based on a previous estimate completed several years earlier and not estimated for each individual purchase order.
  - Commodity forecasts are prepared when Engineering is 40 percent complete and again when engineering is 80 percent complete for the respective commodity.
  - Design allowances and cost allowances beyond the current defined scope are excluded from the direct materials and subcontract pricing, but considered with pricing risk in contingency assessments.

##### *Conclusion*

The pricing basis reflected in the EAC is generally valid and reasonable. It is supported by the project specific commitments and current vendor pricing. The extension of unit costs is correctly applied and summarized to various EAC cost summaries.

### 3.3.7.2 Material and Subcontract Pricing Basis: Indirects

#### *Objective*

Validate the methodology for pricing of indirect costs. Confirm that the appropriate procedures were followed. Validate prices in the EAC cost summaries.

#### *Methodology*

- Reviewed to-date expenditures.
- Selected major subcontractor material requisitions, specifications, and purchase order data to review for consistency and validity in the EAC.
- Selected several commodity items to investigate details of component build-up, source of pricing, and development of the composite to-go unit costs.
- Verified that the to-date costs in the EAC match the accounting records.
- Reviewed the basis for the methodology and for pricing commodities that are tied to craft hour expenditures, bulk quantity installations, schedule duration, or single/one time expenditures.
- Reviewed the charging practices to assure cost was coded appropriately.
- Reviewed the basis for the “surplus” credit taken in the EAC.

#### *Observations*

- The to-date costs balanced to the EAC values, and the items cost coded to the small tool account are valid.
- The EAC estimate for both small tools and consumables is consistent with historical values. The analysis was conducted on a dollar per craft job hour basis. Small tools may be somewhat understated, but by an insignificant amount in the context of the overall EAC.
- The EAC included a credit for salvage value of \$17.1 million for scaffolding and construction equipment/large tools. The value for equipment and tools is \$16 million and has been approved by the DOE to be included in the EAC. This is the same value as in the 2001 approved budget.
- BNI used appropriate processes to price the indirect costs.
- Quantity related “design growth allowances” are included in contingency and not in the detailed accounts. No additional allowances for construction indirects are linked to the direct craft hours.

#### *Conclusion*

The pricing basis reflected in the EAC is generally valid and reasonable. Project specific commitments and current vendor pricing support the estimate. The WTP estimate compares appropriately to benchmark data.

### 3.3.7.3 Material and Subcontract Pricing Basis: Start-up and Commissioning

#### *Objective*

Validate the methodology and confirm the reasonableness of the results in 626 EAC for material and subcontracts costs for start-up and commissioning. Confirm that the appropriate BNI corporate procedures are being followed.

#### *Methodology*

- Selected major commodity items to investigate details of component build-up, source of pricing, and development of the to-go costs.
- Reviewed the division of responsibility between construction and start-up.

#### *Observations*

- The division of responsibility between construction and start-up appears appropriate. As an example, construction has responsibility for hydro testing and start-up is responsible for flushing.
- The EAC includes an allowance of \$21 million in commissioning spare parts to be transitioned to the operator in 2015. The estimate is based on 25 percent of the total spares estimate.
- The WTP project performed a bottoms-up estimate for the top 20 accounts which equates to approximately 50 percent of the EAC costs for this element.
- The ERT reviewed the following accounts:
  - *Vendor representatives* – The start-up/commissioning estimate for vendor representatives is \$6.3 million to support the testing program.
  - *Fuel oil* – At peak, 42,000 gallons per day will be required, resulting in 7 to 8 truck deliveries per day (the on-site storage tank has a several day inventory which assures an undisturbed testing sequence).
  - *Simulant* – BNI’s assumptions associated with the use of simulants appear to be very conservative.
    - Quantities and price of simulants are very high based on the allowable flow-through design rates and the time allowed for cold commissioning. The cost estimate for simulants has used both the glass production quantities as well as the simulant quantities to develop the total simulant costs. This methodology is difficult to follow and needs to be recalculated using the simulant quantities throughout the calculations. The project has also used reagent grade chemical prices for the simulant mixture. Industrial grade chemicals can be used for the stimulant, which are orders of magnitude less in cost than the reagent grade chemicals. However, if the DOE requires BNI to test chemical operations of the facility with the simulant or test a wider range of bounding conditions with the simulant, the quantity and cost of the simulant would increase. This potential for cost impacts from multiple simulants and/or multiple simulant runs has been captured in TPRA line item WTP-PRJ-037.
- Measuring and Testing Equipment (M&TE) - Because all the M&TE is leased, this element was estimated by individual component based on the required duration to support the testing program. Each vendor is responsible for equipment calibration and for keeping an inventory of state-of-the-art testing equipment due to the rapidly changing technology.
- Spare parts were based on the annual expenditures at DWPF and factored for the size and complexity of WTP. This approach appears appropriate.

#### *Conclusions*

- The pricing basis reflected in the EAC is valid and supported by the project specific commitments and current vendor pricing, except for the simulants, which appear to be overstated by an amount in the order of \$10 million.

### 3.3.8 Escalation Basis

#### Objective

Verify escalation basis.

#### Methodology

Review 626 EAC costs and escalation rates and escalation procedure.

#### Observations

- The 626 EAC included \$547 million for escalation. The annual escalation rates differ over time and for resource, generally in the 2.5 percent to 4.0 percent range.
- BNI used appropriate processes and tools to develop escalation forecasts and apply such to the appropriate project costs, including COBRA software and BNI-developed spreadsheets.
- The following refinements would enhance the credibility of the escalation forecast:
  - Escalation in the 626 EAC was embedded in the “price term” of the estimate and not listed as a separate, identifiable amount. At ERT’s suggestion, BNI restructured its BecRAC cost contingency model so that escalation could be modeled as a separate term. In doing so, we determined that \$88 million of the \$547 million was escalation on contingency.
  - Escalation in the 626 EAC was compounded monthly. ERT’s analysis shows that this overstates the effect of annual escalation by approximately \$8 million.
  - Commitments made prior to the 626 EAC were not escalated before use in the detail estimate. ERT estimates that this practice led to an understated amount is in the range of \$10 million.
  - Based on new forecasting data for equipment, material, and craft labor escalation rates acquired by BNI during ERT’s review, ERT recommends an escalation increase of \$106 million.
- The 626 EAC did not show the WTP’s history with escalation, specifically forecast rates versus actual rates. Some historical data specific to the WTP Project would provide a useful benchmark of the credibility of the escalation included in the EAC.

#### Conclusions

- BNI’s escalation processes and tools are appropriate, however, ERT believes some of BNI’s input data to those processes are overly optimistic.
- An additional \$108 million should be added to the EAC for escalation adjustments. See Figure 3-3.

**Figure 3-3 Chronology of ERT Escalation Changes**

|   |           |
|---|-----------|
| 626 EAC Escalation                      | \$547 M   |
| 1. Monthly vs. annual compounding issue | - \$8 M   |
| 2. Commitments prior to Dec 2005 issue  | + \$10 M  |
| 3. Application of new escalation rates  | + \$106 M |
| ERT Recommended Escalation              | \$655 M   |

### 3.3.9 Assumptions, Exclusions and Qualifications

#### *Objective*

To determine if the EAC is bounded properly by its assumptions, exclusions, and qualifications.

#### *Observations*

- The assumptions, qualifications, and exclusions defined in the 626 EAC are generally consistent with acceptable estimating practices. Noteworthy boundary assumptions include:
  - DOE's and regulatory agencies' agreement with design authority cases for seismic, HPAV, and fireproofing.
  - One operational readiness review.
  - DOE's agreement to support sequential commissioning.
  - Retention of critical skills through temporary reassignment.
  - Fire protection requirements for structural steel remain unchanged.
- Of the BNI EAC assumptions, qualifications, or exclusions, the ERT only disagrees with two.
  - *Assumption:* Sufficient qualified personnel will be available to meet staffing needs at the hiring rate required to support the 626 EAC Startup and Commissioning staffing plan. As discussed further in Section 3.3.5.3, the nuclear industry currently has difficulty finding experienced replacements for personnel retiring or changing jobs. At the time WTP will need staff, the nuclear utility industry will be facing a near crisis in replacing experienced personnel.
  - *Assumption:* No additional work is estimated for any flowsheet modification required to align operations research tank utilization and steady state models with final design. BNI's assumption concerning the results of the external flowsheet review has proven invalid. The EFRT identified 17 major issues and 14 potential issues, all of which have been addressed by BNI. BNI included a \$200 million TPRA item for resolution of the EFRT issues. Analyses prepared during the ERT review indicate that \$150 million (\$87 million for base scope and \$63 million for EPCC contingency) of this TPRA item actually belongs in the base scope of the BNI contract.

#### *Conclusions*

- Except as noted above, the identified assumptions, qualifications, and exclusions appropriately bound the 626 EAC.
- The project needs to address several assumptions in the start-up and commissioning area, especially as they relate to staffing and the availability of qualified personnel to support the schedule. The project also needs to review whether the EFRT's recommendations affect current project scope and associated boundaries. The 490 EAC must reflect the cost to address issues raised by the EFRT.

### 3.4 Funding Compliance

#### *Objective*

Verify that BNI has complied with the time phasing of the funding with the requirements of DOE Letter 05-WTP-175, dated 18 August 2005.

#### *Methodology*

- Reviewed applicable contract requirements and DOE letters related to funding.
- Reviewed the execution plan as the underlying driver of funding.
- Confirmed assumptions that bound the ERT's analysis of funding. The ERT limited its review to the DOE's guidance as of 18 August 2005, which provides guidance of project funding of \$626 million for fiscal 2006, and \$690 million per year thereafter. The funding scenario of \$490 million included in DOE Letter 05-OPA-13275 dated 23 November 2005 is not part of the scope of the ERT.
- Analyzed escalation basis and application to understand its impact on the funding forecast.

#### *Observations*

- BNI's constrained funding scenario does not specifically follow DOE's direction that "priority will be placed first on progression of the LAB, LAW, and BOF; followed by the progression of PT and HLW design and engineering, and lastly on construction of the latter two facilities." The schedule, and hence the funding profile, is based on the curtailment of the LAW and the LAB for two years while BNI focuses on completing the design of the PT and HLW facilities.
- BNI's time phased funding forecast reconciles to the time phased estimated cost to complete. The ERT selectively sampled various detail level data and determined that the data used as the cost basis for the funding scenario appropriately rolls up to the total project level.
- BNI's time phased funding forecast includes estimated costs for contingencies within the contract work scope. The ERT believes that inclusion of this contingency in the EAC is appropriate.
- BNI's time phased funding forecast does not include an estimate for fee. The funding profile should include BNI's best estimate of fee so that DOE can budget appropriately.
- The DOE funding limitation of \$690M per year is not adjusted for escalation, having the effect of less real dollars each year to advance the schedule.
- BNI has "fenced" funds estimated for termination costs and does not utilize them for contract performance. BNI included an estimate for termination costs in Volume I Table 7-4 Project Funding Profile. The Termination Liability estimate was developed appropriately using BNI's standard approach that addresses outstanding purchase orders, subcontracts, labor, relocation costs, leases, and travel. The ERT concurs that a funding profile should be accompanied by an estimate of termination costs; however, the ERT does not believe that the amount of available funds for termination should be decremented from the funds available for contract performance. The ERT understands that BNI's position is based on the Limitation of Funds clause (contract Section I, Item I.66 – FAR 52.232-22 Limitation of Funds). ERT members conducted informal conversations with Department of Defense contracting officers and spoke with the DOE WTP Deputy Program Manager on the subject of funding for termination costs. These conversations led the ERT to believe that should the government decide to terminate the contract for convenience, additional funds would be obtained from different funding sources to execute such an action. Further, the ERT believes that termination for government convenience, should it occur, would be known by government executives several months before contractual direction is provided. And finally, the notification requirement in the Limitation of Funds contract clause (60 days prior to reaching expenditure of 75% of the authorized funds) is designed for the government program office to evaluate whether additional funds will be available or a termination for convenience action should begin. This notification activity places the burden on the government to assess its future course of action and take the appropriate steps. The net effect is that the government will be required to come up with the funds to appropriately terminate a contractual effort if that course of action is chosen by the government. Accordingly, the ERT believes that BNI should plan its contractual work based on all available contract funding, which would free up \$55-88M of funds per year in the critical FY2006-2009 timeframe. Finally, the ERT

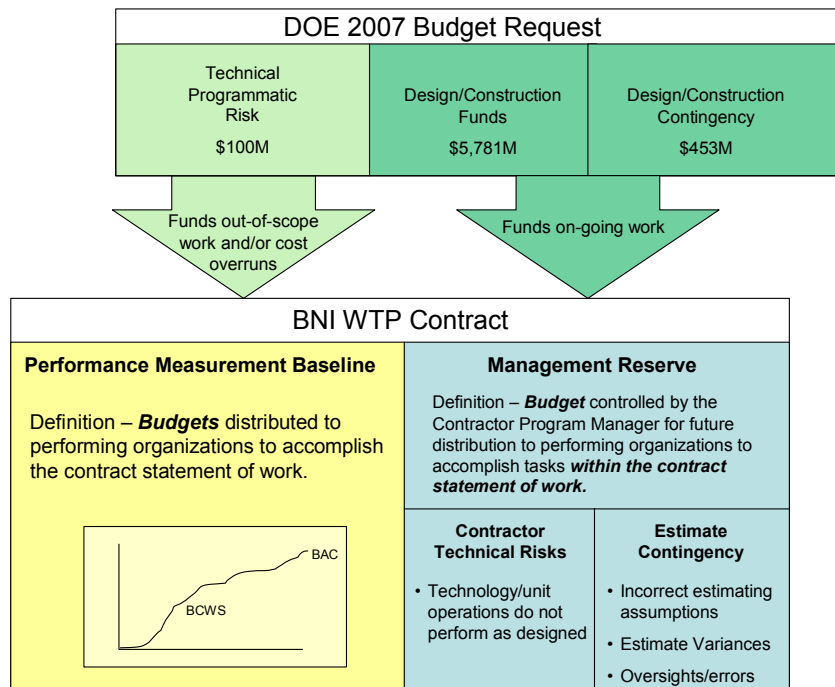
recommends that the DOE get a legal opinion concerning the source of termination funds and work with BNI to implement an agreeable contract arrangement.

- BNI’s funding profile assumes that funds can be “carried over” from year to year. The DOE Deputy Program Manager confirmed that no time limitations apply to the WTP Project funds.
- BNI’s funding profile total does not reconcile with the total EAC value. The BNI funding profile includes annual funding of \$690 million through 2017, which totals \$11.3 billion. The total value of BNI’s EAC is \$8.9 billion. BNI should estimate when the funding ramps down in the funding profile, and the total funding amount should equal the total EAC amount (including all costs and fee).
- Ambiguity exists regarding control over contingency funds. The ERT noted that DOE has separate line items in the WTP FY 2007 budget request for construction contingency (\$453 million) and technical and programmatic risk (\$100 million). Discussions with BNI staff indicated that the construction contingency funds amount equates to the amount in BNI’s management reserve. These funds should be the domain of BNI for in-scope work. The technical and programmatic risk funds should be the domain of DOE and used to fund overruns or work that is not in BNI’s contract scope. WTP staff indicated that, in the spirit of collaboration, the contingency funds were jointly managed by DOE and BNI. While it is important for both parties to work together, separation of control of these contingencies is critical for effective contract management. Figure 3-4 depicts the differences and relationships of the DOE budget/funding process and the contractor’s internal budgeting process.
- DOE’s FY 2007 budget request contains significantly less Technical and Programmatic Risk contingency than is necessary to complete the WTP. The DOE has requested \$100 million for technical and programmatic risk while the EAC review indicates that \$1 billion is a more realistic estimate. The ERT anticipates that DOE will have difficulty maintaining such a large contingency in the Congressional budget process each year, and it will be a challenge for DOE to find an acceptable means to secure and keep contingency funds in the annual funding process.

*Conclusions*

BNI’s funding profile shown in the 626 EAC, Volume 1, Table 7-4 fits within the constrained funding profile directed in DOE letter 05-WTP-175 dated 18 August 2005. The underlying schedule, estimated costs to complete, time phasing of costs, and contingencies appear to provide an appropriate basis for the constrained funding profile.

**Figure 3-4 Risks and Contingencies in the DOE and BNI Budgeting Processes**



### 3.5 Risk Assessment

#### 3.5.1 Cost Risk: EPCC

##### *Objective*

Assess the BNI EPCC cost contingency risk model for reasonableness and restructure as necessary; and input its own data for independent runs reflecting confidence in the underlying elements of the reviewed EAC. EPCC cost quantification of this risk determines the contingency required to complete the project.

##### *Methodology*

- Reviewed the existing BNI Cost Contingency Model in the 626 EAC.
- Identified risk terms and variables in that model and assessed confidence levels.
- Ran BecRAC with ERT team data and interpreted results.
- Adjusted model after consultation with BNI team and reran as necessary.
- Built EAC contingency.

##### *Observations*

- The 626 EAC contains a \$115.6 million allowance for contractor technical risk.
- The 626 EAC contains an EPCC cost contingency of \$812 million, which represents a 16 percent contingency on to-go costs.
- BNI, in accordance with standard DOE policy, selected an 80 percent confidence level as the basis for determining EPCC cost contingency.
- The 626 EAC uses a BNI-proprietary tool, BecRAC, to model risks based on Monte Carlo simulation techniques. It uses appropriate methodology.
- The EPCC cost risk is modeled in five categories: the project functions of engineering, construction, startup & commissioning, and shared services, plus “late adjustments.” These categories are developed for each of the five WTP facilities (Pretreatment, LAW, HLW, Lab, and BOF).
- The EPCC cost risk model is based on input from 416 individual ‘terms’ based on WBS cost elements. The terms used in this modeling constitute all the significant parts of the WTP project.
- The WTP team prepared guidelines for consistency in assessment of confidence ratings.
- The contingency model utilized one set of probability distributions for quantity, productivity, and pricing variables.
- There are a number of adjustments that should be made to the model, discussed below.

##### *Conclusions*

- The contractor technical risk allowance is reasonable.
- The BNI 626 EAC Cost Contingency Model is overly optimistic. The confidence levels used in the 626 EAC cost contingency model are overly optimistic, which in turn make BNI’s \$812 million estimate overly optimistic. As shown in Figure 3-5, 44 percent of BNI’s self-assigned ratings fell in the “high confidence” range. This is not credible for such a large, long-duration project. ERT’s judgment is reflected in Figure 3-7.



**Figure 3-5 BNI's Confidence Level Ratings in 626 EAC EPCC Cost Risk Model**

|                        | <b>Risk Model Variables</b> | <b>%</b> |
|------------------------|-----------------------------|----------|
| High confidence        | 444                         | 44%      |
| High-medium confidence | 238                         | 24%      |
| Medium confidence      | 276                         | 27%      |
| Medium-low confidence  | 41                          | 4%       |
| Low confidence         | 12                          | 1%       |
|                        | 1,011                       | 100%     |

ERT proceeded to make adjustments to the EPCC Cost Contingency model as noted below and summarized in Figure 3-6:

- **Model Fixes**
  - The BNI 626 EAC cost contingency model includes a post award allowance. ERT removed this variable because it duplicates the pricing variable. The result is a decrease in the contingency amount of \$55 million, Model Adjustment 1.A.
  - The 626 EAC model includes a productivity variable for level of effort (LoE) resources. Because those resources are directly tied to labor hours, ERT eliminated the LoE productivity variable to avoid double-counting. The result is a decrease in the contingency amount by \$13 million, Model Adjustment 1.B.
  - The 626 EAC model does not model shared services in a detailed manner. ERT introduced two variables, quantity and price, as risk variables for shared services. ERT assigned “high confidence” ratings to both variables throughout the estimate except for project controls. ERT also introduced a different distribution for the quantity variable in the LoE category. These two adjustments added \$60 million to the contingency amount, Model Adjustments 1.C and 1.D.
- **Assessment Fixes**
  - Equipment quantity terms are rated by BNI inconsistently. Because equipment quantity is based on detailed design, including modeling, ERT believes that quantity could be assigned a “high confidence” level. Similarly, certain bulk materials had inconsistent pricing risk ratings. The variable “price” for pipe in one building was sometimes rated at a different confidence level than the same type of pipe in other buildings. ERT harmonized those price variables to a consistent risk rating. The result of these two adjustments is an increase of \$8 million, Model Adjustments 2.A and 2.B.
- **Application of ERT’s own confidence judgment**
  - After review of the 626 EAC estimate and backup documentation, and interviews with WTP project personnel, the ERT team applied its own judgment to the 626 EAC risk model. One adjustment was to distributable craft labor, as discussed in Section 3.3.5.1.2 of this report. It accounted for an increase of \$19.9 million in the cost contingency, Model Adjustment 3.A.
  - The 626 EAC model had one global variable probability distribution for all three of types of variables: quantity, productivity, and price. ERT defined and implemented three different probability distributions for those three variables (see Figure 3-7), resulting in a \$173 million increase. See Model Adjustment 3.B.
  - Following the analytical cost contingency modeling, ERT determined that the model adjustments for the integrated water runs, cold commissioning, and hot commissioning were overstated for start-up and commissioning. Accordingly, ERT reduced the cost contingency by \$23 million, Model Adjustment 4.A.

*Recommendation*

- The EPCC Cost Contingency should be raised to \$982 million, representing 20% of to-go costs. This returns the EPCC Cost Contingency to an 80% confidence level.

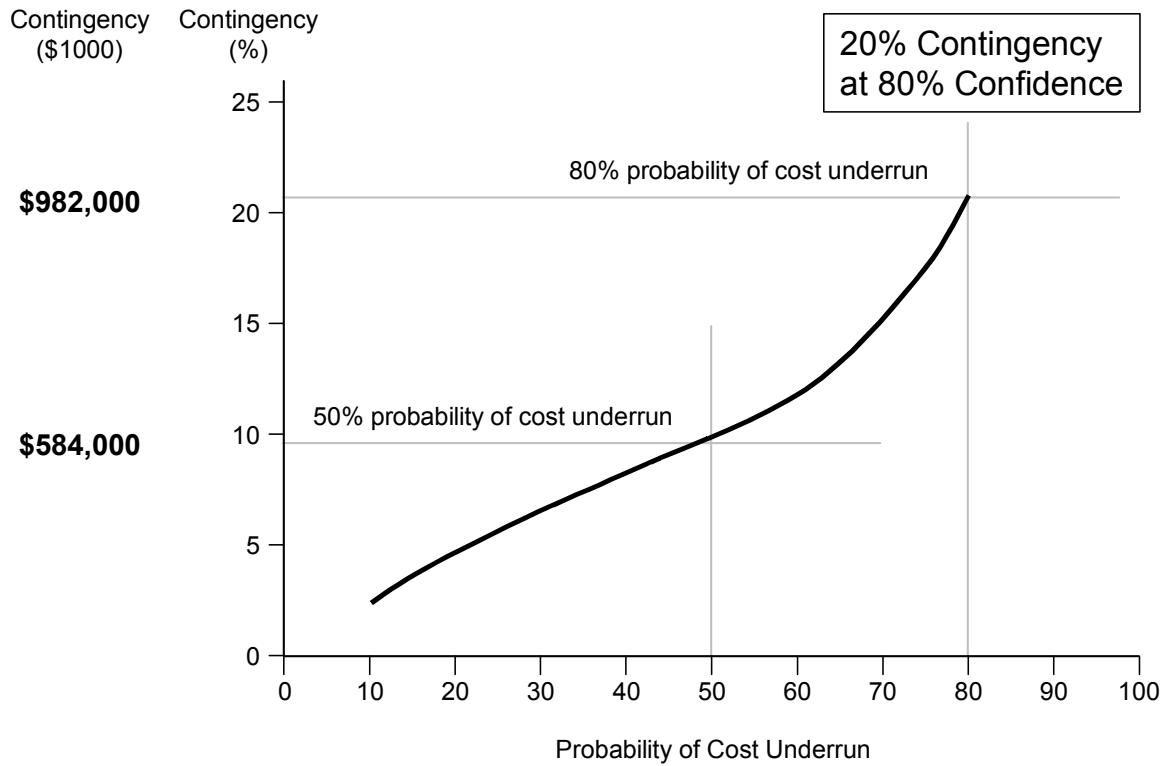
**Figure 3-6 EPCC Cost Contingency Adjustments  
(All costs in \$ millions)**

| <b>626 EAC</b>                         |                   |
|--|-------------------|
| Recommended changes                    | Total Contingency |
| <b>BNI Model Result</b>                | <b>\$812M</b>     |
| <b>1. Model Fixes</b>                  |                   |
| A. PA allowance                        | -\$55M            |
| B. Eliminate LoE productivity variable | -\$13M            |
| C. Two new Support Services variables  | +\$60M            |
| D. LoE quantity variable distribution  | included in 1.C   |
| <b>2. Assessment Fixes</b>             |                   |
| A. Equipment terms                     | included in 2.B   |
| B. Harmonize pricing                   | +\$8M             |
| <b>3. ERT confidence judgment</b>      |                   |
| A. Distributable labor                 | +\$20M            |
| B. Add 3 variable distributions        | +\$173M           |
| <b>4. ERT Late Additions</b>           |                   |
| A. Commissioning schedule              | -\$23M            |
| <b>Total after all adjustments</b>     | <b>\$982M</b>     |

**Figure 3-7 ERT's Proposed Three Variable Probability Distributions**

| ERT's Proposed Quantity Risk Levels |     |     |     |     |     |
|-------------------------------------|-----|-----|-----|-----|-----|
|                                     | 10% | 25% | 50% | 75% | 90% |
| High                                | 98  | 99  | 100 | 106 | 110 |
| MH                                  | 97  | 99  | 100 | 110 | 115 |
| Medium                              | 96  | 98  | 100 | 114 | 123 |
| ML                                  | 95  | 98  | 100 | 119 | 134 |
| Low                                 | 94  | 97  | 100 | 126 | 148 |
| ERT's Proposed Price Risk Levels    |     |     |     |     |     |
|                                     | 10% | 25% | 50% | 75% | 90% |
| High                                | 98  | 99  | 100 | 109 | 115 |
| MH                                  | 97  | 99  | 100 | 114 | 123 |
| Medium                              | 96  | 98  | 100 | 120 | 135 |
| ML                                  | 95  | 98  | 100 | 128 | 151 |
| Low                                 | 94  | 97  | 100 | 138 | 171 |
| ERT's Proposed Productivity Levels  |     |     |     |     |     |
|                                     | 10% | 25% | 50% | 75% | 90% |
| High                                | 90  | 95  | 100 | 112 | 125 |
| MH                                  | 89  | 95  | 100 | 116 | 135 |
| Medium                              | 88  | 94  | 100 | 123 | 150 |
| ML                                  | 87  | 94  | 100 | 133 | 170 |
| Low                                 | 86  | 93  | 100 | 146 | 195 |

Figure 3-8 EPCC Cost Contingency vs. Probability of Overrun



### 3.5.2 Schedule Risk

#### *Objective*

Assess the BNI schedule risk model for reasonableness. Assess the probabilistic risk model and the means by which any time contingency is converted into monetary value.

#### *Methodology*

- Reviewed the existing BNI schedule risk model in the 626 EAC.
- Identified the risk terms and variables in that model and assessed confidence levels.
- Ran the BNI schedule model with ERT team data and interpreted results.
- Based on discussions with BNI team, adjusted model and reran as necessary.
- Built EAC schedule contingency.

#### *Observations*

- BNI uses Primavera Project Planner software to model the project schedule and Pertmaster to model the schedule risk. Pertmaster links to Primavera.
- BNI's schedule risk model contains 400 high-level activities representing critical and near-critical activities. It assumes six points of float fixity: engineering complete; construction complete for PT, HLW, LAW, and Lab; and contract complete.
- All schedule activities in the BNI risk model were restricted to one finish-to-start relationship with another activity. No start-to-start, finish-to-finish or multiple relationships were permitted.
- Confidence levels were assigned by BNI facility superintendents and functional managers.
- The 626 EAC schedule risk analysis computed that fourteen months of schedule contingency were needed (six months for construction, six months for commissioning, and two months for other unknowns associated with the operational readiness review).
- Schedule contingency was translated into dollars by multiplying time and the WTP's monthly hotel load. ("Hotel load" is the time-dependent set of project support costs that arise from schedule extension, such as extended project management.) The monthly hotel load applied at three distinct times in the project, depending upon when the uncertainty was forecast to occur. It was estimated to be \$8.6 million for FY 2008, \$8.1 million for FY 2010, and \$4.4 million for FY 2015. When applied to the fourteen months of schedule contingency, this monthly hotel load translates into \$92 million of schedule contingency in the 626 EAC.
- The BNI Red Team added escalation on the possible schedule slip, bringing the total hotel load to \$113 million.
- After careful study, the ERT made a number of changes to the BNI 626 EAC schedule risk model, focused on the HLW. The HLW portion of the model and its construction completion comprise 42 high risk critical path activities. Only these activities were analyzed due to time limitations. Changes are summarized in Figure 3-9 and explained below.
  - ERT determined that numerous durations were overly-conservative in the 626 EAC Schedule Risk Model (Run HLW2 in Figure 3-9). Adjustments were then made on a step-by-step basis (summarized by Runs HLWJ, HLWK, and HLWL in Figure 3-9).
  - Those modifications shortened the project completion date for HLW construction by nine months. They also reduced the date of 80 percent confidence by more than 10 months. They inexplicably did not affect the one-to-two percent probability of finishing on the projected construction completion date.
  - ERT then increased the confidence ratings for 13 of the 42 activities in order to increase the probabilities of finishing by the projected completion dates from a mere one-to-two percent to a much more credible 20 percent.
  - Most of this benefit comes from focusing on only six of these 13 activities because those 6 had durations greater than 40 days. ERT believes that it is credible for BNI to concentrate on this small number of activities and realize better durations and associated higher confidence levels.
  - These modifications to the HLW reduce the needed schedule contingency for HLW to three months.

- The 626 EAC had an allowance of six months for schedule contingency. Applying ERT’s three months schedule contingency, and an \$8.1 million/month hotel load results in a \$24 million schedule contingency value for HLW, not the \$48.6 million in the 626 EAC. Based on ERT’s analysis, savings of \$24.3 million can thus be realized if similar 3-month schedule contingency reductions can be found in the pretreatment building, which is scheduled concurrent to the HLW.

**Figure 3-9 Chronology of Schedule Contingency Model Adjustments for HLW**

| Run #  | Description  | Projected Construction Completion Date | Probability of finishing by projected construction completion date | 80% date     |
|--------|--|--|--|--------------|
| HLW2 * | Schedule risk model used in 626 EAC.   | Dec 19, 2012                           | 1%   | Jun 25 2013  |
| HLWJ ^ | HLW2 + made changes to durations of 22 activities.                               | Nov 8, 2012                            | 2%   | Apr 25 2013  |
| HLWK ^ | HLWJ + changes to durations of 1 concrete and 1 piping activity.                 | Aug 7, 2012                            | 2%   | Jan 17 2013  |
| HLWL ^ | HLWK + changes to durations of 1 liner, 1 piping and 1 electrical test activity. | Mar 19, 2012                           | 2%   | Aug 15, 2012 |
| HLWM ^ | HLWL + changes to confidence ratings of 12 activities                            | Mar 19, 2012                           | 20%  | Jun 4, 2012  |

\* BNI original schedule risk model

^ ERT changes

*Conclusions*

- BNI’s schedule contingency is generally credible.
- There is an anomaly in the model, as illustrated in Table 3-9. Namely, the projected completion date for construction should have a probability much greater than one percent. The anomaly could be fixed if the following changes are incorporated.
  - The model should be restructured so that an activity can have more than just one finish-to-start relationship with another succeeding activity.
  - The current 400-activity model simulates approximately 25,000 unfinished schedule activities, of which 1,600 are significant path activities. As changes (e.g. to duration) are made in such a highly-abstracted model, important impacts to logic relationships and to critical and near-critical (less than 60 days float) activities in the underlying schedule network may be overlooked.
- The schedule contingency on the HLW should be reduced from 6 months to 3 months. Other schedule time savings may be achievable.

### 3.5.3 TPRA

#### *Objective*

Determine the completeness of the TPRA list, the validity of items currently on the TPRA list, the cost and schedule risk associated with each item, and disposition of the items for the 626 EAC.

#### *Methodology*

- Following project interviews, ERT reviewed the validity, schedule and cost risk values.
- ERT reviewed additional project information to identify any emerging issues to add to list.

#### *Observations*

- The TPRA has a definitive basis. The list as presented in the BNI Risk Assessment Report, dated 23 December 2005, was composed of 45 individual risks. Each was supported by a Risk Assessment Sheet which included a statement of risk, probability of occurrence, consequence, risk level, risk handling strategies, and residual risk impact (both cost and schedule consequence). This is an appropriate method of characterizing the risks and providing input to the risk model.
- The TPRA risk was quantified using input data from the Risk Assessment Sheets to Crystal Ball software, which is an industry-recognized, Monte Carlo-based tool. This is an appropriate method of determining the total TPRA risk value at the desired confidence level.
- Significant data input changes were required to the 45 original sheets to properly characterize the TPRA risk. For example, the ERT had to adequately define the baseline condition from which the risk was derived. The ERT revised the wording of some risks, had to understand where in the project schedule the risk would occur, and changed some cost ranges. Additionally, some risks were renamed or combined with other risks. These changes were provided to BNI, and additional runs were made with the revised data in BNI's Crystal Ball model.
- The ERT determined that certain additional risks, which we believe are legitimate TPRA risks, were not included in the original list of 45. Input sheets for these risks were developed, they were added to the Risk List, and included in Crystal Ball model runs.
- DOE and BNI are not providing proactive systematic management of the TPRA risk process. This management requires mutual tracking of the risk handling strategies on a continuous basis, routine updating of the Risk Assessment Sheets, re-computing the TPRA risk, adding new risks as they emerge, and fully documenting which organization has responsibility for mitigation actions.
- In addition to identifying real risks, the TPRA list appears to be a place to put items that were controversial, and that the project did not want to deal with.
- No allowance has been made for "unknown unknowns," i.e., future issues such as regulatory changes that will emerge on a long-duration project.
- The TPRA list is not a "living document." It became a "stale" collection point for a variety of items.
- There was a hiatus in reporting between April 2004 and August 2005.
- Seismic was never included on the list.
- Pulse jet mixers were included at most likely cost risk of less than \$1 million versus the \$200 million-to-\$300 million impact realized when they needed to be added.

#### *Analysis*

- As a major first-of-a-kind undertaking, WTP is comparable to the pioneer process projects studied by Rand.
  - The Rand study uses five different estimate classes, depending on project development stage, from research & development (Class 0) through construction (Class 4). WTP's engineering is 68% complete, and thus falls between the Class 2 and Class 3 estimates in the Rand report. See Figure 3-10 below.
  - The Rand study indicates that "Class 2" projects were typically underestimated by 28 percent and Class 3 projects by 20 percent.
  - ERT presumes that the Rand data are based on 50 percent confidence level estimates.

- ERT analyzed its cost contingency curve developed for Section 3.5.1 of this report and determined that the ratio between the 80 percent and 50 percent confidence level points of that curve (Figure 3-8) is approximately 1.70.
- ERT adjusted the Rand underestimation data by this 1.70 factor and determined that the risk allowance<sup>3</sup> should range between 34 percent and 48 percent (0.20 x 1.70 and 0.28 x 1.70). Applying these adjustments to the ERT contract base of \$7,979 million yields a range of \$2,713 million to \$3,830 million for additional risk allowance appropriate to a pioneer project.
- The ERT-adjusted 626 EAC has \$2,429 million of risk allowance, or 30 percent of contract base, which is less even than the 34 percent lower bound of the Rand recommended range for risk allowance.

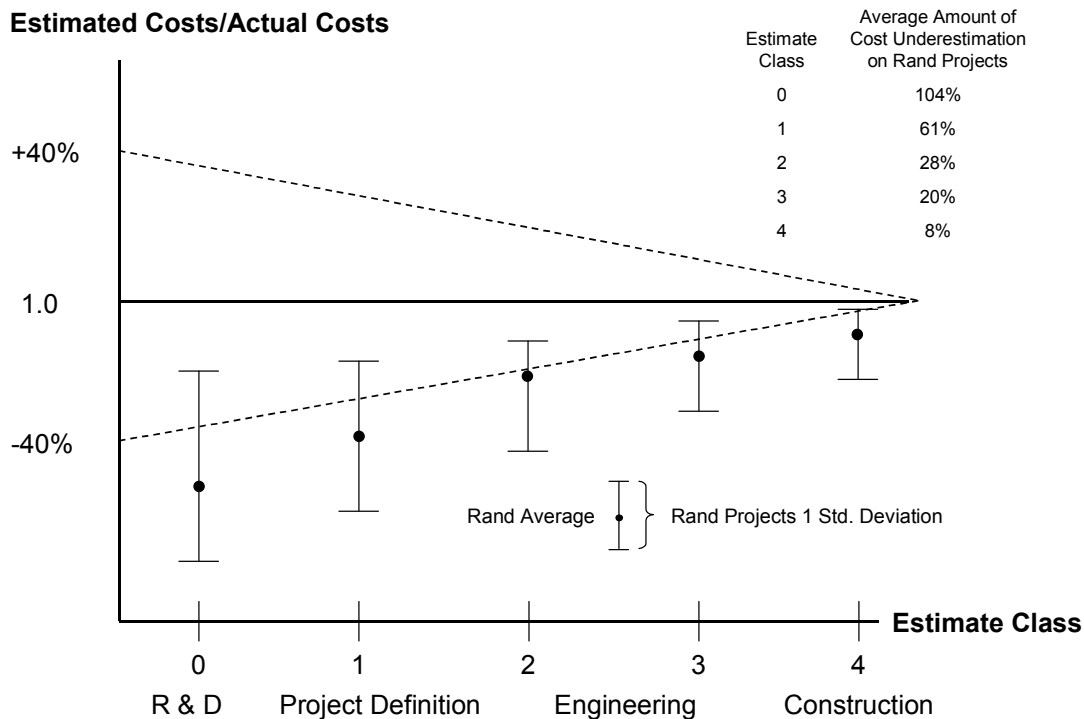
*Conclusions*

- The Crystal Ball software is acceptable and is being properly employed in the TPRA process.
- Not all items on the TPRA list were properly characterized. Following ERT’s review, 20 of 45 were reclassified and the TPRA list now includes 25 items. (A number of the 45 were earmarked by BNI to be moved into the scope but not in the timeframe to include in the 626 EAC.)
- There are schedule and cost inaccuracies in some items. However, WTP committed to review all questioned items.
- TPRA is not a proactive and focused program and has not been updated on a timely and regular basis.
- Based on the Rand study, WTP should have a risk allowance of between 34 percent and 48 percent. Using the average of these endpoints, WTP should have a risk allowance of 41 percent to allow for “unknown unknowns” and bring the base EAC plus TPRA to an 80 percent confidence level.

*Recommendation*

- Add \$1 billion to TPRA.

**Figure 3-10 Rand Projects by Estimate Class**



<sup>3</sup> Defined here as BNI management reserve (EPCC cost contingency) plus TPRA.





## APPENDIX A

# External Review Team Members' Biographical Information



| <b>Member</b>      | <b>Company</b>   | <b>Background</b>  |
|--------------------|--|--|
| John O. Bodman     | Consultant<br>Chemical<br>Engineering/<br>Commissioning                  | Mr. Bodman is President and Chief Executive Officer of John O. Bodman Consulting, Inc., an international, emerging business and litigation consulting firm. He has over 40 years of Senior and Executive Management experience in the energy fuels and petro-chemical industries, and has been associated with plant commissioning for a number of plants including Kerr McGee Cimarron Uranium and Plutonium Dioxide Pelletizing Plants, and Sequoyah Uranium Hexafluoride Conversion Plant. His plant commissioning experience also includes Chevron's Richmond Refinery Catalytic Cracking and Alkylation Units. Mr. Bodman has applied his commercial and technical expertise as an American Arbitration Association arbitrator in large, complex, construction/commissioning cost litigations. Example: Wabash vs PSI Energy (Cinergy). This case settled the large cost overrun involved in the construction/commissioning of an experimental, DOE financed, coal/coke gasification facility. Mr. Bodman holds degrees from the University of Maryland (JD), Harvard Business School (MBA), and Princeton University (BSChE).  |
| David L. Brannen   | Consultant –<br>Retired Bechtel<br>Executive<br>Power /<br>Commissioning | Mr. Brannen has over 30 years of executive, managerial, and functional experience on a wide range of nationally significant engineering, procurement, construction, and commissioning nuclear, fossil fuel, and telecommunications projects ranging in value up to \$9 billion. Mr. Brannen served at Bechtel Power Corporation as Chief Startup Engineer, Chief Plant Design Engineer, Engineering manager for Operating Plant services, and was the Business Line Manager for Nuclear and Fossil Operating Plant Services. As Deputy Program Manager on loan to Lucent Technologies, he was responsible for construction of its Advanced Hybrid Fiber Coaxial (HFC) Telecommunications Systems infrastructure, and Bechtel's Program Director for the WINFIRST Telecommunications Project responsible for the build-out of its \$5 billion telecommunications network. Mr. Brannen has testified at FERC as an expert witness on nuclear plant capital expenditures. Mr. Brannen was Manager of the Frederick office, responsible for Engineering, Procurement, and Construction and associated service organizations for the Telecom and Power Business Lines. Mr. Brannen was a member of several ANSI committees developing standards and guidelines for the nuclear construction industry. |
| Thomas Levitte Cox | Jacobs Engineering<br>Group, Inc<br>Engineering                          | Mr. Cox has over 16 years of experience in the process engineering, project management, and data management areas. He is currently the Process Engineering Department Manager for Jacobs Federal Operations. He has been the Jacobs Site Manager for the DOE Remediation Project (Fernald Closure Project) at the Fernald site, lead numerous process engineering projects and is familiar with managing groups of personnel on technically-complex projects, change control systems, and vendor, client, and public interaction. Mr. Cox is a Process Engineer and has been the lead Process Engineer for several design efforts. His responsibilities have included the development and management of budget, scope, schedule and work assignments for the process engineering team. The work included interaction with the client and vendors, development of block flow diagrams, process flow diagram, piping and instrumentation diagrams, general arrangements, specifications and datasheets, and supporting calculations.   |

| <b>Member</b>         | <b>Company</b>   | <b>Background</b>   |
|-----------------------|--|---|
| William B. Derrickson | Consultant –<br>IBEX Engineering<br>Services               | Mr. Derrickson has over 40 years of engineering, management, and consulting experience in the nuclear power and utilities industries. His broad-based experience includes senior project management responsibilities for engineering, procurement, construction, start-up, and commissioning of new facilities as well as conduct of major modifications to existing plants. Mr. Derrickson has consulted on nationally significant projects including the Alaska Oil Pipeline, Yucca Mountain, and High Level Waste projects. He holds degrees in Electrical Engineering and Political Science from the University of Delaware (BSEE, BS) and attended the Harvard Business School Program for Management Development. He has attended graduate studies in Electrical Engineering and Business Administration from the University of Delaware. Mr. Derrickson has authored numerous publications related to management and construction of nuclear power plants and was recognized as Construction Man of the Year by McGraw-Hill / Engineering News Record Magazine.  |
| Alice Cochran Doswell | BWXT Services,<br>Inc<br>Program Manager/<br>Environmental | Ms. Doswell has over 24 years experience in the management of nuclear programs, projects and operations within complex technology environments. 14 years experience with Department of Energy facilities in the areas of nuclear laboratory operations, safety management, waste management, deactivation and decommissioning, and soil and groundwater restoration projects. As Deputy Assistant Manager for the Waste Disposition Project at the Savannah River Site, was responsible for the treatment, storage and disposal of highly radioactive liquid waste, and transuranic (TRU), low-level, mixed, and sanitary solid waste. As the acting Assistant Manager for Health and Safety, managed site-level technical programs including industrial safety and hygiene, nuclear safety, criticality safety, D&D, engineering and construction, radiological protection, etc. As Director for Laboratory Operations, had start-up responsibilities for nuclear and two radiological laboratory facilities. She is an established leader demonstrating performance in streamlining processes to achieve significant cost and schedule improvements. She holds degrees from Clemson University, SC (MS), Mary Baldwin College (BA), and is a Registered Environmental Manager, NREP and recognized Senior Technical Safety Manager. |

| <b>Member</b>     | <b>Company</b>  | <b>Background</b>   |
|-------------------|---|---|
| Dr. William Ibbs  | Consultant – University of California - Berkeley                              | Dr. William Ibbs is a Professor of Civil Engineering (in the Construction Management Program) at the University of California at Berkeley. His teaching and research work is in project cost and schedule performance, and project control systems. He holds degrees in Civil Engineering (Construction Management) from the University of California at Berkeley (Ph.D.), and Carnegie Mellon University (BSCE, MSCE). Prior to his academic career he worked in design and construction capacities in the power, petrochemical, technology, manufacturing, and military industries. Dr. Ibbs has been a Director of the Project Management Institute’s College of Scheduling and Chair of the American Society of Civil Engineer’s Project Controls Committee, and has received numerous awards from PMI, ASCE and the National Science Foundation for that leadership. As part of his 25 years of international consulting experience, he has provided peer review service for numerous projects including Boston’s Big Dig, the San Francisco Bay Bridge, the San Francisco Hetch Hetchy Water System, and the Los Angeles Metro Rail System, and has testified in a number of public hearings. |
| Alan C. Kaufman   | Bechtel Power Project Controls / Estimating Manager, Project Business Manager | Mr. Kaufman has over 25 years of Project Controls and Business Management experience on a wide variety of engineering, procurement, construction, and commissioning projects, principally in the nuclear and fossil fuel power plant industries. Mr. Kaufman has served on a number of advisory and recovery teams as a consultant, advising projects on budgetary, schedule, and client relationship issues. His projects were valued in excess of \$1.5 billion. Mr. Kaufman holds degrees in Civil Engineering/Construction Management from Rutgers University (BS) and Civil Engineering Technology from Ocean County College (AA).   |
| Timothy P. Kruzic | Principal Consultant – FOCIS Associates                                       | Mr. Kruzic has over 25 years experience in managing complex government programs. He has worked on multi-billion government programs including the Department of Defense’s Assembled Chemical Weapons Alternatives Program (including the Pueblo Chemical-Agent Disposal Pilot Plant and the Blue Grass Chemical-Agent Disposal Pilot Plant) and the Federal Aviation Administration’s National Airspace System. As Deputy Program Manager of the ACWA support contract, Mr. Kruzic is responsible for the Program Control Organization including evaluation of Earned Value Management Systems, EVMS reported data, Estimates at Completion, scheduling, and funding. Mr. Kruzic holds Technology Management and Accounting degrees from the University of Maryland (MS/BS). Mr. Kruzic is an employee of FOCIS Associates, Inc which has recently been purchased by SAIC.  |

| <b>Member</b>                 | <b>Company</b>  | <b>Background</b>   |
|-------------------------------|---|---|
| Dr. Bernard L. Meyers         | Consultant – Retired Bechtel Executive Nuclear          | National and international nuclear regulatory agencies recognize Dr. Meyers for his technical and thought leadership in nuclear quality and regulatory compliance. Dr. Meyers is an accomplished corporate executive whose career has spanned over 30 years where he managed construction projects ranging in value from \$2.1 to \$19 billion. Dr. Meyers is a registered Professional Engineer in 21 states. He is a Fellow of the American Society of Civil Engineers and a member of the Nuclear Energy Institute and American Society of Mechanical Engineers. Dr. Meyers holds degrees in Civil Engineering from Cornell University (PhD), University of Missouri (MSCE), and Polytechnic University of Brooklyn (BCE).   |
| Constantinos “Dinos” Nicolaou | Consultant  | Mr. Nicolaou has over 30 years of Project Controls and engineering, construction, start-up and outage project planning and scheduling experience. He is currently a Supervising Project Controls Engineer and serves on an independent review team for DOE sponsored programs. His broad-based experience encompasses nuclear and fossil fuel electrical generation plants, nuclear waste treatment and cleanup projects, and chemical and biological ammunition cleanup projects. Mr Nicolaou has served as Manager of Project Controls, Supervising Scheduling Engineer, and Project Controls Engineer on a multitude of projects up to \$2.5 billion in value. He holds degrees in Business Administration from the University of Puget Sound (MBA) and Economics and Business from the College of Staten Island, (BS, AAS). Mr. Nicolaou has also consulted for Burns & Roe.  |
| Eugene Onopko                 | Consultant – Former Bechtel Chief Estimating Supervisor | Mr. Onopko has over 30 years of national and international engineering, procurement, and construction project estimating experience. As Chief Estimator, he managed the estimating efforts for projects ranging in value from \$1.0 to \$5.0 billion. Examples include the Nuclear Power industry for Hope Creek, WNP 2, WNP 1&4, Advanced Nuclear Concept studies, and the New Production Heavy Water Reactor. Other examples include the Integrated Gasification Combined Cycle, Solar Power, Refinery Upgrades, Gas Turbine Co Generators, Boeing New Wind Tunnel Complex, a Titanium Dioxide Plant, and an aluminum smelter. As a consultant, Mr. Onopko had provided numerous methods and systems evaluations along with in-depth major project estimating training. He has received a Certificate from Footscray Technical College for completion of coursework in Electrical Engineering. Mr. Onopko currently holds a consulting agreement with DOE and has provided estimating services for several government facilities. |

| <b>Member</b>     | <b>Company</b>                                       | <b>Background</b>   |
|-------------------|--|---|
| John A. Rutgers   | Consultant – Retired Bechtel 40 Yr Executive - Power | Mr. Rutgers has over 40 years experience in all aspects of project management in the nuclear, fossil, and cogeneration industry. His extensive career included construction, cost engineering and project management and development leadership for domestic and international projects ranging in value from \$0.5 to 4.0 billion. Mr. Rutgers has published several papers on a variety of topics including construction cost control, integrated management services, construction finance, and project risk. He holds a degree in Civil Engineering from Princeton University (BSCE) and a diploma from the Tuck Executive Program at Dartmouth College.  |
| John Scango, P.E. | Consultant Nuclear / Scheduling                      | Mr. Scango is a consultant in all aspects of a wide-range of significant Department of Energy Projects that span his 36-year career in public and private industry. He served as Director of Cost for the US Synthetic Fuels Corporation, and was the Assistant Project Manager of Engineering for the US Strategic Petroleum Reserve Project. Mr. Scango has led reviews including the \$8B Superconducting Supercollider Baseline, the \$5.3B Environmental Cleanup Program, and has managed over 40 Independent Cost Estimates. As a consultant he has participated in numerous External Independent Reviews including such projects as the Hanford Tank Farm, the Waste Treatment Plant Critical Decisions, the Brookhaven Graphite Research Reactor Decommissioning, and the Spallation Neutron Source. He holds a degree from Carnegie Mellon University (BSME).  |
| Gary W. Stanley   | Consultant – Retired Bechtel Nuclear & Environment   | Mr. Stanley has more than 30 years of broad-based experience in nuclear plant construction, start-up, and operations and has held senior leadership positions for nationally significant nuclear waste cleanup projects ranging in value from \$0.1 to \$10 billion. He has held numerous leadership positions where he managed and directed quality control, engineering, procurement, start-up, and plant maintenance over the course of his career. Mr. Stanley supervised construction on the Grand Gulf and Zimmer Nuclear Power Plants. He was Project Manager on Hope Creek and Tennessee Valley Authority projects. Mr. Stanley has served as Construction Manager and Vice President and Manager of Project Operations for the Savannah River Site. Mr. Stanley attended Kansas State and Wichita State University schools of Engineering and achieved certification in the Bechtel Executive Plan Director’s Advisory Group. He received the Saturn Role of Honor Contributions from the National Aeronautics and Space Administration for the successful Apollo moon launch. |

| <b>Member</b>     | <b>Company</b>                      | <b>Background</b>   |
|-------------------|-------------------------------------|---|
| Ellis Julio Valle | Shaw Group, Inc<br>Construction     | Mr. Valle has over 30 years of experience in construction, engineering, commissioning, maintenance, and project management in nuclear, fossil fuel and cogeneration industry. His extensive career included various consulting project management positions with Southern California Edison, Texas Utilities, Commonwealth Edison, Northeast Utilities and construction management support services through AE firms such as Bechtel, Fluor and Halliburton. Mr. Valle holds a degree in Safety Engineering from Kennedy Western University (BSSE) and Project Management Certification from University of California-Irvine.   |
| Ike Zeringue      | Consultant<br>Project<br>Management | Mr. Zeringue is a Senior Consultant to the nuclear industry with over 30 years of Senior and Executive Management experience. He served as Tennessee Valley Authority's Chief Nuclear Officer and was ultimately appointed as President and Chief Operating Officer where he led management of TVA power production, transmission, power trading, and resource management programs. Additionally, he headed the TVA's Executive Committee and chaired TVA's Business Council. Mr. Zeringue holds a degree in Nuclear Engineering from North Carolina State University (BS), completed graduate work in mechanical engineering, and is a graduate of the Advanced Management Program at Harvard Business School. |



## APPENDIX B

# Matrix of Work Breakdown Structure with External Review Team Members and Interviewees





|                 | 3.1.1   | 3.1.2.1      | 3.1.2.2                | 3.1.3                    | 3.1.4             | 3.1.5              | 3.3.1.1               | 3.3.1.2             | 3.3.1.3               | 3.3.2.1               | 3.3.2.2                | 3.3.4.1        | 3.3.4.2                   | 3.3.5.1.1             | 3.3.5.1.2               | 3.3.5.1.3           | 3.3.5.2                    | 3.3.5.3            | 3.3.6.1                  | 3.3.6.2                       | 3.3.6.3                 | 3.3.6.4                | 3.3.7.1                   | 3.3.7.2                     | 3.3.7.3               | 3.3.8            | 3.3.9                                | 3.4                | 3.5                 | 3.5.1           | 3.5.2         | 3.5.3                    |  |  |  |  |  |  |
|-----------------|---|--------------|------------------------|--------------------------|-------------------|--------------------|-----------------------|---------------------|-----------------------|-----------------------|------------------------|----------------|---------------------------|-----------------------|-------------------------|---------------------|----------------------------|--------------------|--------------------------|-------------------------------|-------------------------|------------------------|---------------------------|-----------------------------|-----------------------|------------------|--------------------------------------|--------------------|---------------------|-----------------|---------------|--------------------------|--|--|--|--|--|--|
|                 | Baseline Scope                                    | Baseline EPC | Baseline Commissioning | Baseline Contract Status | Baseline Schedule | Baseline EAC Costs | Forecast - Quantities | Forecast - Schedule | Forecast - Cost Basis | Technical Basis - EPC | Tech Basis - SU & Comm | Schedule Basis | Schedule Basis - Start Up | Job Hr - Craft Direct | Job Hr - Craft Indirect | Job Hr - Non-Manual | Job Hr - Eng & Home Office | Job Hr - SU & Comm | Labor Cost Basis - Craft | Labor Cost - Field Non-Manual | Labor Cost - Eng & Comm | Labor Cost - SU & Comm | M&SC Cost Basis - Directs | M&SC Cost Basis - Indirects | M&SC Cost - SU & Comm | Escalation Basis | Inclusion Exclusion - Qualifications | Funding Compliance | EPC Risk Assessment | Cost (EPC) Risk | Schedule Risk | TPRA Risk Considerations |  |  |  |  |  |  |
| Hagerty, Dean   |   |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Hardin, Dave    | BSII Manager Of Plant Ops,Maint & Startup         |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Henschel, Jim   | Manager of EAC Dev/EVMS Cert.                     |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Hood, Mike      | Project Manager Overview                          |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Johnson, Joe    | Construction General Superintendent               |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Juerling, Greg  | Construction Site Services Manager                |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Kahn, Karim     | PC Special Project Coordinator                    |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Kraemer, Ken    | PC Start Up & Commissioning                       |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Ledesma, John   | PC Engineering Cost & Reporting                   |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Lewis, Mike     | Sr. Designer, Electrical                          |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Lung, Bill      | Construction Manager                              |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Lynch, Steve    | Construction Deputy Manager                       |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Meyer, Todd     | Deputy Mgr Of Eng/Design Support Mgr              |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Minor, Tim      | Project Controls Function Data Integration        |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Montizaan, Hank | Construction Field Engineering Manager            |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Mueller, Dave   | Project Controls Lead Project Schedule Engineer   |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Neubauer, Scott | Construction HLW/PT Planning Eng Automation       |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Olenius, Amy    | Project Controls Mat and Equip Reporting/Trending |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Payne, Buck     | Project Controls Coordinator USACE                |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Rawlings, Don   | Acquisition Services Purchase Manager             |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Porcaro, Paul   | HLW/PT Supervisor                                 |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Rocha, Mike     | Project Controls Dep Special Projects Coordinator |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Rogers, Ed      | Business Services Manager                         |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Roupe, Mark     | LBL Integration                                   |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Schertz, Neal   | Deputy Discipline Production Eng Mgr              |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Shell, George   | Project QA Manager                                |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Swan, Kelly     | Project Controls EAC Supervisor                   |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Wentink, Mike   | Proeject Controls Eng Trending/Contingency        |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Whiting, Daisy  | Lead Subcontract Admin/Backcharge Coordinator     |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Wilson, Toby    | Project Controls HLW/PT Facility Integration      |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Davis, Garry    | Ops SU & Comm & Training Area Integration Proc    |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Hamlett, Ross   | DCS Testing Lead, Start Up                        |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Hamrick, Julia  | Integration Manager                               |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Mikula, George  | Project Risk Manager                              |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |
| Piccolo, Steve  | Project Management Dep Proj Director              |              |                        |                          |                   |                    |                       |                     |                       |                       |                        |                |                           |                       |                         |                     |                            |                    |                          |                               |                         |                        |                           |                             |                       |                  |                                      |                    |                     |                 |               |                          |  |  |  |  |  |  |

WGI



## Appendix C

# Project Cost Summary



| ERT REPORT SECTION | DESCRIPTION   | 2005 COST | TO-GO ESCAL'N | EPCC CONTINGENCY   |                | 2005 EAC  | TPRA (80% confidence values) |                   |                  | TOTAL WTP PROGRAM     |
|--------------------|---|-----------|---------------|--------------------|----------------|-----------|------------------------------|-------------------|------------------|-----------------------|
|                    |   |           |               | General Estimating | Technical Risk |           | Program                      | Contract Managed* | Unknown Unknowns |                       |
|                    | <b>All costs in \$1,000</b>   |           |               |                    |                |           |                              |                   |                  |                       |
|                    | December 2005 EAC   | 7,189,294 | 547,000       | 812,406            | 115,600        | 8,777,600 | 1,760,000                    | 0                 |                  | 10,537,600            |
|                    | DESCRIPTION   |           |               |                    |                |           |                              |                   |                  |                       |
| 3.3.5.3            | <b>Adjustments for modified EAC C&amp;T staffing basis (WBS 3.3.6.4)</b>                              |           |               |                    |                |           |                              |                   |                  |                       |
| 3.3.5.3            | 1 Operator availability. Modify graded approach to operator training                                  | 100,000   |               |                    |                |           |                              |                   |                  |                       |
| 3.3.5.3            | 2 Operator training increase  | 5,000     |               |                    |                |           |                              |                   |                  | 100,000               |
| 3.3.5.3            | 3 Operator procedure writing  | 5,000     |               |                    |                |           |                              |                   |                  | 5,000                 |
| 3.3.5.3            | 4 Operator efficiency   | 20,000    |               |                    |                |           |                              |                   |                  | 5,000                 |
|                    | <b>Adjustments for simulant quantities and costing (WBS 3.3.7.3)</b>                                  | (10,000)  |               |                    |                | (10,000)  |                              |                   |                  | (10,000)              |
| 3.3.8              | <b>Escalation analysis (WBS 3.3.8)</b>  |           |               |                    |                |           |                              |                   |                  |                       |
| 3.3.8              | 6 Future escalation rates for 80% confidence  |           | 106,000       |                    |                | 106,000   |                              |                   |                  | 106,000               |
| 3.3.8              | 7 Monthly compounding escalation rates  |           | (8,000)       |                    |                | (8,000)   |                              |                   |                  | (8,000)               |
| 3.3.8              | 8 Omitted to-date escalation  |           | 10,000        |                    |                | 10,000    |                              |                   |                  | 10,000                |
| 3.5.1              | <b>Contingency analysis (WBS 3.5.1 and 3.5.2)</b>   |           |               |                    |                |           |                              |                   |                  |                       |
| 3.5.2              | 9 Cost  |           |               | 169,586            |                | 169,586   |                              |                   |                  | 169,586               |
| 3.5.2              | 10 Schedule - Potential reduction of 3 months   |           |               |                    | (24,000)       | (24,000)  |                              |                   |                  | (24,000)              |
| 3.5.3              | <b>TPRA Analysis (WBS 3.5.3)</b>  |           |               |                    |                |           |                              |                   |                  |                       |
|                    | General TPRA Review Results   |           |               |                    |                |           |                              |                   |                  |                       |
|                    | 11 Transfers from TPRA to EPCC scope  | w/1       |               |                    |                |           |                              |                   |                  |                       |
|                    | 12 A change to the Sequential Commissioning Approach  | w/1       |               |                    |                |           |                              |                   |                  |                       |
|                    | 13 Multiple Operational Readiness Reviews (ORRs) - one for each facility                              |           |               |                    |                |           | (341,886)                    |                   |                  | (341,886)             |
|                    | 14 Ultrafiltration Risks - due to insufficient flux rate  |           |               |                    |                |           | (123,079)                    |                   |                  | (123,079)             |
|                    | 15 Oxidative Leaching design changes  |           |               |                    |                |           | (8,260) w/22                 |                   |                  | (8,260)               |
|                    | 16 Catalyst is Poisoned in Offgas System  |           |               |                    |                |           | (6,838) w/22                 |                   |                  | (6,838)               |
|                    | 17 Premature LAW Melter Failure (Planned transfer to operating spares account)                        |           |               |                    |                |           | (236) w/22                   |                   |                  | (236)                 |
|                    | 18 Premature HLW Melter Failure (Planned transfer to operating spares account)                        |           |               |                    |                |           | (30,682)                     | 15,000            |                  | (15,682)              |
|                    | 19 Key Process Scale Up risks result in marginal performance  |           |               |                    |                |           | (23,322)                     | 15,000            |                  | (8,322)               |
|                    | 20 Cesium Resin Performance - does not perform as needed/expected                                     |           |               |                    |                |           | (66,085) w/22                |                   |                  | (66,085)              |
|                    | 21 Sampling Line Pluggage   |           |               |                    |                |           | (1,510) w/22                 |                   |                  | (1,510)               |
|                    | 22 Effect of probabilistic modelling  |           |               |                    |                |           | (3,540) w/22                 |                   |                  | (3,540)               |
|                    | 23 Reviews by Technical Best and Brightest (B&B) team requires additional analysis and design changes | 4,400     |               |                    |                | 4,400     | 47,466 w/22                  |                   |                  | 47,466                |
|                    | 24 Effect of probabilistic modelling  |           |               |                    |                |           | (273,509)                    | 146,000           |                  | (123,109)             |
|                    | 25 Transfers from TPRA to EPCC contractor risk  |           |               |                    |                |           | 21,443                       |                   |                  | 21,443                |
|                    | 26 Spent Resin Disposal   |           |               |                    |                |           |                              |                   |                  |                       |
|                    | 27 Inability to Meet Contract Clause H.13 Self-Performed Work Ratio (assumes WGI in sub. Calc.)       |           |               |                    |                |           | (1,368)                      | 1,368             |                  |                       |
|                    | 28 Design Authority Hydrogen in Pipe and Ancillary Vessels (HPAV) Case not accepted                   |           |               |                    |                |           | (14,407)                     | 14,407            |                  |                       |
|                    | 29 Design Authority Case for Structural Fireproofing is not accepted by the regulator                 |           |               |                    |                |           | (46,277)                     | 46,277            |                  |                       |
|                    | 30 Formation of Hazardous Mercury Compounds (Dimethyl Mercury) in Evaporator Overheads                |           |               |                    |                |           | (18,881)                     | 18,881            |                  |                       |
|                    | 31 Nonacceptance of Design Authority Seismic Case- Piping   |           |               |                    |                |           | (3,540)                      | 3,540             |                  |                       |
|                    | 32 Nonacceptance of Design Authority (DA) Structural Seismic Case                                     |           |               |                    |                |           | (2,926)                      | 2,926             |                  |                       |
|                    | 33 Congressional Line Item Re-Alignment - implementation/reduction of flexibility/inc. risk           |           |               |                    |                |           | (6,608)                      | 6,608             |                  |                       |
|                    | 34 WTP 2006 Funding reduction or changes to 626 EAC base case   |           |               |                    |                |           | (64,360)                     | 64,360            |                  |                       |
|                    | 35 Hydrogen Buildup in Mechanically Agitated Tanks  |           |               |                    |                |           | (233,668)                    | 233,668           |                  |                       |
|                    | 36 Effect of probabilistic modelling  |           |               |                    |                |           | (2,360)                      | 2,360             |                  |                       |
|                    | 37 80% Confidence level adjustment for pioneer plant experience (Rand Report)                         |           |               |                    |                |           | 30,813                       | (30,813)          |                  |                       |
|                    | 38 Program cost, including schedule impact  |           |               |                    |                |           |                              | 1,000,000         |                  | 1,000,000             |
|                    | 39 Rounding   | 6         |               | 8                  |                | 14        |                              |                   |                  |                       |
|                    | TOTAL Changes by ERT  | 124,406   | 108,000       | 169,594            |                | 378,000   | (1,173,600)                  | 539,600           | 1,000,000        | 743,900               |
|                    | TOTAL PROGRAM 2005 EAC  | 7,313,700 | 655,000       | 982,000            | 115,600        | 9,155,600 | 586,400                      | 539,600           | 1,000,000        | 11,281,500            |
|                    | Contractor Fee  | TBD       |               |                    |                | TBD       |                              |                   |                  | TBD                   |
|                    | <b>Note:- ALL COSTS ARE ESCALATED AND EXCLUDE FEE</b>   |           |               |                    |                |           |                              |                   |                  | <b>Say 11,300,000</b> |

Notes:  
Includes consideration for sequential commissioning approach and individual facility ORR's

Contingency model and confidence levels  
Contingency duration  
Full staff to end of contract instead of gradual de-staffing.

Included with items 1-4  
Included with items 1-4  
Item 23 includes \$15M in EAC and \$10M TPRA  
Item 23 includes \$6M in EAC and \$5M TPRA  
Item 23 includes design hours to mitigate risk  
Includes \$5M installation and schedule impact  
Includes \$5M installation and schedule impact  
Item 23 includes design hours and \$20M testing programs to mitigate risk.  
Item 23 includes design hours to mitigate risk  
Item 23 includes \$5M in EAC and \$7M TPRA  
Includes above items 14 thru 21 as well as mitigation of other B&B issues.

Actual incl schedule effect is 1,088,500  
Projected for class 2-3 estimate at 65% design status. Say \$1 billion

\* Value of those risks ERT recommends by managed by Contractor. ERT does not judge whether the included items are inside or outside of Contractor scope



## APPENDIX D

# Matrix of Documents Reviewed by External Review Team Work Breakdown Structure



| Documents  | 3.1.1 Baseline Scope | 3.1.2.1 Baseline EPC | 3.1.2.2 Baseline Commissioning | 3.1.3 Baseline Contract Status | 3.1.4 Baseline Schedule | 3.1.5 Baseline EAC Costs | 3.3.1.1 Forecast - Quantities | 3.3.1.2 Forecast - Schedule | 3.3.1.3 Forecast - Cost Basis | 3.3.2.1 Technical Basis - EPC | 3.3.2.2 Tech Basis - SU & Comm | 3.3.4.1 Schedule Basis | 3.3.4.2 Schedule Basis - Start Up | 3.3.5.1.1 Job Hr - Craft Direct | 3.3.5.1.2 Job Hr - Craft Indirect | 3.3.5.1.3 Job Hr - Non-Manual | 3.3.5.2 Job Hr - Eng & Home Office | 3.3.5.3 Job Hr - SU & Comm | 3.3.6.1 Labor Cost Basis - Craft | 3.3.6.2 Labor Cost - Field Non-Manual | 3.3.6.3 Labor Cost - Eng & Comm | 3.3.6.4 Labor Cost - SU & Comm | 3.3.7.1 M&SC Cost Basis - Directs | 3.3.7.2 M&SC Cost Basis - Indirects | 3.3.7.3 M&SC Cost - SU & Comm | 3.3.8 Escalation Basis | 3.3.9 Inclusion Exclusion - Qualifications | 3.4 Funding Compliance | 3.5 EPC Risk Assessment | 3.5.1 Cost (EPC) Risk | 3.5.2 Schedule Risk | 3.5.3 TPRA Risk Considerations |  |  |  |  |
|--|----------------------|----------------------|--------------------------------|--------------------------------|-------------------------|--------------------------|-------------------------------|-----------------------------|-------------------------------|-------------------------------|--------------------------------|------------------------|-----------------------------------|---------------------------------|-----------------------------------|-------------------------------|------------------------------------|----------------------------|----------------------------------|---------------------------------------|---------------------------------|--------------------------------|-----------------------------------|-------------------------------------|-------------------------------|------------------------|--|------------------------|-------------------------|-----------------------|---------------------|--------------------------------|--|--|--|--|
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Overview, dated 30 December 2005   |                      | X                    | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Scope Definition, dated 30 December 2005   |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Current Project Status, dated 30 December 2005   |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Project Schedule, dated 30 December 2005   |                      |                      | X                              |                                | X                       | X                        |                               | X                           | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Cost Estimate, dated 30 December 2005  |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Risk Assessment, dated 30 December 2005  |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Cost and Staffing Profiles, dated 30 December 2005   |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Late Adjustments, dated 30 December 2005   |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Opportunities, dated 30 December 2005  |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Reasonableness of EAC and Benchmarking, dated 30 December 2005                                 |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, BNI Response to the U.S. Army Corps of Engineers April 2005 EAC Review, dated 30 December 2005 |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix A, Work Breakdown Structure and Dictionary, dated 30 December 2005                    |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix B, Cost Tables, dated 30 December 2005  |                      |                      | X                              |                                | X                       | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |

| Documents  | 3.1.1 Baseline Scope | 3.1.2.1 Baseline EPC | 3.1.2.2 Baseline Commissioning | 3.1.3 Baseline Contract Status | 3.1.4 Baseline Schedule | 3.1.5 Baseline EAC Costs | 3.3.1.1 Forecast - Quantities | 3.3.1.2 Forecast - Schedule | 3.3.1.3 Forecast - Cost Basis | 3.3.2.1 Technical Basis - EPC | 3.3.2.2 Tech Basis - SU & Comm | 3.3.4.1 Schedule Basis | 3.3.4.2 Schedule Basis - Start Up | 3.3.5.1.1 Job Hr - Craft Direct | 3.3.5.1.2 Job Hr - Craft Indirect | 3.3.5.1.3 Job Hr - Non-Manual | 3.3.5.2 Job Hr - Eng & Home Office | 3.3.5.3 Job Hr - SU & Comm | 3.3.6.1 Labor Cost Basis - Craft | 3.3.6.2 Labor Cost - Field Non-Manual | 3.3.6.3 Labor Cost - Eng & Comm | 3.3.6.4 Labor Cost - SU & Comm | 3.3.7.1 M&SC Cost Basis - Directs | 3.3.7.2 M&SC Cost Basis - Indirects | 3.3.7.3 M&SC Cost - SU & Comm | 3.3.8 Escalation Basis | 3.3.9 Inclusion Exclusion - Qualifications | 3.4 Funding Compliance | 3.5 EPCC Risk Assessment | 3.5.1 Cost (EPCC) Risk | 3.5.2 Schedule Risk | 3.5.3 TPRA Risk Considerations |  |  |  |
|--|----------------------|----------------------|--------------------------------|--------------------------------|-------------------------|--------------------------|-------------------------------|-----------------------------|-------------------------------|-------------------------------|--------------------------------|------------------------|-----------------------------------|---------------------------------|-----------------------------------|-------------------------------|------------------------------------|----------------------------|----------------------------------|---------------------------------------|---------------------------------|--------------------------------|-----------------------------------|-------------------------------------|-------------------------------|------------------------|--|------------------------|--------------------------|------------------------|---------------------|--------------------------------|--|--|--|
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix C, Summary Schedules and Commodity Curves, dated 30 December 2005                                 |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix D, Detailed Schedules, dated 30 December 2005   |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix E, Key Quantity Summaries, dated 30 December 2005   |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix F, Engineering Cost Estimates, dated 30 December 2005   |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix G, Direct Capital Cost Estimate, dated 30 December 2005   |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix H, Acquisition Services, Plant Equipment and Bulk Material Cost Estimates, dated 30 December 2005 |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix I, Construction Cost Estimates, dated 30 December 2005  |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix J, Environmental and Nuclear Safety Cost Estimates, dated 30 December 2005                        |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix K, Research and Technology Cost Estimates, dated 30 December 2005                                 |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix L, Startup and Commissioning Cost Estimates, dated 30 December 2005                               |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix M, Project Management and Support Services Estimate, dated 30 December 2005                       |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix N, Cost Reconciliation, dated 30 December 2005  |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix O, Plant Wide EPCC and Shared Services Allocation, dated 30 December 2005                         |                      | X                    |                                |                                |                         | X                        |                               |                             | X                             | X                             | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |

| Documents  | 3.1.1 Baseline Scope | 3.1.2.1 Baseline EPC | 3.1.2.2 Baseline Commissioning | 3.1.3 Baseline Contract Status | 3.1.4 Baseline Schedule | 3.1.5 Baseline EAC Costs | 3.3.1.1 Forecast - Quantities | 3.3.1.2 Forecast - Schedule | 3.3.1.3 Forecast - Cost Basis | 3.3.2.1 Technical Basis - EPC | 3.3.2.2 Tech Basis - SU & Comm | 3.3.4.1 Schedule Basis | 3.3.4.2 Schedule Basis - Start Up | 3.3.5.1.1 Job Hr - Craft Direct | 3.3.5.1.2 Job Hr - Craft Indirect | 3.3.5.1.3 Job Hr - Non-Manual | 3.3.5.2 Job Hr - Eng & Home Office | 3.3.5.3 Job Hr - SU & Comm | 3.3.6.1 Labor Cost Basis - Craft | 3.3.6.2 Labor Cost - Field Non-Manual | 3.3.6.3 Labor Cost - Eng & Comm | 3.3.6.4 Labor Cost - SU & Comm | 3.3.7.1 M&SC Cost Basis - Directs | 3.3.7.2 M&SC Cost Basis - Indirects | 3.3.7.3 M&SC Cost - SU & Comm | 3.3.8 Escalation Basis | 3.3.9 Inclusion Exclusion - Qualifications | 3.4 Funding Compliance | 3.5 EPC Risk Assessment | 3.5.1 Cost (EPC) Risk | 3.5.2 Schedule Risk | 3.5.3 TPRA Risk Considerations |  |  |   |  |
|--|----------------------|----------------------|--------------------------------|--------------------------------|-------------------------|--------------------------|-------------------------------|-----------------------------|-------------------------------|-------------------------------|--------------------------------|------------------------|-----------------------------------|---------------------------------|-----------------------------------|-------------------------------|------------------------------------|----------------------------|----------------------------------|---------------------------------------|---------------------------------|--------------------------------|-----------------------------------|-------------------------------------|-------------------------------|------------------------|--|------------------------|-------------------------|-----------------------|---------------------|--------------------------------|--|--|---|--|
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix P, Craft Productivity, dated 30 December 2005 |                      |                      | X                              |                                |                         | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix Q, Escalation, dated 30 December 2005         |                      |                      | X                              |                                |                         | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix R, Facility Layouts, dated 30 December 2005   |                      |                      | X                              |                                |                         | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 1, Appendix S, Management Reserve, dated 30 December 2005 |                      |                      | X                              |                                |                         | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| 24590-WTP-CE-PC-05-002-00, Rev 0, Total WTP Project Estimate at Completion, Volume 2-8, dated 30 December 2005                               |                      |                      | X                              |                                |                         | X                        |                               |                             | X                             |                               | X                              | X                      | X                                 |                                 |                                   |                               | X                                  | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| 24590-WTP-PL-MG-01-006, Rev 2, Project Implementation Plan, dated 1 November 2004.   |                      | X                    | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| BNI Contract, Contract No. DE-AC27-01RV14136, Section C, "Statement of Work," Modification No. M047, dated December 11, 2000.                |                      | X                    |                                |                                |                         | X                        |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  | X |  |
| 24590-WTP-PL-G-01-002, Rev 0, Commissioning Plan Part "A", dated 01 July 2002.   |                      | X                    | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| 24590-WTP-PL-OP-05-0002, Rev A, WPT Commissioning Plan Part "B", CNN 125284, dated 14 September 2005.  |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| 3D Model   | X                    |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| Set Route  | X                    |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| Equipment List   | X                    |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| Instrument Index   | X                    |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| Engineering Estimate   | X                    |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| Comprehensive Review of the Adequacy of the Hanford Water Treatment Plan Design and Flowsheet  | X                    |                      |                                |                                |                         |                          |                               |                             |                               | X                             |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| Project List of Qualifications, Exclusions, Assumptions, and Source Documents  | X                    |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| Staffing Plans and Curves WTP Contract   |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               | X                                  |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| Readiness Review Strategy for Commissioning the Hanford Tank Waste Treatment and Immobilization Plant Project                                |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| WTP Integrated Commissioning Strategy Whitepaper   |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| Application of the Graded Approach to Commissioning Activities, CCN 089177, Attachment 1   |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |
| WTP Contract, Standard 5, Contingency Variable Matrix  |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |   |  |

| Documents  | 3.1.1 Baseline Scope | 3.1.2.1 Baseline EPC | 3.1.2.2 Baseline Commissioning | 3.1.3 Baseline Contract Status | 3.1.4 Baseline Schedule | 3.1.5 Baseline EAC Costs | 3.3.1.1 Forecast - Quantities | 3.3.1.2 Forecast - Schedule | 3.3.1.3 Forecast - Cost Basis | 3.3.2.1 Technical Basis - EPC | 3.3.2.2 Tech Basis - SU & Comm | 3.3.4.1 Schedule Basis | 3.3.4.2 Schedule Basis - Start Up | 3.3.5.1.1 Job Hr - Craft Direct | 3.3.5.1.2 Job Hr - Craft Indirect | 3.3.5.1.3 Job Hr - Non-Manual | 3.3.5.2 Job Hr - Eng & Home Office | 3.3.5.3 Job Hr - SU & Comm | 3.3.6.1 Labor Cost Basis - Craft | 3.3.6.2 Labor Cost - Field Non-Manual | 3.3.6.3 Labor Cost - Eng & Comm | 3.3.6.4 Labor Cost - SU & Comm | 3.3.7.1 M&SC Cost Basis - Directs | 3.3.7.2 M&SC Cost Basis - Indirects | 3.3.7.3 M&SC Cost - SU & Comm | 3.3.8 Escalation Basis | 3.3.9 Inclusion Exclusion - Qualifications | 3.4 Funding Compliance | 3.5 EPC Risk Assessment | 3.5.1 Cost (EPC) Risk | 3.5.2 Schedule Risk | 3.5.3 TPRA Risk Considerations |  |  |  |  |  |  |  |
|--|----------------------|----------------------|--------------------------------|--------------------------------|-------------------------|--------------------------|-------------------------------|-----------------------------|-------------------------------|-------------------------------|--------------------------------|------------------------|-----------------------------------|---------------------------------|-----------------------------------|-------------------------------|------------------------------------|----------------------------|----------------------------------|---------------------------------------|---------------------------------|--------------------------------|-----------------------------------|-------------------------------------|-------------------------------|------------------------|--|------------------------|-------------------------|-----------------------|---------------------|--------------------------------|--|--|--|--|--|--|--|
| Outstanding Contract Change Requests (BNI Ltrs)  |                      |                      |                                | X                              |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| BNI Trend and Pending Item Register  |                      |                      |                                | X                              |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Flowsheet Review Team Conclusion   |                      |                      |                                |                                | X                       |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Quantity Development Packages for each Commodity   |                      |                      |                                |                                |                         |                          | X                             |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Basic Design Drawings (i.e., P&IDs, General Arrangements, Single Lines, etc)   |                      |                      |                                |                                |                         |                          | X                             |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Review Quantity Data Reports generated from the model, INtools, CIS, and the inherent methods                        |                      |                      |                                |                                |                         |                          | X                             |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Quantity Unit Rate Report (QURR)   |                      |                      |                                |                                |                         |                          | X                             |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Applicable Schedules and Procedures  |                      |                      |                                |                                |                         |                          | X                             |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Internal BNI Memoranda or similar records of review of the Schedules   |                      |                      |                                |                                |                         |                          | X                             |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Key Design Documents & 3D CADD Models  |                      |                      |                                |                                |                         |                          |                               | X                           |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Project Responses to Comprehensive Review of the Adequacy of the Hanford Waste Treatment Plant Design and Flowsheets |                      |                      |                                |                                |                         |                          |                               |                             |                               | X                             |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Comprehensive WTP Flowsheet Review, ERT, Interim Report, December 14, 2005   |                      |                      | X                              |                                |                         |                          |                               |                             |                               | X                             |                                |                        |                                   |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Commodity Curves for the HLW and PT facilities   |                      |                      |                                |                                |                         |                          |                               |                             |                               | X                             |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| EAC, July 2004, including base schedule, 24590-WTP-CE-PC-04-001, Rev 0   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Primavera Schedules (Level 4 for PT, LAW, HLW, LAB, BOF, and Shared Services)  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Cobra cost printouts by facility, FY, and functional level   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| HLW and PT Planning Area Presentations   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Performance Curves   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Code of Accounts   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Data from reference projects, including: Pre-TMI, Post-TMI, and Anniston project data                                |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Craft Curves   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Construction Execution Strategy  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Project Schedule   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Engineering Execution Strategy   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Forecast Cost Estimate   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Project EDPI's   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| EPPR   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Red Team Review  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Technical Review of the Project  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                | X                      |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |

| Document   | 3.1.1 Baseline Scope | 3.1.2.1 Baseline EPC | 3.1.2.2 Baseline Commissioning | 3.1.3 Baseline Contract Status | 3.1.4 Baseline Schedule | 3.1.5 Baseline EAC Costs | 3.3.1.1 Forecast - Quantities | 3.3.1.2 Forecast - Schedule | 3.3.1.3 Forecast - Cost Basis | 3.3.2.1 Technical Basis - EPC | 3.3.2.2 Tech Basis - SU & Comm | 3.3.4.1 Schedule Basis | 3.3.4.2 Schedule Basis - Start Up | 3.3.5.1.1 Job Hr - Craft Direct | 3.3.5.1.2 Job Hr - Craft Indirect | 3.3.5.1.3 Job Hr - Non-Manual | 3.3.5.2 Job Hr - Eng & Home Office | 3.3.5.3 Job Hr - SU & Comm | 3.3.6.1 Labor Cost Basis - Craft | 3.3.6.2 Labor Cost - Field Non-Manual | 3.3.6.3 Labor Cost - Eng & Comm | 3.3.6.4 Labor Cost - SU & Comm | 3.3.7.1 M&SC Cost Basis - Directs | 3.3.7.2 M&SC Cost Basis - Indirects | 3.3.7.3 M&SC Cost - SU & Comm | 3.3.8 Escalation Basis | 3.3.9 Inclusion Exclusion - Qualifications | 3.4 Funding Compliance | 3.5 EPC Risk Assessment | 3.5.1 Cost (EPC) Risk | 3.5.2 Schedule Risk | 3.5.3 TPRA Risk Considerations |  |  |  |  |  |
|--|----------------------|----------------------|--------------------------------|--------------------------------|-------------------------|--------------------------|-------------------------------|-----------------------------|-------------------------------|-------------------------------|--------------------------------|------------------------|-----------------------------------|---------------------------------|-----------------------------------|-------------------------------|------------------------------------|----------------------------|----------------------------------|---------------------------------------|---------------------------------|--------------------------------|-----------------------------------|-------------------------------------|-------------------------------|------------------------|--|------------------------|-------------------------|-----------------------|---------------------|--------------------------------|--|--|--|--|--|
| <b>Documents</b>   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Comprehensive Review and Analysis of the WTP Flowsheet, Tamosaitis   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| WTP Technical and Programmatic Risk Management Process, Saunders   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Worksheet Model for Craft Labor Cost Development   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Tabulation of Actual Craft Mix Experience at Level 3 of Commodity Code   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Selected Sample Craft Wage Rate Agreement for Pipe Filters, Defining the Base Wages, Fringes, & other Cost Provisions  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Extracted Payroll Data for each Salary Classification Depicting Amounts for Salary, Payroll Additives, Overheads, G&A, and B&O Tax by Year (9/30/01-9/25/05) |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                | X                                     |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| FY05 Forward Pricing Rates   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                | X                                     |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Staffing Plans for the To-Go Work Scope, by Position and Salary Classification   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                | X                                     |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Tabulation of WGI Composite Rates per Hour by Salary Classification  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Extracted Payroll data for Start-Up and Commissioning Dept, by Salary Classification, for the EAC Cut-Off Period   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| BETK Reports   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Selected Equipment Specifications, MR & PO Commitments   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| COCO Reports   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Selected Equipment Pricing Forecast Worksheets   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Selected Bulk Commodity Pricing Development Worksheets   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Commodity Bulk Purchase Orders   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| WTP Monthly Construction Distributable Material Cost Report  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| BNI Standard Procedure for Preparing a Forecast  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Bulk Commodity Curves  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Subcontract for Surveying  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Survey Subcontractors Invoice for Payment  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Controllers Reporting System   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Small Tools to Date Cost History Graph   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Quantity and Unit Rate Report  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Data Warehouse   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| BNI Median Distributable Unit Rates  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Expenditures Curves  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Equipment Bar Charts/Utilization Schedules   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| COBRA  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |
| Start Up and Commissioning Execution Plan  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            | X                                |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |

| Documents   | 3.1.1 Baseline Scope | 3.1.2.1 Baseline EPC | 3.1.2.2 Baseline Commissioning | 3.1.3 Baseline Contract Status | 3.1.4 Baseline Schedule | 3.1.5 Baseline EAC Costs | 3.3.1.1 Forecast - Quantities | 3.3.1.2 Forecast - Schedule | 3.3.1.3 Forecast - Cost Basis | 3.3.2.1 Technical Basis - EPC | 3.3.2.2 Tech Basis - SU & Comm | 3.3.4.1 Schedule Basis | 3.3.4.2 Schedule Basis - Start Up | 3.3.5.1.1 Job Hr - Craft Direct | 3.3.5.1.2 Job Hr - Craft Indirect | 3.3.5.1.3 Job Hr - Non-Manual | 3.3.5.2 Job Hr - Eng & Home Office | 3.3.5.3 Job Hr - SU & Comm | 3.3.6.1 Labor Cost Basis - Craft | 3.3.6.2 Labor Cost - Field Non-Manual | 3.3.6.3 Labor Cost - Eng & Comm | 3.3.6.4 Labor Cost - SU & Comm | 3.3.7.1 M&SC Cost Basis - Directs | 3.3.7.2 M&SC Cost Basis - Indirects | 3.3.7.3 M&SC Cost - SU & Comm | 3.3.8 Escalation Basis | 3.3.9 Inclusion Exclusion - Qualifications | 3.4 Funding Compliance | 3.5 EPC Risk Assessment | 3.5.1 Cost (EPC) Risk | 3.5.2 Schedule Risk | 3.5.3 TPRA Risk Considerations |  |  |  |  |  |  |  |
|---|----------------------|----------------------|--------------------------------|--------------------------------|-------------------------|--------------------------|-------------------------------|-----------------------------|-------------------------------|-------------------------------|--------------------------------|------------------------|-----------------------------------|---------------------------------|-----------------------------------|-------------------------------|------------------------------------|----------------------------|----------------------------------|---------------------------------------|---------------------------------|--------------------------------|-----------------------------------|-------------------------------------|-------------------------------|------------------------|--|------------------------|-------------------------|-----------------------|---------------------|--------------------------------|--|--|--|--|--|--|--|
| Sample of POs and Subcontracts  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| BNI Lessons Learned   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| March 2003 EAC, including Base Estimate and Schedule  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Global Insights and other Escalation Information  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| BNI/WGI Forecast for Non-manual and manual Labor Escalation   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Consolidated Assumptions List   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| List of TPRA Items  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| EAC Contingency Items   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| DOE Construction Project Data Sheet from Project Inception through 2005   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| DOE Letters subsequent to 05-WTP-175 (8/18/05) that provide additional direction the BNI for the EAC basis or funding parameters      |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Project Execution Plan from 2003 Baseline   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| BNI Project Milestone/Resource Loaded Schedule that forms basis for BNI EAC   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| BNI EAC time phased expenditure plan (cost plus fee) for both the constrained and unconstrained scenarios                             |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| BECRAC analysis for 2004 EAC for WTP  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| BECRAC analysis for a comparable major project (Savannah River)   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| BECRAC Input Spreadsheet  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Primavera "Pertmaster" Output data, December 2005   |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Pertmaster Input data, December 2005  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| TPRA Item Risk Assessment Sheets  |                      |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Commissioning & Training December 2005 Estimate at Completion Pretreatment Facility Basis of Estimate, 24590-WTP-RPT-OP-05-009, Rev 0 |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Commissioning & Training December 2005 Estimate at Completion High Level Waste Basis of Estimate 24590-WTP-RPT-OP-05-011, Rev 0       |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Commissioning & Training December 2005 Estimate at Completion Low Activity Waste Basis of Estimate 24590-WTP-RPT-OP-05-010, Rev 0     |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Commissioning & Training December 2005 Estimate at Completion Laboratory Facility Basis of Estimate 24590-WTP-RPT-OP-05-012, Rev 0    |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |
| Commissioning & Training December 2005 Estimate at Completion Balance of Facilities Basis of Estimate 24590-WTP-RPT-OP-05-008, Rev 0  |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                         |                       |                     |                                |  |  |  |  |  |  |  |



| Documents  | 3.1.1 Baseline Scope | 3.1.2.1 Baseline EPC | 3.1.2.2 Baseline Commissioning | 3.1.3 Baseline Contract Status | 3.1.4 Baseline Schedule | 3.1.5 Baseline EAC Costs | 3.3.1.1 Forecast - Quantities | 3.3.1.2 Forecast - Schedule | 3.3.1.3 Forecast - Cost Basis | 3.3.2.1 Technical Basis - EPC | 3.3.2.2 Tech Basis - SU & Comm | 3.3.4.1 Schedule Basis | 3.3.4.2 Schedule Basis - Start Up | 3.3.5.1.1 Job Hr - Craft Direct | 3.3.5.1.2 Job Hr - Craft Indirect | 3.3.5.1.3 Job Hr - Non-Manual | 3.3.5.2 Job Hr - Eng & Home Office | 3.3.5.3 Job Hr - SU & Comm | 3.3.6.1 Labor Cost Basis - Craft | 3.3.6.2 Labor Cost - Field Non-Manual | 3.3.6.3 Labor Cost - Eng & Comm | 3.3.6.4 Labor Cost - SU & Comm | 3.3.7.1 M&SC Cost Basis - Directs | 3.3.7.2 M&SC Cost Basis - Indirects | 3.3.7.3 M&SC Cost - SU & Comm | 3.3.8 Escalation Basis | 3.3.9 Inclusion Exclusion - Qualifications | 3.4 Funding Compliance | 3.5 EPCC Risk Assessment | 3.5.1 Cost (EPCC) Risk | 3.5.2 Schedule Risk | 3.5.3 TPRA Risk Considerations |  |  |  |  |
|--|----------------------|----------------------|--------------------------------|--------------------------------|-------------------------|--------------------------|-------------------------------|-----------------------------|-------------------------------|-------------------------------|--------------------------------|------------------------|-----------------------------------|---------------------------------|-----------------------------------|-------------------------------|------------------------------------|----------------------------|----------------------------------|---------------------------------------|---------------------------------|--------------------------------|-----------------------------------|-------------------------------------|-------------------------------|------------------------|--|------------------------|--------------------------|------------------------|---------------------|--------------------------------|--|--|--|--|
| Commissioning & Training December 2005 Estimate at Completion Plant Wide EPCC Basis of Estimate 24590-WTP-RPT-OP-05-007, Rev 0 |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| Startup December 2005 Estimate at Completion Pretreatment Facility Basis of Estimate, 24590-WTP-RPT-OP-05-016, Rev 0           |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| Startup December 2005 Estimate at Completion High Level Waste Basis of Estimate 24590-WTP-RPT-OP-05-018, Rev 0                 |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| Startup December 2005 Estimate at Completion Low Activity Waste Basis of Estimate 24590-WTP-RPT-OP-05-017, Rev 0               |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| Startup December 2005 Estimate at Completion Balance of Facilities Basis of Estimate 24590-WTP-RPT-OP-05-015, Rev 0            |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| Startup December 2005 Estimate at Completion Laboratory Facility Basis of Estimate 24590-WTP-RPT-OP-05-019, Rev 0              |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| Startup December 2005 Estimate at Completion Plant Wide EPCC Basis of Estimate 24590-WTP-RPT-OP-05-014, Rev 0                  |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| Pipe Data Sheets   | X                    |                      |                                |                                |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| BNI Contract, Contract No. DE-AC27-01RV14136   |                      |                      |                                | X                              |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| BNI Contract, Contract No. DE-AC27-01RV14136 - Modifications   |                      |                      |                                | X                              |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| BNI Contract Change Request Letters  |                      |                      |                                | X                              |                         |                          |                               |                             |                               |                               |                                |                        |                                   |                                 |                                   |                               |                                    |                            |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |
| SU Basis of Estimate, 24590-WTP-RPT-OP-05-004, Rev 0   |                      |                      | X                              |                                |                         |                          |                               |                             |                               |                               | X                              |                        | X                                 |                                 |                                   |                               |                                    | X                          |                                  |                                       |                                 |                                |                                   |                                     |                               |                        |  |                        |                          |                        |                     |                                |  |  |  |  |

## APPENDIX E

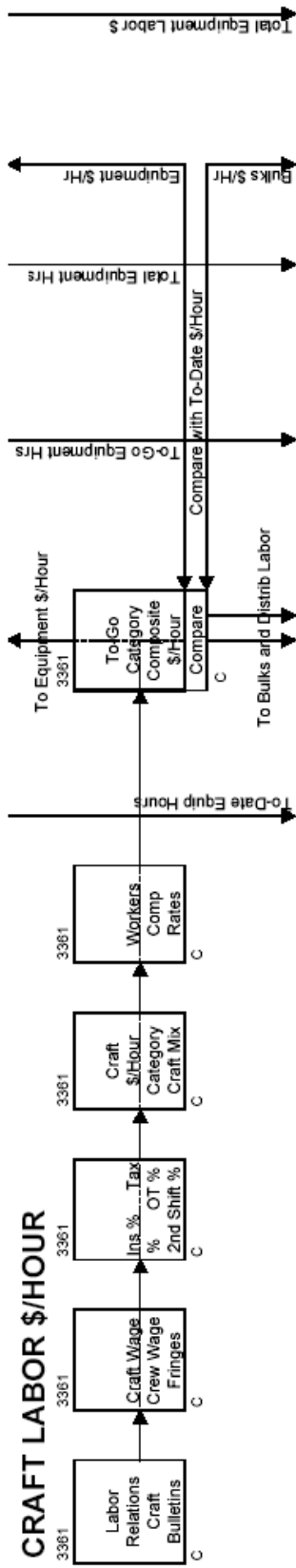
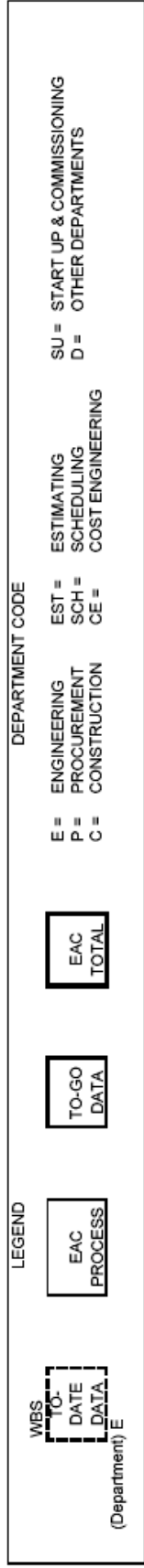
# External Review Team Review Process

# Detailed Flow Diagrams

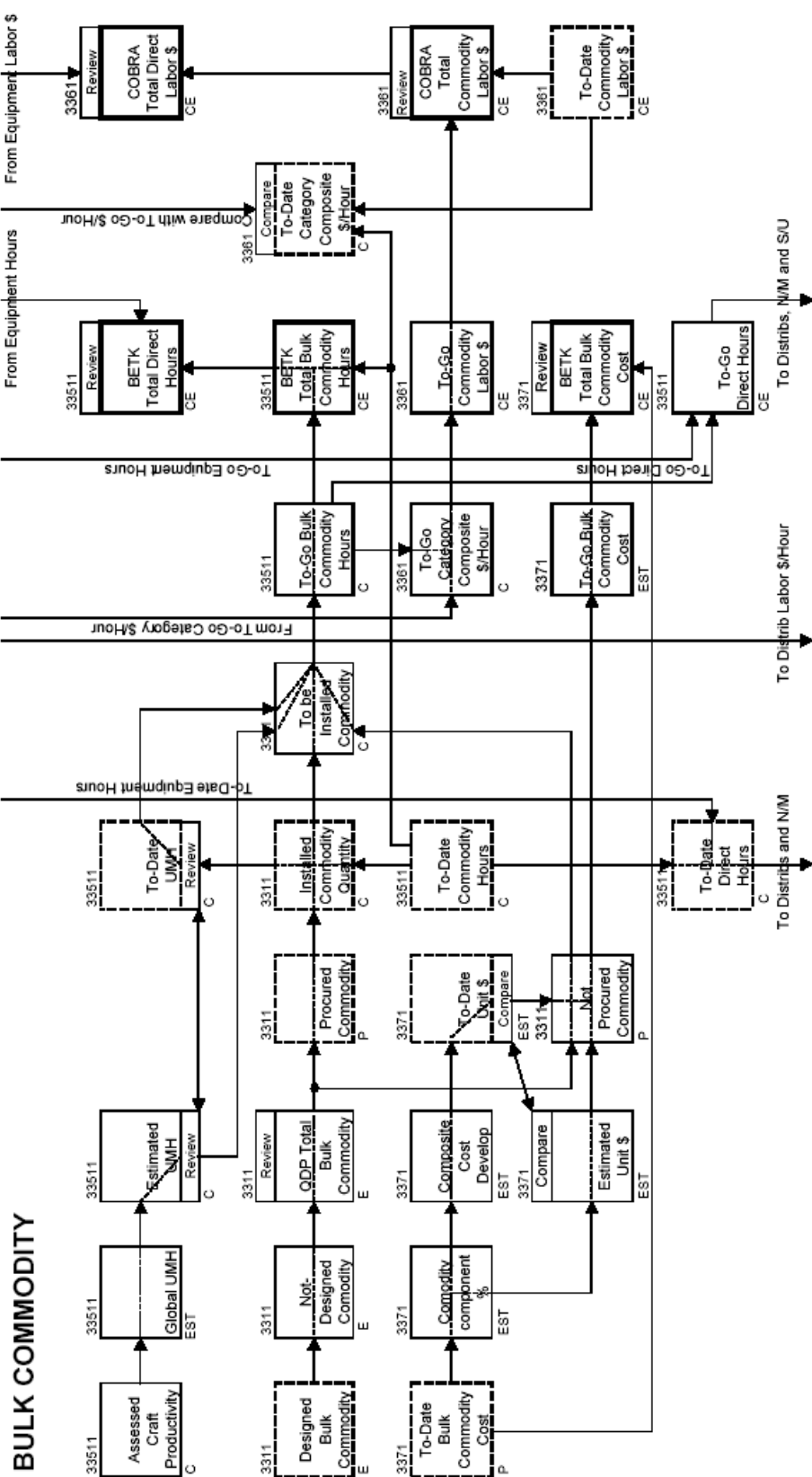
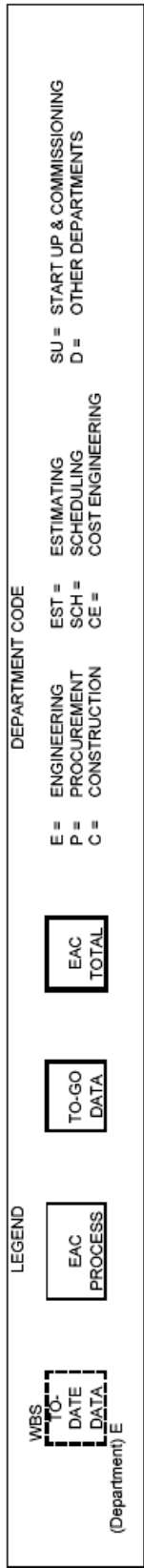




# External Review Team December 2005 EAC Planned Review Process



# External Review Team December 2005 EAC Planned Review Process





# External Review Team December 2005 EAC Planned Review Process

**LEGEND**

WBS TO-DATE DATA (Department) E

EAC PROCESS

TO-GO DATA

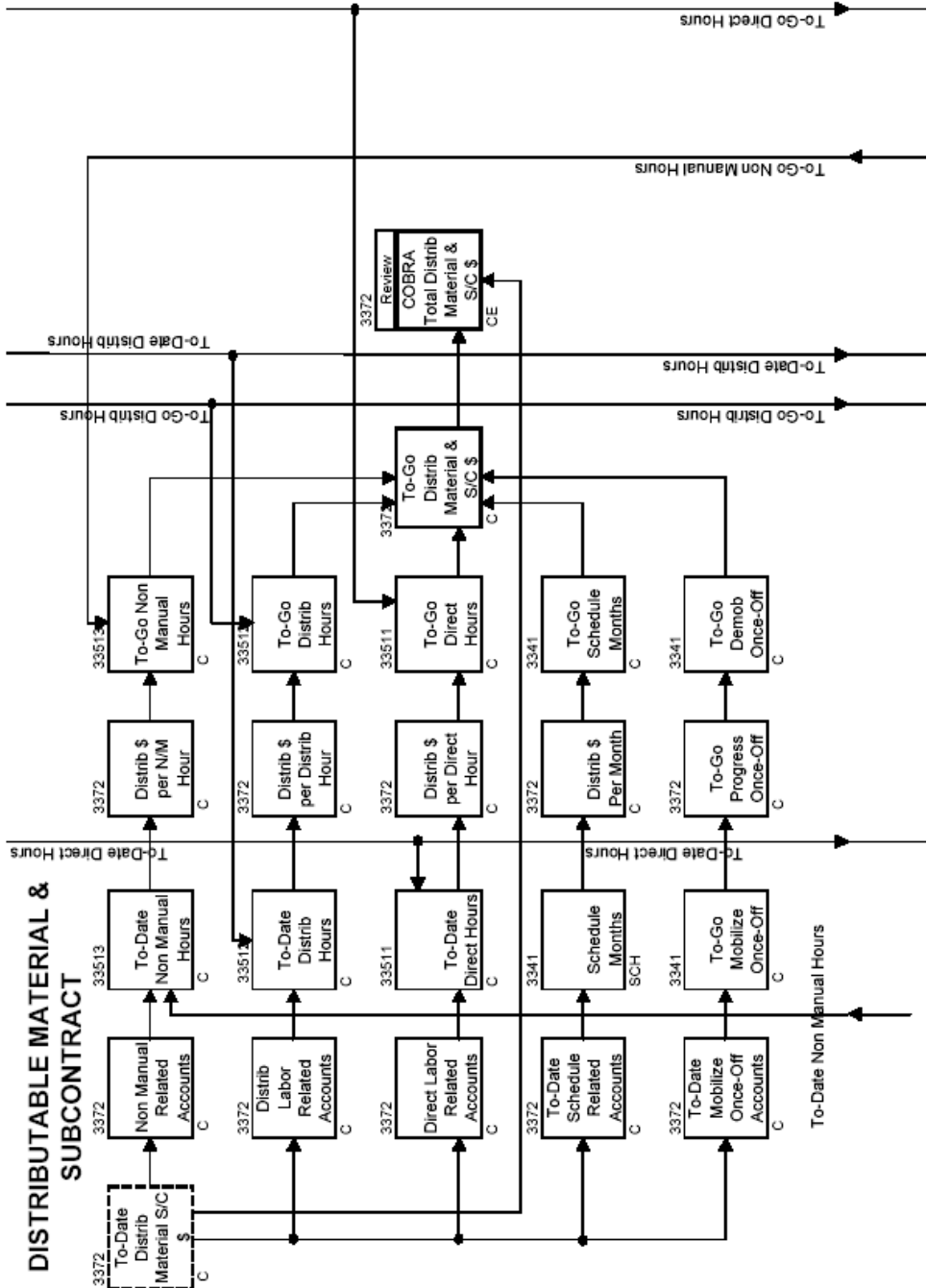
EAC TOTAL

DEPARTMENT CODE

E = ENGINEERING  
P = PROCUREMENT  
C = CONSTRUCTION

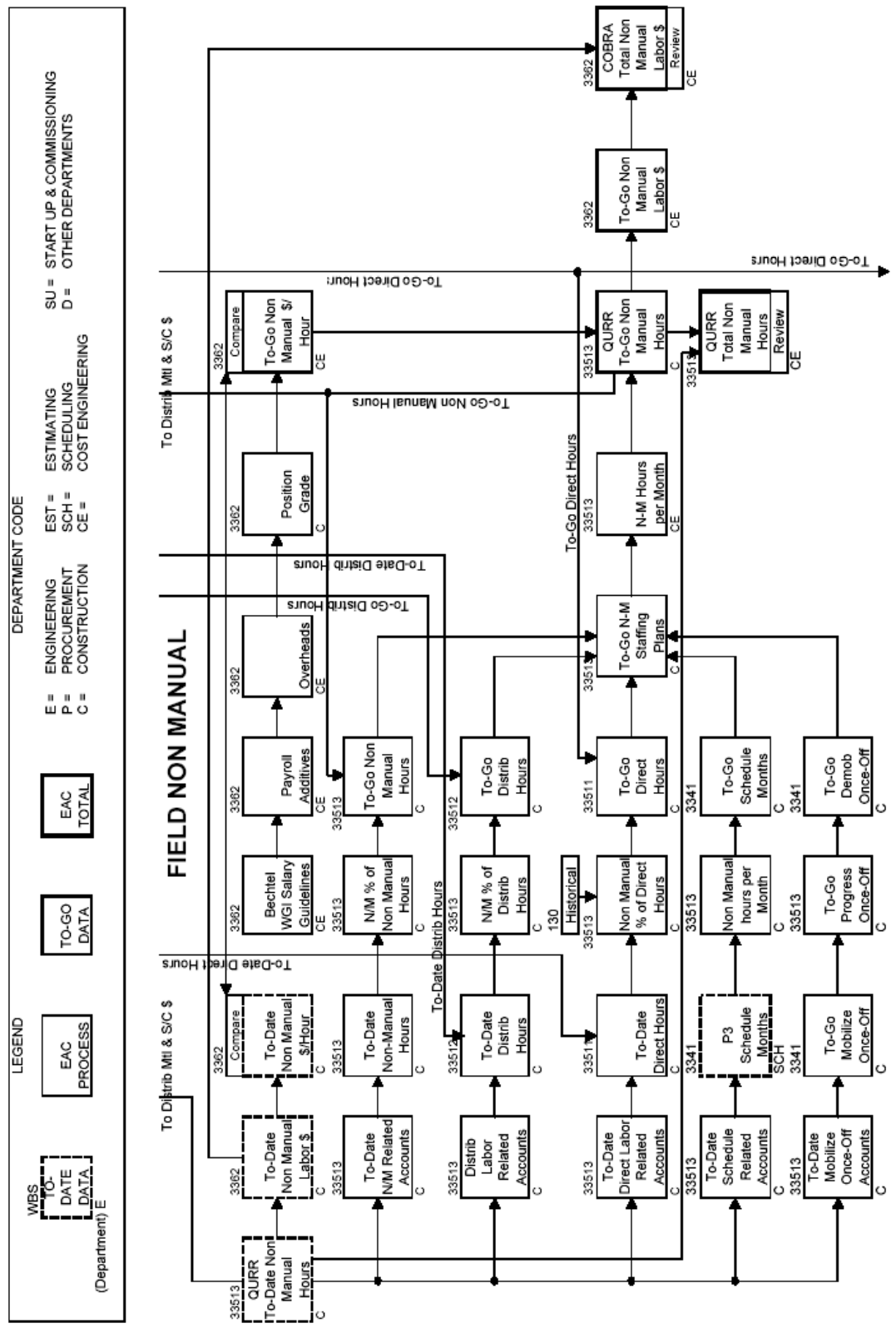
EST = ESTIMATING  
SCH = SCHEDULING  
CE = COST ENGINEERING

SU = START UP & COMMISSIONING  
D = OTHER DEPARTMENTS

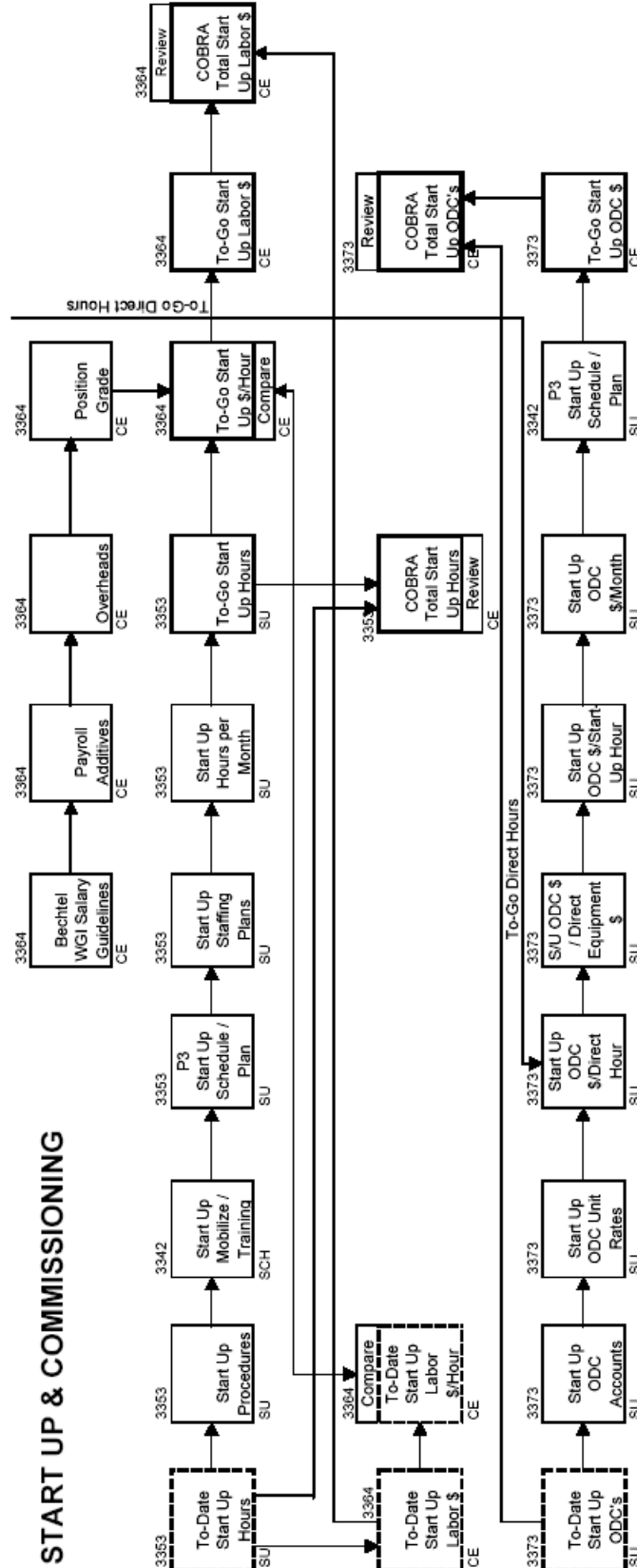
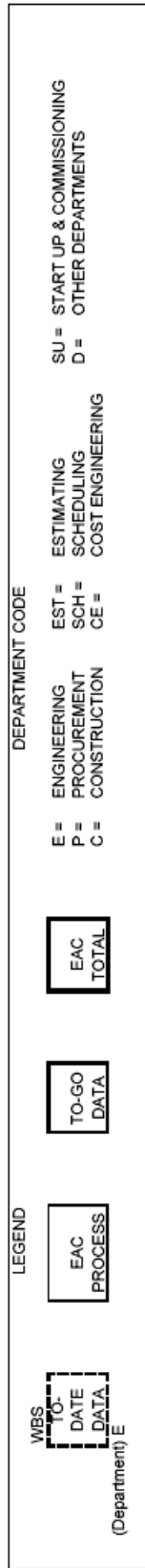




# External Review Team December 2005 EAC Planned Review Process

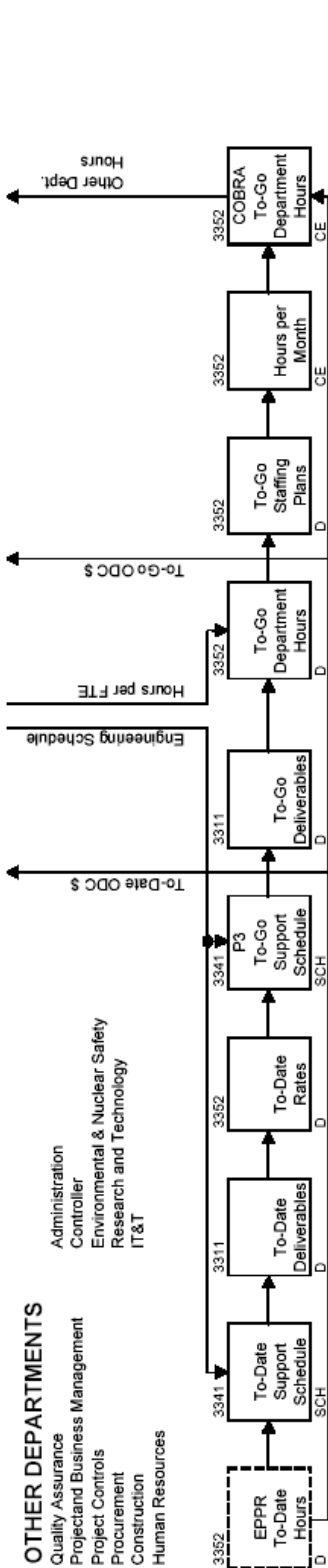
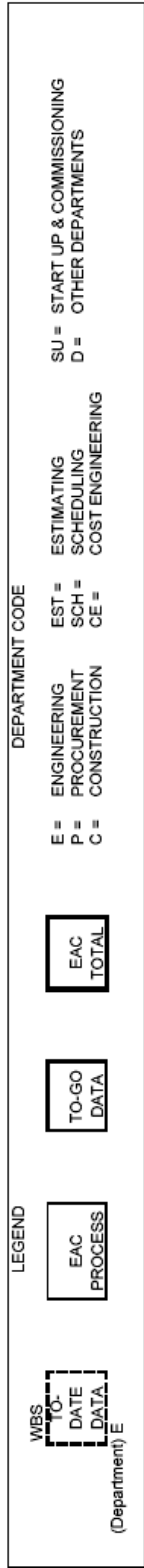


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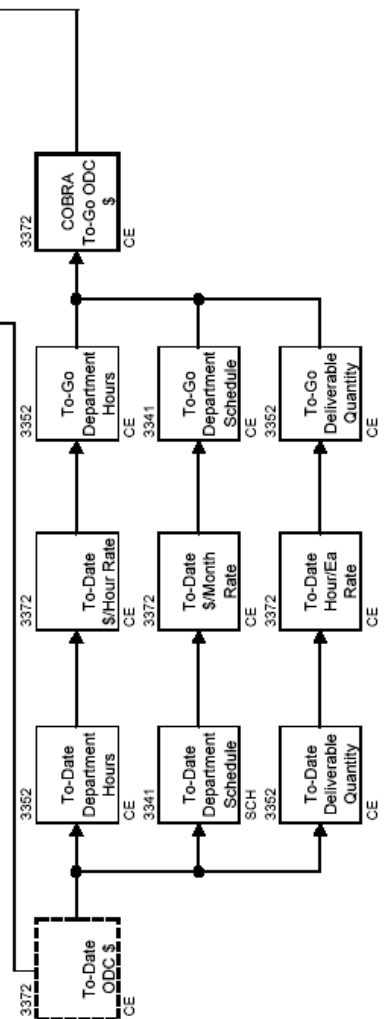


# External Review Team December 2005 EAC Planned Review Process



**OFF PROJECT SUPPORT**  
EXTERNAL REVIEW TEAMS  
SUBCONTRACTS

**DEPARTMENT ODC \$**





## APPENDIX F

# Operational Readiness

# A Long Term Strategic Approach



## OPERATIONAL READINESS A LONG TERM STRATEGIC APPROACH

### Summary

**Situation:** The current contract with Bechtel National, Inc. (BNI) does not adequately address the long-term operation of the Waste Treatment Plant (WTP) facility. While BNI's strategy for start-up and commissioning satisfies contract requirements, the tailored approach allowed by the current contract does not position the U.S. Department of Energy (DOE) for the most efficient and cost effective transition to an Operations and Maintenance contractor for the facility.

**Observations:** BNI has developed a "graded" approach (tailored training/procedures) to start-up and commissioning based upon hiring experienced test and operating personnel who will need less training than "novice" employees. Consequently, BNI's training program and procedures will be developed for very experienced personnel. This program, while satisfying Hot Commissioning requirements, will not be adequate for an operations and maintenance contractor with employees with varying experience levels. Therefore, the new operating contractor must develop a set of operating and maintenance procedures and training programs tailored to the experience level of its staff, which will differ from those developed by BNI. Furthermore, the contract does not address operating spare parts and equipment for long-term operation. Consequently, a high risk exists that the plant will be turned over to a new operator without sufficient training, procedures, or operating spare parts that may be needed to keep the facilities operating reliably. In addition, DOE may have to duplicate the Operational Readiness Review (ORR). The purpose of the ORR is to evaluate the readiness of the plant, administrative control and management, and the personnel that are maintaining and operating the facility. Since the ORR will be performed with BNI commissioning staff, a second ORR will have to be performed for a long-term operating contractor since BNI's responsibilities cease upon Hot Commissioning.

**Recommendations:** DOE should immediately advise BNI of their intent to invoke the post-commissioning services clause in the contract. They should direct BNI to hire test and commissioning personnel with the intent of transferring them to the permanent operating staff; increase commissioning and testing staff to meet the full facility operating requirements; and modify the graded approach to commissioning.

**Benefits:** This approach provides DOE with a plan to take the facility through testing into production using the testing and commissioning staff. It eliminates the requirement to have two ORRs, eliminates the duplication of training and procedure development, and provides for early purchase of operating spare parts. Most importantly, it allows the facility to have a fully staffed and trained Operations group at the end of Hot Commissioning. The net impacts will be: 1) a decrease of \$300 million over the EPCC timeframe, 2) a \$110 million decrease during the operating phase of the project, 3) and reduced mission duration of 1.5 years due to operational efficiency.



## **OPERATIONAL READINESS A LONG TERM STRATEGIC APPROACH**

### **PURPOSE**

The purpose of this document is to provide insight with respect to the BNI's current plans and contract obligations regarding start-up and commissioning services as well as challenges and opportunities to address DOE's long term operation requirements for the WTP.

### **BACKGROUND**

DOE's contract allows BNI to construct, start -up and commission the WTP facility using a tailored approach where each facility is commissioned sequentially and not operated as an integrated facility. To meet contractual requirements, BNI will provide a staffing level that is only sufficient to sequentially test and operate facilities individually. Staffing assumptions include the ability to hire experienced personnel from the nuclear industry or other industries with appropriate Conduct of Operations training and culture indoctrination, and qualified personnel can be hired as quickly as required by the BNI staffing plan. BNI staffing will only be maintained to meet contract commitments and not the long-term operation of the facilities.

When the High Level and Low Level waste facilities have completed Hot Commissioning (the last facilities to be commissioned), only one of the five facilities will have a full operating crew. The remaining facilities will have minimal crews sufficient to properly maintain the equipment and systems in a safe manner in compliance with appropriate procedures. Once BNI has completed the Hot Commissioning program, they will have met their obligations under the contract and will shutdown the facilities. Accordingly, BNI will decrease their total operating and maintenance staff from approximately 500 personnel to 25 personnel within a 2-3 month period. The remaining personnel will have the responsibility to close out the contract for Start-up and Commissioning. BNI developed a training program that assumes that personnel recruited will all have certain minimum experience level, and hence, reduced training requirements based upon the assumed level of experienced testing, maintenance and operating personnel. BNI used the same approach for testing and procedure development.

The ERT believes that BNI's Start-up and Commissioning plan meets contract requirements. Staffing levels are appropriate for sequential testing, organizational structure and responsibilities are well defined, programs and processes to safely maintain and operate the facilities are identified, and the necessary program elements are in place or identified to demonstrate Hot Commissioning. However, the current contract with BNI does not adequately address the long-term operation of the WTP facility.

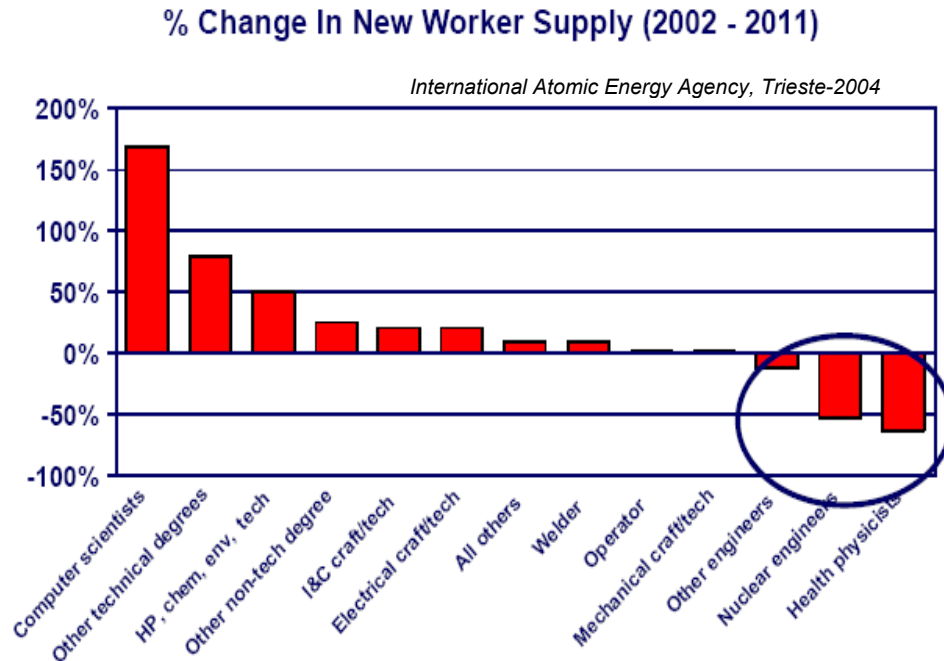
### **DOE APPROACH COMPARED TO TRADITIONAL INDUSTRY APPROACH**

In a typical transition from Construction/Start-up/Commissioning to long-term operations, the operating contractor is usually on board with a sufficient number of operations and maintenance personnel to participate in the component and system testing. The proposed operating contractor develops the long-term operating spare parts and spare equipment lists and begins ordering long lead items. The operations and maintenance group begins the development of training programs, maintenance and operating procedures. They witness and sign off all system tests as well as operate the systems for those tests.

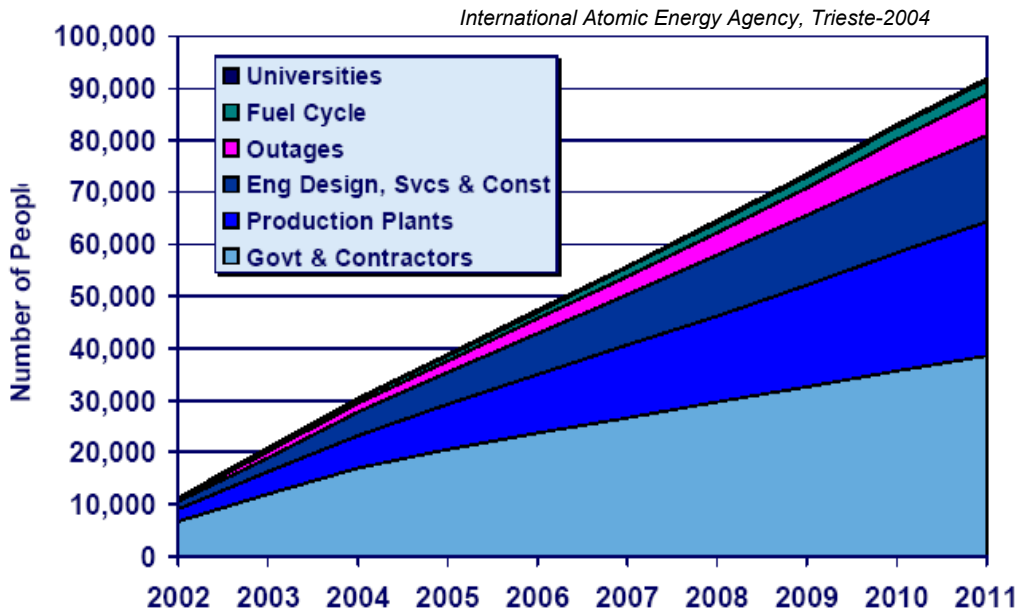
The program proposed by BNI contains an inherent risk regarding the availability of staffing to support the tailored approach. Since the inception of the WTP project in 2000, the demographics for staffing nuclear operation facilities have changed dramatically. The WTP project completion date has shifted from 2007 to approximately 2016. The majority of current utility nuclear power plants are submitting applications to extend current operating licenses for a minimum of 20 years thereby continuing to provide employment for those that may have been available in the job market had the license expired. The utility

industry constructed a substantial number of plants in the 1960s and 1970s. As shown in Figures A-1 and A-2, a significant number of those employees are now retired or will retire within the next 10 years, putting a great resource strain on the nuclear industry.

**Figure A-1 Worker Supply Projected to Decrease in Key Areas**



**Figure A-2 Cumulative Demand for New Workers**



Based upon the assumption of available personnel, BNI plans to bring in experienced test and operating personnel who will need less training than “novice” employees. Consequently, BNI’s training program and procedures will be developed for very experienced personnel. This program, while satisfying Hot Commissioning requirements, will not be adequate for an operations and maintenance contractor with employees with varying experience levels. Therefore, the new operating contractor must develop a set of operating and maintenance procedures and training programs tailored to the experience level of its staff,

which will differ from those developed by BNI. Furthermore, the contract does not address operating spare parts and equipment for long-term operation. Consequently, a high risk exists that the plant will be turned over to the new contract operator without sufficient operating spare parts that may be needed to keep the facilities operating reliably.

DOE will also have to duplicate the Operational Readiness Review (ORR). The purposes of the ORR are to evaluate the readiness of the plant, administrative control and management, and the personnel that are maintaining and operating the facility. Since the ORR will be performed with the BNI commissioning staff, the ORR required for the long-term operating contractor commissioning staff will have to be duplicated since BNI's responsibilities end upon completion of Hot Commissioning.

### **OPPORTUNITIES FOR LONG-TERM OPERATION OF THE WTP**

In order to meet the long-term mission and avoid the added costs and complications associated with an abrupt transition from a commissioning phase to an operation phase, the following changes will improve the transition to the operations phase of the WTP project and improve the operating reliability of the facility.

1. **Plan to take the facility through testing into production using the testing and commissioning staff.** Using the testing and commissioning staff as the future operating staff will provide the operations team invaluable experience that could not be attained had the testing and commissioning been performed by a separate organization.
2. **Eliminate the requirement to have two ORRs.** As indicated earlier, the first ORR would have tested the testing and commissioning crew to assure safe operation during cold and hot commissioning. Using the same group for both commissioning and long-term operation eliminates the need for the duplication of a significant portion of the ORR.
3. **Eliminate the duplication of training and procedure development.** By changing from a graded approach to one that meets the requirements of the operating staff, there is no need to develop an additional training and procedure development program to handle different levels of capability between a separate test & commission team and an operations group.
4. **Have a fully staffed and trained Operations Group at the end of Hot Commissioning.**
5. **Purchase operating spare parts earlier.** The testing and commissioning group will also function as the long-term operation group allowing them to analyze and procure the appropriate spare parts required for long-term operation.

### **RECOMMENDATION:**

DOE should immediately notify BNI of their intention to invoke the post-commissioning clause in the contract. DOE should direct BNI to:

- a. **Hire test and commissioning personnel with the intent of transferring them to the permanent operating staff** when the hot commissioning is successfully completed.
- b. **Increase test and commissioning personnel to meet testing schedule and provide full operating and maintenance staff complement.** Since the current contract would only require BNI to sequentially staff the project to meet their current commissioning requirements, the new contract operator would have to hire the additional 350 personnel and train them after the turnover from BNI. Deciding that the testing and commissioning organization will become the contract operating staff after hot commissioning will eliminate the risk of starting initial contract operations with an inexperienced crew.

Upon receipt of DOE direction, BNI should modify graded approach (tailored training/ procedures) to commissioning. This will eliminate the duplication of training and procedures, which will occur with a late entry of the operating contractor.

### **KEY ASSUMPTIONS**

- Commissioning and Test employees transfer to Operations.
- DOE acquisition process time frame is at least five years.
- Union rules and jurisdiction are not a consideration.

### **ISSUES**

- Long-term career opportunities need to be defined for future operating staff in order to have assurances of their long-term commitment.
- Current BNI contract needs to be modified to address the following:
  - a) Increase Test and Commissioning staff to provide full operations complement at the end of Hot Commissioning.
  - b) Modify the training program to accommodate additional Operations staff.
  - c) Modify training and procedure development for contract operations.

### **COST IMPACTS**

#### **During the contract**

- Staffing increase: \$100M
- Training increase: \$5M
- Procedure development increase: \$5M
- Procedure inefficiency increase: \$20M
- Testing duration decrease: \$90M
- TPRAs decrease (multiple ORRs): \$90M
- TPRAs decrease ( sequential commissioning): \$250M
- Elimination of “graded” staffing approach: not quantified

#### **After the existing BNI contract**

- Training cost reduction: \$100M
- Training & Procedure development cost reduction: \$10M
- Increased Facility availability/production
  - 20 percent availability improvement (proven experienced staff)
  - \$200M cost avoidance in first two years

#### **Net Impact**

- Decrease of \$410M in life-cycle costs
- Shorter Mission Duration (improvement of 1.5 Years)

### **LIFECYCLE RISK MITIGATION**

- Test schedule risk.
- Staffing/ graded approach risk.
- Sequential testing risks.
- Multiple ORR risks.
- Facilities shutdown/limited operations following Hot Commissioning.
- Repeat ORR with operating contractor prior to “Commercial” Operation.
- Ability to meet TPA milestones improved.

**CRITICAL MILESTONE DATES**

- DOE should direct BNI **now** (and modify the contract) to revise its execution plan and reflect the revised approach in the 490 EAC.
- Begin hiring additional staff to support long term operations – January 2012.
- Begin training additional staff – June 2012.

