

## **PROJECT COST AND SCHEDULE**

### **Introduction**

Members of the EFCOG Project Management Working Group (PMWG) were asked by DOE to investigate root causes for projects not being completed within the original baseline schedule or budget or both. A sample set was provided containing the Line Item projects completed during Fiscal Year 2005. The purpose is to determine the cause(s) and provide any observations / conclusions for overruns or schedule delays with the goal of improving processes for future projects.

### **Methodology**

OECM provided a list of projects (attached) that either overran budget or schedule or both based upon the Critical Decision -2 (CD-2) baseline. The PMWG Cost and Schedule panel developed the attached questionnaire to guide interviews and discussions with the Federal Project Director of each project. Members of the panel interviewed the FPDs assigned to four of the six projects with variances for approximately 60 minutes and completed the questionnaires. The completed questionnaires are included in the appendix.

### **Observations / Conclusions**

*The FPDs fully understood their project and reasons for variances in either budget or schedule.*

*There generally was no formal CD-2 on the projects reviewed.*

The projects selected were all initiated prior to the full implementation of DOE Order 413. The projects transitioned to the order and adapted their processes while the project was in progress. It was difficult to determine the CD-2 baseline and establish if overruns occurred or if the stated baseline was established before the project was fully defined. Many of the FPDs noted that the projects were completed within the Approved Baseline, though not within the Original 'CD-2' Baseline. The definition of baseline should include all approved baseline changes. This may be different from the CD-2 baseline but represents acceptable changes (e.g., increased costs due to delayed funding or new technologies, etc.). Schedule completion is further compounded by the lack of definition of project completion (e.g., substantially complete or all contractual actions closed).

*There was generally no formal risk management process or formal ANSI compliant EVMS on the projects reviewed*

The projects selected were all initiated prior to the implementation of DOE Order 413. Advances in implementation and certification of EVMS have improved the quality of the plan, tracking of execution, and improvements in forecasting both budget and schedule. Use of EVMS will identify variances and improve the potential for successful corrective actions. Formal risk management processes were not generally at a level or maturity to be effective. With implementation of DOE Order 413, we expect better project control and risk management.

*Many projects experienced changes to their funding profiles.*

Delays in funding due to budget priorities cause projects to extend the execution period which causes schedule increases and often cost overruns or baseline change proposals.

Appendix A

Project List

SCIENCE	Projects past Critical Decision 2 (approved performance baseline)									
Project Name Federal Project Director name, CPD(Level), phone	Site	Status	Original TPC at CD-2 (\$M)	Current Approved TPC (\$M)	Final Cost (\$M)	Percent of original baseline	Original (CD-2) Completion Date	Actual Completion Date	Completed within 10% of Cost, Schedule, Scope (Y/N)	
Neutrinos at the Main Injector (NuMI) (98-G-304) Stephen Webster (630) 840-2130, stephen.webster@ch.doe.gov	FERMI	CD-4	\$139.4	\$171.4	\$167.8	120.3%	4Q FY03	February 28, 2005	NO (cost and schedule)	
Research Support Center (MEL-001-25) Les Ginn (865) 576-7317, ginnfl@ornl.gov	ORNL	CD-4	\$16.3	\$16.2	\$16.1	99.0%	Dec. 2004	October 31, 2004	YES	
Mechanical and Control Systems Upgrade-PH I (MEL-001-17) Jurgis Paliulionis 630-252-2724, jurgis.paliulionis@ch.doe.gov	Argonne East	CD-4	\$9.1	\$9.1	\$9.0	98.9%	May-05	Jun-05	YES	
<b>SC Total</b>			<b>\$155.7</b>	<b>\$187.6</b>						

National Nuclear Security Administration Defense Programs		Projects past Critical Decision 2 (approved performance baseline)							
Project Name Federal Project Director name, CPD(Level), phone	Site	Status	Original TPC at CD-2 (\$M)	Current Approved TPC (\$M)	Final Cost (\$M)	Percent of original baseline	Original (CD-2) Completion Date	Actual Completion Date	Completed within 10% of Cost, Schedule, Scope (Y/N)
NMSSUP (Phase 1) (99-D-132-LANL) Jesus Amezcuita (505) 667-2268, jamezcuita@doeal.gov	Los Alamos	Closeout	70.90	73.95	72.75	103%	March 31, 2005	May 19, 2005	YES
Distributed Information Systems Laboratory (01-D-101) Deborah Garcia-Sanchez (505) 845-5460, dgarcia-sanchez@doeal.gov	Sandia - CA	CD-4	38.01	38.01	37.26	98%	June 30, 2005	April 5, 2005	YES
Stockpile Management Restructuring Initiative (98-D-124) Harry Peters (865) 576-6812, petershe@y12.doe.gov	Oak Ridge Y-12	CD-4	33.20	24.70	24.70	74%	June 1, 2005	September 26, 2005	NO (schedule)
Sensitive Compartmented Information Facility (01-D-800) Anita Martin (925) 422-1141, anita.martin@oak.doe.gov	LLNL	CD-4	25.10	24.82	24.82	99%	January 1, 2004	December 1, 2004	NO (schedule)
Protection of Real Property Phase II (Roof Reconstruction) (99-D-104) Anita Martin (925) 422-1141, anita.martin@oak.doe.gov	LLNL	CD-4	19.96	18.43	18.32	92%	June 1, 2004	March 30, 2005	NO (schedule)
Stockpile Management Restructuring Initiative (99-D-128) Johnnie Guelker (806) 477-3183, jguelker@pantex.doe.gov	Pantex Plant	CD-4	17.86	13.02	13.02	73%	September 30, 2004	June 23, 2005	NO (schedule)
Storm, Drain, Sanitary Sewer, and Domestic Water (96-D-102-05) Ivan Rose (505) 845-4195, irose@doeal.gov	Sandia - NM	CD-4	16.09	16.09	15.96	99%	December 31, 2004	December 9, 2004	YES
Sewage Treatment Quality Upgrade Pantex (96-D-122) Johnnie Guelker (806) 477-3183, jguelker@pantex.doe.gov	Sandia - NM	CD-4	12.80	12.80	12.80	100%	June 30, 2004	March 25, 2005	NO (schedule)
	<b>NNSA Total</b>		<b>\$233.92</b>	<b>\$221.82</b>	<b>\$219.63</b>	94%			

Appendix B

Questionnaire

EFCOG Project Management Working Group, Cost and Scheduling Estimating Questionnaire/

General Questions

1. Name of project and brief description
2. Was the project over schedule or over budget or both?

Baseline

1. When was the baseline established (CD level)?
2. Was it based upon a conceptual design or completion of preliminary design or something else?
3. Was the baseline realistic?
4. What confidence level was inherent in the baseline?
5. What percentage of contingency was incorporated into the baseline?
  - a. Did the DOE department agree to the budget/schedule?
  - b. Did the contractor agree to the budget/schedule?
6. What drove the baseline budget or schedule (looking for outside forces/constraints)?
7. Considering the triple constraint of scope, cost and schedule, was there more emphasis placed on one factor than the others?
8. What risk items were identified in cost or schedule?

Execution - Planning

1. Describe the planning effort and review process in place as this project was initiated.
2. What risk items were identified in cost or schedule?
3. Were there any cost and schedule limits imposed early in the planning process that created risks?
  - a. Was this the optimal duration?
  - b. If not, why was this schedule duration established in the CD-2 baseline? (funding availability, mission need, etc.)
  - c. Were mitigation plans developed to address the potential schedule overruns? Were they implemented?
  - d. Were there identified potential cost overruns? Describe?
  - e. Were these documented? In the Risk Management Plan? If not, how?
  - f. Were mitigation plans developed to address the potential cost overruns? Were they implemented?

### Execution – Schedule Issues

1. Was the schedule met?
2. Were there owner directed changes such as funding profile changes that resulted in schedule delays? Describe.
3. Were schedule delays documented/approved in BCPs?
4. What were the primary causes for schedule overruns/delays?
5. How long after CD-2 did the project team first forecast a schedule delay?
6. What actions were taken at that point?
7. How did the project keep within cost when the project took longer than originally scheduled?

### Execution – Budget Issues

1. Did the EVMS project a cost overrun? When in the project life (percent complete)?
2. What actions were taken at that point?
3. What were the primary causes for cost overruns?
4. Had these causes been identified in risk planning?
5. Were cost overruns documented/approved?

We would like to get the contractor's view also. Would you provide the name of the contractor representative?

Appendix C  
Completed Questionnaires

## Discussion Questions Roofs

### General Questions

1. **Name of project and brief description:** *Protection of Real Property Phase II (Roof Reconstruction) (99-D-104)*
2. **Was the project over schedule or over budget or both?** *Completed after the 'Original Performance Baseline' date but within the Approved Baseline. The project funding profile was changed through reprogramming May '02 which stretched out the project.*

### Baseline

1. **When was the baseline established (CD level)?** *CD-1 (Rescission in '2000)*
2. **Was it based upon a conceptual design or completion of preliminary design or something else?** *Baseline established on a CDR.*
3. **Was the baseline realistic?** *Yes, They had done this type of project before at the LLNL site and had established a good process for completing this type of work.*
4. **What confidence level was inherent in the baseline?** *High, we had done similar types in the past successfully.*
5. **What percentage of contingency was incorporated into the baseline?** *~14%*
  - a. **Did the DOE department agree to the budget/schedule?** *Yes*
  - b. **Did the contractor agree to the budget/schedule?** *Yes*
6. **What drove the baseline budget or schedule (looking for outside forces/constraints)?** *Funding profile drove the schedule. Based on Tri-Lab agreement on out year funding splits.*
7. **Considering the triple constraint of scope, cost and schedule, was there more emphasis placed on one factor than the others?** *No*
8. **What risk items were identified in cost or schedule?** *Weather cycle for roofs and normal contamination issues resulting from potential fume hood outfall.*

### Execution - Planning

1. **Describe the planning effort and review process in place as this project was initiated.** *-CDR prepared  
-Formal Review process on site at LLNL  
-Validation through the NNSA HQ PM Office NA-54*

2. **Were there any cost and schedule limits imposed early in the planning process that created risks?** *No, worked to the approved budget.*
  - a. **Was this the optimal duration?** *No, funding constraints drove the schedule.*
  - b. **If not, why was this schedule duration established in the CD-2 baseline? (funding availability, mission need, etc.)** *Funding.*
  - c. **Were mitigation plans developed to address the potential schedule overruns? Were they implemented?** *Yes, brainstormed potential risks and solutions.*
  - d. **Were there identified potential cost overruns? Describe?** *No, pretty straight forward.*
  - e. **Were these documented? In the Risk Management Plan? If not, how?** *No formal Risk Management docs.*
  - f. **Were mitigation plans developed to address the potential cost overruns? Were they implemented?** *No, cost was not a problem. Potential cost problems on the roof preparation (i.e. removing old equipment and raising platforms). Used On-site Union labor contractor to complete prep work since they were familiar with the processes and procedures to do prep. This lessened the bid risk and simplified the contract.*

#### Execution – Schedule Issues

1. **Was the schedule met?** *Current Approved Baseline was met*
2. **Were there owner directed changes such as funding profile changes that resulted in schedule delays? Describe.** *Yes. Project was rescheduled based on budget rescissions and Tri-Lab funding profile changes.*
3. **Were schedule delays documented/approved in BCPs? . What were the primary causes for schedule overruns/delays?** *Yes. Funding Re-programming efforts.*
4. **How long after CD-2 did the project team first forecast a schedule delay?** *~2 years.*
5. **What actions were taken at that point?** *Re-planned the work.*
6. **How did the project keep within cost when the project took longer than originally scheduled?** *Proactive Project Management. Good project performance prior to change. A matrixed project team and sufficient work elsewhere allowed the project to weather the extended schedule.*

#### Execution – Budget Issues

1. **Did the EVMS project a cost overrun? When in the project life (percent complete)?** *N/A*
2. **What actions were taken at that point?** *N/A*
3. **What were the primary causes for cost overruns?** *N/A*

4. Had these causes been identified in risk planning? *N/A*

5. Were cost overruns documented/approved? *N/A*

## Discussion Questions SCIF

### General Questions

1. **Name of project and brief description:** *Sensitive Compartmented Information Facility (SCIF) (01-D-800)*
2. **Was the project over schedule or over budget or both?** *Completed after the 'Original Performance Baseline' date but within the Approved Baseline.*

### Baseline

1. **When was the baseline established (CD level)?** *CD-2 but schedule date on OECM spread sheet is not consistent with CD-2 Docs.*
2. **Was it based upon a conceptual design or completion of preliminary design or something else?** *Conceptual Design that was a couple of years old then updated and escalated?*
3. **Was the baseline realistic?** *Yes, but it was tight.*
4. **What confidence level was inherent in the baseline?** *Acceptable.*
5. **What percentage of contingency was incorporated into the baseline?** *~15%*
  - a. **Did the DOE department agree to the budget/schedule?** *Yes*
  - b. **Did the contractor agree to the budget/schedule?** *Yes*
6. **What drove the baseline budget or schedule (looking for outside forces/constraints)?** *Budget driven by funding limitations.*
7. **Considering the triple constraint of scope, cost and schedule, was there more emphasis placed on one factor than the others?** *No, had to get them all.*
8. **What risk items were identified in cost or schedule?** *DOE Accreditation for SCIF and a formal Risk Assessment was completed with emphasis on the accreditation risk mitigation.*

### Execution - Planning

1. **Describe the planning effort and review process in place as this project was initiated.** *-CDR  
-EIR  
-IPR*
2. **Were there any cost and schedule limits imposed early in the planning process that created risks?** *Tight budget. Very budget driven.*

- a. **Was this the optimal duration?** *Yes, Duration validated by EIR was optimal.*
- b. **If not, why was this schedule duration established in the CD-2 baseline? (funding availability, mission need, etc.)** *N/A.*
- c. **Were mitigation plans developed to address the potential schedule overruns? Were they implemented?** *Yes, SCIF Accreditation Mitigation planned.*
- d. **Were there identified potential cost overruns? Describe?** *Yes, the SCIF accreditation process takes place at the very end of the project and if there were corrective actions necessary, the project was at risk for a potential cost overrun.*
- e. **Were these documented? In the Risk Management Plan? If not, how?** *Yes, the Risk Management Plan addressed this.*
- g. **Were mitigation plans developed to address the potential cost overruns? Were they implemented?** *Yes, tight budget late in the project execution forced a formal mitigation plan to prevent cost overrun to be implemented.*

#### **Execution – Schedule Issues**

- 1. **Was the schedule met?** *Yes, Approved Baseline schedules were met.*
- 2. **Were there owner directed changes such as funding profile changes that resulted in schedule delays? Describe.** *Budget Rescission made the budget tighter but did not drive schedule.*
- 3. **Were schedule delays documented/approved in BCPs? What were the primary causes for schedule overruns/delays?** *Yes. Accreditation process took longer. Documented in EIR and BCP's.*
- 4. **How long after CD-2 did the project team first forecast a schedule delay?** *Determined prior to CD-2 of EIR.*
- 5. **What actions were taken at that point?** *Schedule was adjusted and approved through BCP Process.*
- 6. **How did the project keep within cost when the project took longer than originally scheduled?** *Aggressive cost management from a Matrixed project team.*

#### **Execution – Budget Issues**

- 1. **Did the EVMS project a cost overrun? When in the project life (percent complete)?** *No, EVMS was not certified at that time.*
- 2. **What actions were taken at that point?** *Recovery plan/Corrective actions.*
- 3. **What were the primary causes for cost overruns?** *N/A*

4. **Had these causes been identified in risk planning?** *N/A*
5. **Were cost overruns documented/approved?**

## Discussion Questions

### General Questions

1. Name of project and brief description – Stockpile Management Restructuring Initiative (SMRI).  
Project Number 98-D-124
2. Was the project over schedule or over budget or both? Mr. Peters claims the project was on schedule and under budget. The data table from OECM indicates the project was schedule for completion June 1, 2005 but actually achieved CD-4 on September 26, 2005, an approximately four month slip. (The 4 month difference is within the six month window allotted by the PEP.)

### Baseline

1. When was the baseline established (CD level)? This project was originally started in 1996 and managed out of HQ DOE. The project concept and the working/approved final baseline was established in 2001 and managed from the site. Project was re-started with the new baseline.
2. Was it based upon a conceptual design or completion of preliminary design or something else? Something else. By 2001 the project “concept” was firmed up and nailed down.
3. Was the baseline realistic? The original baseline was very conceptual. But the 2001 baseline was realistic and the project was managed to that baseline.
4. What confidence level was inherent in the baseline?
  - Original baseline – minimal.
  - 2001 baseline – relatively high
5. What percentage of contingency was incorporated into the baseline? Both the contractor and the Federal Project Director had contingency incorporated into the baseline; the contractor for unexpected higher costs, and the Project Director for scope changes/creep. Release criteria were documented in the Project Execution Plan.
  - a. Did the DOE department agree to the budget/schedule? Yes, after the 2001 baseline.
  - b. Did the contractor agree to the budget/schedule? Yes, after the 2001 baseline.
6. What drove the baseline budget or schedule (looking for outside forces/constraints)? HQ managed this project originally. Baseline was very conceptual.
7. Considering the triple constraint of scope, cost and schedule, was there more emphasis placed on one factor than the others? All treated equally after 2001 baseline established.
8. What risk items were identified in cost or schedule? There was no risk management plan. However, risks were identified and known.

### Execution - Planning

1. Describe the planning effort and review process in place as this project was initiated. Project was initiated and managed by HQ from inception until Mr. Peters was assigned to be Federal Project

Director when the baseline was finalized in 2001. The project was beset with lots of misdirection, poor baseline control, scope creep, inadequate progress, etc.

2. Were there any cost and schedule limits imposed early in the planning process that created risks? Project definition and execution was inadequate, resulting in cost overruns and schedule delays early in the project. (early in the project – yes, inadequate baseline control, direction from stakeholders outside that changed the scope and approach, etc.)
  - a. Was this the optimal duration?
  - b. If not, why was this schedule duration established in the CD-2 baseline? (funding availability, mission need, etc.) (prior 413.3)
  - c. Were mitigation plans developed to address the potential schedule overruns? Were they implemented?
  - d. Were there identified potential cost overruns? Describe?
  - e. Were these documented? In the Risk Management Plan? If not, how? Project risks were identified but no formal risk management plan was developed.
  - f. Were mitigation plans developed to address the potential cost overruns? Were they implemented? Establishment of two sets of contingency/management reserve, one for the contractor and one for the Federal Project Director, and then careful management of both contingencies, were the primary mitigation measures used once the project's baseline was established in 2001. The project used a trend analysis process to identify items that were potentially out of baseline control. The contract identifies these and they were discussed with the Federal Project Director and brought to resolution.

#### Execution – Schedule Issues

1. Was the schedule met? The Federal Project Director indicated that the project was completed within the Approved Baseline Schedule and accompanying thresholds as defined within the Project Execution Plan.
2. Were there owner directed changes such as funding profile changes that resulted in schedule delays? Describe. No. Once the 2001 baseline was established, the project was funded per the baseline. The Federal Project Director did have to find the funding at least once but those efforts did not impact the flow of funding to the contractor.
3. Were schedule delays documented/approved in BCPs? No schedule delays.
4. What were the primary causes for schedule overruns/delays? N/A, though there were some software delivery issues.
5. How long after CD-2 did the project team first forecast a schedule delay? There was no formal CD-2 and the project was not over schedule.
6. What actions were taken at that point? N/A
7. How did the project keep within cost when the project took longer than originally scheduled? Project did not take longer than scheduled. Costs were actually ~\$1.3 million less than budgeted.

### Execution – Budget Issues

1. Did the EVMS project a cost overrun? When in the project life (percent complete)? Project did not exceed budget – no overall project cost overrun. The BWXT EVMS was used and basically worked adequately except near the end of the project. Use of EVM on a monthly basis near the end of the project is not a good indicator of project performance (and estimates to complete).
2. What actions were taken at that point? If a subproject was forecasting a cost overrun, the contractor could recommend to the Federal Project Director that funding be moved between subprojects.
3. What were the primary causes for cost overruns? N/A
4. Had these causes been identified in risk planning? N/A
5. Were cost overruns documented/approved? Subproject cost overruns were documented by the contractor and funding was shifted between subprojects by the Federal Project Director, resulting in a cost under run for the overall project. All changes in funding were at or below the Federal Project Director's approval threshold.

The key to this success seems to be a very involved Federal Project Director and good communications between the contractor and the Federal Project Director. The Federal Project Director at the site had the authority to execute the scope, schedule, budget, within established thresholds and took the initiative to maintain the funding profile.

EFCOG Project Management Working Group, Cost and Scheduling Estimating Questionnaire/

General Questions

3. **Name of project and brief description:** Neutrinos at the Main Injector (NuMI), Fermi Lab. Direct a neutrino beam from Fermi lab to a detector in Minnesota. Technical issues included a 300 foot deep protecting the focusing magnets and associated electrical equipment at this depth.
4. **Was the project over schedule or over budget or both?** Both. However, the project was finished ahead of schedule and under budget after re-baselining in 2001.

Baseline

9. **When was the baseline established (CD level)?** Was initiated prior to 413. Baselines were broken up differently than the current CD levels.
10. **Was it based upon a conceptual design or completion of preliminary design or something else?**
11. **Was the baseline realistic?** There were insufficient engineering resources of the proper experience (e.g., deep tunnel magnet protection) to properly estimate the project. Yes, at project origination.
12. **What confidence level was inherent in the baseline?**
13. **What percentage of contingency was incorporated into the baseline?**
  - a. **Did the DOE department agree to the budget/schedule?** Yes.
  - b. **Did the contractor agree to the budget/schedule?**
14. **What drove the baseline budget or schedule (looking for outside forces/constraints)?** Primary driver was funding. The funding profile was not executed.
15. **Considering the triple constraint of scope, cost and schedule, was there more emphasis placed on one factor than the others?**
16. **What risk items were identified in cost or schedule?**

Execution - Planning

4. **Describe the planning effort and review process in place as this project was initiated.** This project was executed by the M&O contractor using the same process as a recently successfully completed project.
5. **What risk items were identified in cost or schedule?**
6. **Were there any cost and schedule limits imposed early in the planning process that created risks?**
  - a. **Was this the optimal duration?**

- b. **If not, why was this schedule duration established in the CD-2 baseline? (funding availability, mission need, etc.)**
- c. **Were mitigation plans developed to address the potential schedule overruns? Were they implemented?**
- d. **Were there identified potential cost overruns? Describe?**
- e. **Were these documented? In the Risk Management Plan? If not, how?**
- f. **Were mitigation plans developed to address the potential cost overruns? Were they implemented?**

Execution – Schedule Issues

- 8. **Was the schedule met?** No.
- 9. **Were there owner directed changes such as funding profile changes that resulted in schedule delays? Describe.** The project agreed to the construction contractor's change order to use a tunnel boring machine rather than drill and blast. The TBM was argued to be cheaper and faster.
- 10. **Were schedule delays documented/approved in BCPs?**
- 11. **What were the primary causes for schedule overruns/delays?** The change to the TBM resulted in a lot greater quantity of water to be treated for solids removal and additional treatment. (pH was adjusted to remove the solids then they had to re-adjust the pH). TBM ran into difficulties with roof support boring through rock.
- 12. **How long after CD-2 did the project team first forecast a schedule delay?**
- 13. **What actions were taken at that point?**
- 14. **How did the project keep within cost when the project took longer than originally scheduled?**

Execution – Budget Issues

- 6. **Did the EVMS project a cost overrun? When in the project life (percent complete)?** Yes it did project schedule and budget overruns.
- 7. **What actions were taken at that point?**
- 8. **What were the primary causes for cost overruns?** Escalation of construction costs. They had five or more bids on all subcontracted civil construction effort. All were significantly higher than the multiple independent estimates.
- 9. **Had these causes been identified in risk planning?** The project execution plan included risk management but there was not a separate risk management plan.
- 10. **Were cost overruns documented/approved?** Yes. The re-baselined budget was 171.4M and the project was delivered for 167.8M.

OTHER

The DOE Federal Project Director stated they needed better construction management skilled people to oversee the construction contractor, especially the TBM contractor. They had a FFP contract and while they did not agree with the manner in which the TBM contractor was executing the work, they were reluctant to give the contractor direction. They tried alternative dispute resolution but this was ineffective.

The other reason for costs increases above the original budget was a lack of proper engineering resources. While they had built similar neutrino projects in the past, they had not built one underground and that deep. There were difficulties in transporting materials down the deep shaft, significant slopes, and into relatively confined areas.

