

**LIFE EXTENSION 2
CONCEPTUAL DESIGN REPORT
VOLUME I
INTRODUCTION**



**U.S. DEPARTMENT OF ENERGY
STRATEGIC PETROLEUM RESERVE
PROJECT MANAGEMENT OFFICE
NEW ORLEANS, LOUISIANA
CONTRACT NO. DE-FE-0023538**

July 31, 2016

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I. Introduction

This Conceptual Design Report (CDR) encompasses 97 Tasks across all four Strategic Petroleum Reserve Sites in Support of Critical Decision 1 (CD-1) for Life Extension 2. These tasks were selected for inclusion in the Life Extension 2 Program based on mission needs as approved in Critical Decision 0 (CD-0) on October 30, 2015. The purpose of this CDR is to provide recommended preferred alternative selection for task groupings as appropriate, and to provide budgetary cost information for the recommended preferred alternatives.

The two main guiding documents for this CDR are DOE Order 413.3B Change 2 (5-12-2016) “Program and Project Management for the Acquisition of Capital Assets” and GAO 16-22 Report to Congressional Committees (October 2015) Appendix I “Best Practices for the Analysis of Alternatives Process.”

Analysis of Alternatives (AoA) was conducted on 60 projects (comprised of 78 Tasks) and each AoA document is presented as a stand-alone analysis. It should be noted, however, that many project studies were interrelated and some project assumptions were made based on other project analyses.

Several tasks were identified as not requiring a full analysis of alternatives and are included as two categories of study. The two categories of projects are a Go/No-Go Project and an AFC Project.

A Go/No-Go Project is a project that has a conceptual scope already defined which is included as a project justification rather than a full analysis of alternatives. These projects include those that are replace-in-kind equipment, projects that clearly only have one alternative, projects that are continuations of multi-site work that is complete at some sites but not others, and projects that have already undergone the Engineering Change Proposal (ECP) process which is essentially an alternatives analysis process. There are 9 projects (comprised of 12 tasks) that are included as Go/No-Go analysis documents.

An AFC Project is a project that has already or close to completion of Approved for Construction (AFC) plans and specifications. These projects did not require analysis or project justification, rather were included with brief scope summaries of the completed or near completed designs. There are 5 projects (comprised of 7 Tasks) that are included as AFC project documents.

II. Executive Summary of Recommendations

The following tables summarize the recommended preferred alternatives by site as a result of the analysis of alternatives process, as well as the recommended projects from the Go/No-Go analysis and the AFC projects. The detailed Analysis of Alternatives, Go/No-Go Analysis, and AFC Project Descriptions are grouped by site in the following volumes of this CDR:

Volume II – Bayou Choctaw

Volume III – West Hackberry

Volume IV – Big Hill

Volume V – Bryan Mound

Because of the size and sensitivity of the cost backup information, Volume VI – Cost Appendix is included for reference information on all alternatives studied. Volume VII – Preliminary Hazard Reviews is included for reference on all recommended preferred alternatives.

A. Bayou Choctaw Summary of Recommended Preferred Alternatives

Task Number(s)	Task Description	Recommended Alternative	Total Estimated Cost (TEC)
BC-MM-1297	Replace Timber Supports	Replace with New Steel Beams and Concrete Cap Existing Timber Piles	\$975,156
BC-MM-1339	Replace Perimeter Security Detection System	FlexZone	\$6,270,241
BC-MM-1344	Replace/Recomplete Brine Disposal Wells	Drill New Brine Disposal Wells	\$151,498,817
BC-MM-1351/420/420A	Degas Plant	In-Storage Degassing	\$37,257,938
BC-MM-1360	Site Road Access to BC-19, -101	Replace Bridge; Replace N-S and E-W Bridges with concrete box culvert	\$5,319,455
BC-MM-1361	Replace and Relocate High Speed Barriers	Design an Employee Parking Area Entrance with Wafer Access Entry	\$709,210
BC-MM-1364/1531	Replace Below Grade Firewater Headers	Replace Fire Water Pumps/Drivers and Controllers	\$1,032,321
BC-MM-1461	Replace Oil-in-Water Monitors	New UV Fluorescence Monitors	\$4,174,122
BC-MM-1526	Replace CCTV System at BC	Replace CCTV System (Digital)	\$5,815,969
BC-MM-308	Upgrade Outdoor Lighting	Replace All Utility Poles, All Lights and Associated Cabling (LED)	\$1,690,962
BC-MM-437	Sewage Treatment Plant	Construct a New Treatment Plant	\$1,332,021
BC-MM-769/824	Install Brine Disposal System/Replace Brine Tank	Continue to Use Existing Brine Pond with Modifications	\$16,990,060
BC-MM-770	Upgrade and Automate Brine Disposal Well Valves & Meters	Install New Motor Operated Control Valves, Motor Operated Isolation Valves and Check Valves at Each of the Brine Disposal Flow Lines to Each Well and Install a New Brine Pipeline Motor Operated Isolation Valve	\$2,261,469
BC-MM-771	Upgrade Brine Disposal Well MCCs and MCC Electrical Service	Electrical Switch Racks to Replace the Existing MCCs	\$2,422,401
BC-MM-775	Replace / Line Brine Disposal Well Branch Piping to Pads 2 and 3	Install New Piping on Above Ground Supports	\$7,470,383
BC-MM-810	Replace Site Emergency Generator	Conduct Load Analysis and Install a New Generator	\$1,070,929

B. West Hackberry Summary of Recommended Preferred Alternatives

Task Number(s)	Task Description	Recommended Alternative	Total Estimated Cost (TEC)
WH-MM-1025	Replace the 42 Inch Pigging Water Underground Pipeline	Settlement Pond	\$24,624,027
WH-MM-1100/1100A	Replace WHT-1 Flush Water and WHT-10 Seal Flush Tanks	This project is in progress to issue as Approved for Construction (AFC)	\$2,591,929
WH-MM-1144	Enhance Access to Valve Stations	Approved for Construction (AFC)	\$1,804,549
WH-MM-1148	Repair/Replace Roofs on Buildings 301, 317 & 320	Repair/Replace Roofs on Buildings 301, 317, and 320 (New Metal Panel Roof)	\$2,522,110
WH-MM-1150	Replace Fuel Source WHEG-5/LCMS	Replace Fuel Source at LCMS (WHEG-5)	\$292,035
WH-MM-1281	Replace Perimeter Security Detection System	FlexZone	\$9,442,679
WH-MM-1334	Recap Anhydrite Ponds	This project has been issued as Approved for Construction (AFC)	\$3,052,096
WH-MM-1359	Revise WH RWINJ Pump Exercise System	Combine with WH-MM-1025 and Share the Pond	\$3,249,257
WH-MM-1363	Replace and Relocate High Speed Barriers	Design an Employee Parking Area Entrance with Wafer Access Entry	\$713,462
WH-MM-1366	Replace Firewater Headers	High Density Polyethylene - FM Approved	\$19,375,237
WH-MM-1372	Heat Exchanger Bundle Spares	New Isolation Valves/Spares (SeaCure)	\$3,624,514
WH-MM-1409/1350	Replace Brine Disposal Line to Gulf	Clean Existing Wells, Develop New Brine Disposal Wells	\$83,439,559
WH-MM-1463	Replace Oil-in-Water Monitors	New UV Fluorescence Monitors	\$9,481,169
WH-MM-1525	RWIS Infrastructure Upgrades at WH	Perform Overhaul of RWIS	\$5,281,373
WH-MM-1529	Replace CCTV System at WH	Replace Digital CCTV System (Cameras)	\$7,537,818
WH-MM-337/649/1349	Subsidence and Inundation Mitigation	Perform Site Wide Study and Provide a Means for Protection	\$2,050,635
WH-MM-617/A/652/A	Lighting Upgrades at WH	Replace All Lights, Designated Utility Poles and Associated Cabling (LED)	\$2,586,840
WH-MM-693	Marine Service Center	Construct Marine Services Center	\$2,452,378
WH-MM-753	Upgrade ADAS System	Upgrade/Replace Existing ADAS System	\$1,221,461
WH-MM-788	Replace Slop Oil Pump (517/518)	Replace Slop Oil Pumps and Install Sump	\$1,313,613
WH-MM-791/791A	Replace CO Injection Pumps WHP-22,23,131 at WH	Two New Pumps and Motors	\$16,672,564
WH-MM-794/794A	Replace Meter Skid Actuators at WH & Sun	Replace/Upgrade existing EIM actuators with Rotork IQ	\$5,494,523
WH-MM-1025	Replace the 42 Inch Pigging Water Underground Pipeline	Settlement Pond	\$24,624,027

C. Big Hill Summary of Recommended Preferred Alternatives

Task Number(s)	Task Description	Recommended Alternative	Total Estimated Cost (TEC)
BH-MM-1338/793/793A	Replace Raw Water Injection Pumps to Maintain Drawdown	Install New, Larger RWI Pumps	\$79,538,016
BH-MM-1356	Replace Raw Water Header Above Grade	Below Grade Replacement	\$31,014,869
BH-MM-1357	Replace Crude Oil Header Above Grade	Below Grade Replacement	\$39,758,133
BH-MM-1362	Replace and Relocate High Speed Barriers	Design an Employee Parking Area Entrance with Wafer Access Entry	\$674,145
BH-MM-1370	Heat Exchanger Bundle Spares	New Isolation Valves and Spare Tube Bundles (SeaCure)	\$2,007,630
BH-MM-1429	Lighting Upgrades at BH	Replace Designated Lights and Associated Cabling (LED)	\$1,030,633
BH-MM-1523	RWIS Infrastructure Upgrades at BH	Perform Overhaul of RWIS	\$5,971,115
BH-MM-1527	Replace CCTV System at BH	Replace Existing Digital CCTV System (Cameras)	\$5,846,579
BH-MM-1530	Replace Perimeter Security Detection System	FlexZone	\$7,398,830
BH-MM-1552	Replace Oil-in-Water Monitors	New UV Fluorescence Monitors	\$6,790,838
BH-MM-523	Replace 5KV Outdoor Bus Ducts	Cable Bus	\$901,784
BH-MM-596/596A	Replace Onshore Section of Brine Disposal Line	New On-Shore Pipeline; Optimize New Line Size with New Brine Disposal Pumps and Motors	\$81,520,527
BH-MM-597/597A	Replace Raw Water Intake Pipeline at BH	Construct New Raw Water Pipeline that Extends Beyond the Raw Water Injection Pumps and Install New Pig Receiver	\$167,098,827
BH-MM-611	Replace Crude Oil Injection Pump Motors and Skids	Replace Pump and Motor on New Skid Base; Repair/Revise Concrete Base	\$13,051,535
BH-MM-670	Site Building Upgrades Phase 2 (E2P2)	This project has been issued as Approved for Construction (AFC)	\$899,059
BH-MM-750	Upgrade ADAS System Servers and Workstations	Upgrade/Replace Existing ADAS Servers and Workstations	\$1,199,790
BH-MM-756/756A	Replace Section of 36" COP at Hillebrandt Bayou	This project has been issued as Approved for Construction (AFC)	\$9,541,558
BH-MM-776/776A	Replace Actuators on Meter Skid Valves	Replace Meter Skid Actuators at Big Hill and Sun Logistics Nederland Terminal	\$3,375,124
BH-MM-782	Replace Slop Oil Tank & Pumps (BHT-6, BHP-51 & 52)	Replace Pumps in Kind and Tank with Upgrade to Stainless Steel	\$2,055,712
BH-MM-806	Replace Mark V Circuit Switchers	Replace Mark V Circuit Switchers with Technology Upgrades	\$773,249
BH-SP-1307/1307A	BH Simultaneous Distribution to Chevron/Unocal, Shell and Sun	Local Control of ACT Flow Meter Skid at Shell-Zydeco with Standard Security	\$16,702,720
BH-SP-1407/1407A	BH Pipeline - Beaumont Terminal Flow Control	Install Remote Ultrasonic Flow Meters Control at Shell, Phillips 66, and Sun	\$15,924,977
BH-MM-1338/793/793A	Replace Raw Water Injection Pumps to Maintain Drawdown	Install New, Larger RWI Pumps	\$79,538,016

D. Bryan Mound Summary of Recommended Preferred Alternatives

Task Number(s)	Task Description	Recommended Alternative	Total Estimated Cost (TEC)
BM-MM-1055	Convert BMT-4 to External Floating Roof	Domed Internal Floating Roof	\$9,422,335
BM-MM-1171	Replace Microwave Security System at CO Transfer Pumps	Microwave Sensor (UltraWave)	\$424,970
BM-MM-1340	Replace Perimeter Security Detection System	FlexZone	\$8,467,536
BM-MM-1354	Replace Crude Oil Injection Pumps BMP -1, -4	Two New Pumps and Motors	\$12,487,804
BM-MM-1355	Replace Brine Tank BMT-1 with Purpose Built System	One New Tank	\$13,883,853
BM-MM-1358	Install Vapor Recovery BMT-2, -3, -4	Vapor Recovery on All Tanks	\$38,824,910
BM-MM-1365	Replace Below Grade Firewater Headers	High Density Polyethylene - FM Approved	\$5,781,299
BM-MM-1371	Heat Exchanger Bundle Spares	New Isolation Valves and Spare Tube Bundles (SeaCure)	\$4,965,437
BM-MM-1462	Replace Oil-in-Water Monitors	New UV Fluorescence Monitors	\$8,549,528
BM-MM-1524	RWIS Infrastructure Upgrades at BM	Perform Overhaul of RWIS	\$5,359,482
BM-MM-1528	Replace CCTV System at BM	Replace CCTV System (Digital)	\$7,217,151
BM-MM-369	Lighting Upgrades at BM	Replace Designated Utility Poles, All Lights and Associated Cabling (LED)	\$2,319,349
BM-MM-590/590A	Replace Raw Water Intake Pipeline No. 1	HDD Under Levee with Underground HDPE Pipe Routed Through Center of Site (Route 2) and North to Pump House at BMT-1. CS Aboveground at Pig Launcher and Receiver	\$20,116,357
BM-MM-774/774A	Replace Actuators on Meter Skid Valves	Replace Meter Skid Actuators at Bryan Mound Meter Station	\$3,282,891

III. Organizational Responsibilities

The Department of Energy (DOE) Strategic Petroleum Reserve Project Management Office (SPRPMO) has overall responsibility to manage the Life Extension 2 (LE 2) Program. For the generation of this document, the DOE SPRPMO provides scope direction on what projects are to be included in the program, provides management and coordination of various SPRPMO contractors that are participants in the process, and provides adequate participation of their personnel to provide background information and technical expertise regarding the SPR facilities. One SPRPMO person is also tasked per project with providing a technical evaluation of each alternative studied.

Vali Cooper International, LLC (VCI) is the Department of Energy (DOE) Strategic Petroleum Reserve (SPR) Architect-Engineer and is tasked with providing a Conceptual Design Report (CDR) for the Life Extension 2 tasks identified as Equipment and Infrastructure Upgrades. This CDR is provided as a contract deliverable to be incorporated into the Critical Decision 1 (CD-1) document for Life Extension 2. VCI provides staffing required to produce the CDR; one Project Engineer assigned to multiple projects to manage the Analysis of Alternatives (AoA) process and provide a technical evaluation of each alternative studied, as well as staff to identify the preferred alternatives by comparing the technical evaluations and project cost information.

Fluor Federal Petroleum Operations (FFPO) is the DOE SPR Operations and Maintenance Contractor and is tasked with providing the recommended tasks and descriptions of work on what projects are to be included in the program and providing adequate participation of their personnel to provide background information and technical expertise regarding the SPR facilities. One FFPO person is also tasked per project with providing a technical evaluation of each alternative studied.

Sandia is an SPRPMO specialty consultant and is tasked with alternatives analysis of new brine disposal wells at West Hackberry along with selection of the preferred alternative. Sandia produced one alternatives analysis that was vetted through the Design Review process, which is ultimately incorporated into this Conceptual Design Report.

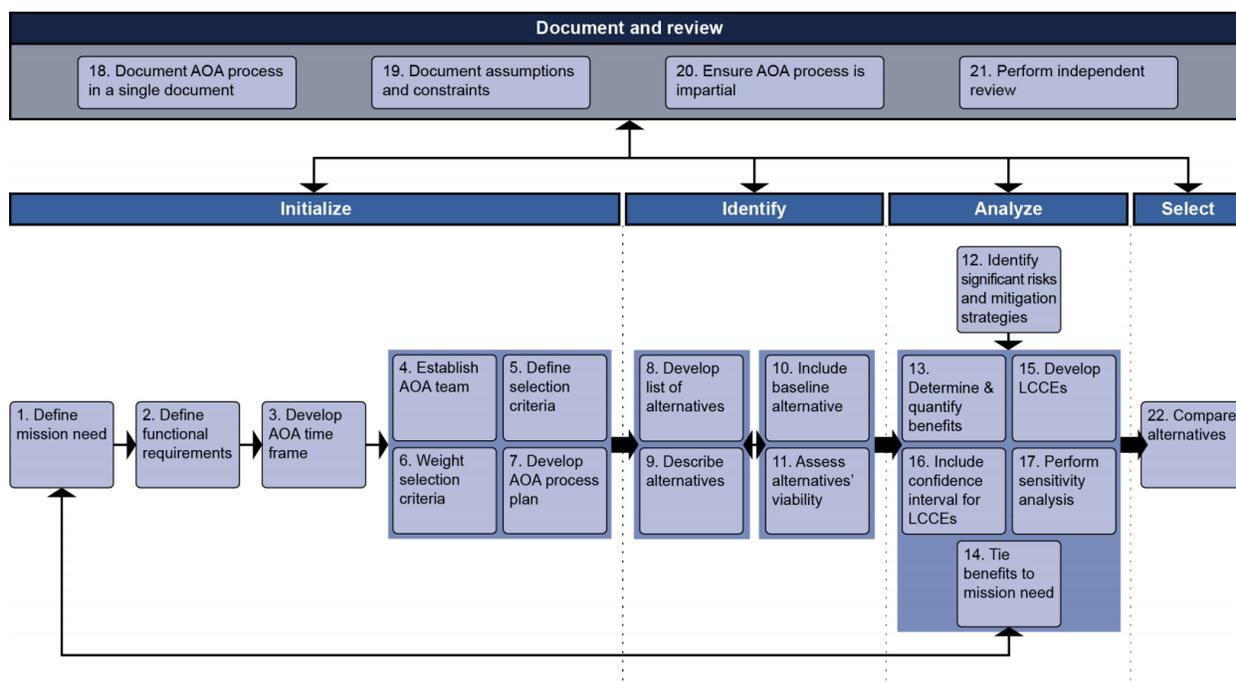
IV. Approach

The number of discreet tasks to be included in this study required many diverse personnel to be allocated in a short period of time across multiple organizations. In order to provide an objective and consistent study, the GAO Best Practices for the Analysis of Alternatives Process were used as a guide to create the scheduled process followed. The 22 best practices identified by GAO are grouped into 5 phases as follows:

1. Initialize the AoA Process: includes best practices that are applied before starting the process of identifying, analyzing, and selecting alternatives. This includes determining the mission need and functional requirements, developing the study time frame, creating a study plan, and determining who conducts the analysis.
2. Identify Alternatives: includes best practices that help ensure the alternatives to be analyzed are sufficient, diverse, and viable.
3. Analyze Alternatives: includes best practices that compare the alternatives to be analyzed. The best practices in this category help ensure that the team conducting the analysis uses a standard, quantitative process to assess alternatives.
4. Document and Review the AoA Process: includes best practices that would be applied throughout the AoA Process, such as documenting all steps taken to initialize, identify, and analyze alternatives and to select a preferred alternative in a single document.
5. Select a Preferred Alternative: includes a best practice that is applied by the decision maker to compare alternatives and to select a preferred alternative.

The following figure graphically depicts the process of the 22 best practices grouped into the 5 phases:

GAO Best Practices for the Analysis of Alternatives Process



The first three phases above (Initialize, Identify, Analyze) were utilized in a gated process approach for each AoA. As each project progressed, each participating organization agreed through a computerized workflow approval process (gate) that a phase had been completed, thus enabling the project to proceed to the next phase of work. This provided positive control to the phased approach, ensured in-process participation by all organizations, and real-time schedule progress that helped track progress on the large number of tasks to be analyzed.

A. Schedule

The Conceptual Design Report process began with the issuance of the Description of Work for Life Extension 2 Equipment and Infrastructure Upgrades, Revision 0 on December 31, 2015. Revision 1 was issued on February 29, 2016, and Revision 2 was issued on April 27, 2016. Delivery of the CDR to support the CD-1 deliverable was originally scheduled on May 31, 2016, and was subsequently re-baselined to July 31, 2016 to allow for the later scope additions.

The schedule for delivery of the CDR was grouped into five phases based on GAO 16-22, Appendix I: Best Practices for the Analysis of Alternatives Process. In order to provide control over the phased process that involved 97 tasks, a workflow system was developed to provide tracking control of the first three phases. The 100% CDR submittal, which included the documentation for all 97 tasks, had an independent Design Review that was accomplished by the DOE SPR's formal system, which involves a controlled document distribution, common accessed design comment system, and a Design Review Meeting to resolve comments made during the review period.

The Design Schedule for the CDR was baselined with all other CD-1 Deliverable Activities, and tracked with the following key interim dates:

Activity ID	Activity Name	Start	Finish
09-1005	Phase 1 – CDR Initiation	14 January 2016	06 May 2016
09-2025	Phase 2 – Alternatives Identification	15 February 2016	06 May 2016
09-3030	Phase 3 – Alternatives Analysis	11 March 2016	17 June 2016
09-4015	Phase 4 – 100% CDR Document	14 March 2016	24 June 2016
09-4030	Phase 4 – Independent Design Review	24 June 2016	01 July 2016
09-4035	Bayou Choctaw Design Review Meeting	06 July 2016	06 July 2016
09-4050	West Hackberry Design Review Meeting	07 July 2016	07 July 2016
09-4045	Bryan Mound Design Review Meeting	12 July 2016	12 July 2016
09-4040	Big Hill Design Review Meeting	13 July 2016	13 July 2016
09-5005	Phase 5 – Alternative Selection	30 May 2016	22 July 2016
09-4055	Final CDR Document Submission	15 July 2016	29 July 2016

B. Analysis of Alternatives Team Formation

In order to accomplish a significant number of Analysis of Alternatives across all four operating DOE SPR Sites, VCI established a management organization internally, consisting of an overall LE 2 CDR Lead, and ultimately 5 Project Engineers charged with projects that were grouped mostly by discipline. The Project were appointed a “Core Team Member” from the Department of Energy (DOE), Fluor Federal Petroleum Operations (FFPO), and Vali Cooper International (VCI). Each Project ultimately had three Core Team Members.

These Project Engineers, along with the assistance of the other Core Team Members, assembled diverse teams consisting of all disciplines required from DOE and FFPO, both in New Orleans and from the SPR Sites. The Core Team Members were each responsible for ensuring that the needed expertise was involved and informed about each respective project that was studied.

C. Selection Criteria Establishment

The Project Engineers began the process of defining selection criteria for each project, and soon found that establishing a core set of criteria across all projects would lead to the most consistent evaluation of alternatives. Therefore, a standard set of selection criteria was created as a starting point for all AoA documents. However, the inclusion of a particular criteria, and its relative importance (weight) to a particular AoA was discussed, approved and documented in each individual AoA document.

The below listed criteria was used to evaluate the various alternatives for each of the Life Extension 2 Projects. The alternatives analysis core team members select the appropriate criterion and determine the relative significance for each identified alternative. Not all criterion will be used for each project. The selected criteria are identified in a matrix when evaluating the various alternatives.

Constructability during On-going Oil Deliveries. The selected alternative is able to be implemented with little or no impact to on-going oil delivery operations

Ease of Maintenance. The selected alternative is similar in nature to existing equipment resulting in commonality of similar systems for future maintenance and sparing consideration.

Technically Sound Solution. The selected alternative can be engineered to meet mission goals the project functional requirements.

Ease of Operations. The selected alternative when implemented will result in a system that is able to be operated without significant additional training and is similar to existing systems and equipment.

Sustainability. The selected alternative when implemented will be able to achieve DOE Sustainability goals for energy consumption as outlined in the Strategic Sustainability Performance Plan.

Safety during Construction. The selected alternative when implemented will be able to be constructed safely and operated safely.

Security during Construction. The selected alternative when implemented will be able to be constructed with minimal to zero impacts to Site Security detection systems

D. Analysis of Alternative Process Plan

The establishment of a consistent process plan was crucial to ensuring as much objectivity in the process of selecting a preferred alternative on the large number of analysis of alternatives being conducted. The mission needs and functional requirements were established first by each AoA team, along with the selection criteria and weighting. However, the methodology for performing in-process reviews, independent review, and selection of the preferred alternative were standardized for all teams.

AoA Teams conducted initial screenings of all identified alternatives and documented their findings in each AoA document during weekly meeting(s). Any alternative(s) that did not meet a mission need or functional requirement was screened off and the reason(s) documented. Alternatives that may meet mission needs and/or functional requirements, but were determined by the team as non-viable, had those reasons documented as well. The non-viability of an alternative that may meet mission needs and/or functional requirements was typically based on its weaknesses based on the defined selection criteria. Once this process was completed, the AoA Core Team members approved the in-process document in workflow as having passed through Gate 2.

The alternatives selected for further development at the conclusion of Phase 2 were researched and analyzed in Phase 3 such that the information gathered provided the ability to evaluate each alternative against the selection criteria and compare alternatives' merits. The development of each alternative included but was not limited to the following:

- Significant Risk Identification and Mitigation
- Identification of Benefits and Effectiveness on meeting requirements
- Development of Life-Cycle Cost Estimates

Once the Alternative Analysis in Phase 3 was completed, it was formally documented in a 100% Draft CDR that was disseminated for a formal team review. Once this formal team Review was completed, the consolidated document was the basis for the Alternative Selection.

The Selection of the Preferred Alternative in Phase 5 will be conducted by an initial evaluation, consolidation of those evaluation results, comparison of the alternatives technical and cost evaluations, selection of a preferred alternative, presentation to the AoA Team for approval, and documentation of the consensus decision. The following process details how the selections will be made, by whom, and the time frame for accomplishment.

- a. The AOA Core Team will be provided the AoA document that has completed Phase 3 as the basis for their evaluation. These individuals will also be given an evaluation sheet for each alternative for the project.
- b. The AOA Core Team Members will have 2 work days to conduct their evaluation and return to the VCI Team Leader for consolidation of results. The AOA Core Team Members are encouraged to solicit information and opinion from their groups so that their evaluation is representative of the AoA Team Members from their organization. However, the AOA Core Team Members are responsible for delivering the completed evaluation to the VCI Team Leader by the deadline.
- c. The VCI Estimating Team will be responsible for ranking and briefly comparing the Life Cycle Cost and Total Estimated Cost for the alternatives studied.
- d. The VCI Team Leader will consolidate the results of the alternative evaluations and the cost comparisons and identify the proposed preferred alternative after receipt of all evaluations. This comparison of alternatives and selection of the preferred alternatives will be documented and presented in the AoA.

Alternative Analysis Evaluation – Non-Cost Criteria

- a. The non-cost selection criteria defined in AoA Step 5 shall be weighted in three categories such that they are grouped in Most Important, Important and Less Important Categories.
 1. **"Most Important"** describes selection criteria that are most critical to mission success.

2. **“Important”** describes selection criteria that are still critical to mission success, but less so than those deemed most important.
 3. **“Less Important”** describes selection criteria that are still important to mission success, but less so than those deemed important.
- b. Each Alternative shall be evaluated on each non-cost criteria, and shall be rated by each AoA Core Team member to be “Excellent”, “Good”, “Adequate” or “Marginal” with respect to each criteria. An alternative found to be “Marginal” for any “Most Important” or “Important” selection criteria likely should have been found to be non-viable and screened off in the Phase 2 process.
1. **“Excellent”** describes an alternative which will provide the highest overall performance and/or efficiency in addressing the selection criteria. Numerous advantages or strengths are identified in the alternative with essentially no disadvantages or weaknesses identified. The alternative is considered to provide very low risk to attainment of the selection criteria goals.
 2. **“Good”** describes an alternative which will meet or exceed the stated criteria, with some advantages and strengths identified, with few relatively minor disadvantages identified. The alternative is considered to provide low risk to attainment of the selection criteria goals.
 3. **“Adequate”** describes an alternative which substantively meets the stated criteria, with both advantages and disadvantages identified, where the advantages are not outweighed by the disadvantages. The alternative is considered to provide moderate risk to attainment of the selection criteria goals.
 4. **“Marginal”** describes an alternative which may not meet the stated criteria. The alternative has significant disadvantages that outweigh any identified advantages. The alternative poses a high level of risk to attainment of the selection criteria goals.

Alternative Analysis Evaluation – Cost Criteria

Two factors will be utilized in evaluating the cost of a project alternative: Life Cycle Cost, and Total Estimated Cost.

- a. Life Cycle Cost (LCC) – A life cycle cost analysis will be performed on each alternative during the Alternative Analysis in Phase 3. This Life Cycle Cost for each alternative will be discounted to a Net Present Value (NPV) to compare alternatives. The alternatives will be ranked in order from their lowest NPV to the highest NPV.
- b. Total Estimated Cost (TEC) – All engineering design costs (after conceptual design), facility construction costs and other costs specifically related to those construction efforts. TEC will include, but is not limited to: project, design and construction management; contract modifications (to include equitable adjustments) resulting in changes to these costs; design; construction; contingency; contractor support directly related to design and construction; and equipment rental and refurbishment.

Alternative Analysis Evaluation – Consolidated Decision

The VCI Team Leader will be responsible for consolidating the evaluations of the selection criteria, both non-cost and cost, into a table that shows the ratings and rankings for all alternatives. In consultation with the VCI Project Engineer, a recommendation will be drafted identifying the proposed preferred alternative. This should address any trade-offs that occurred in the decision making, along with other key factors that were identified in the evaluations and discussions. This recommendation will be discussed with the AoA Team if necessary for concurrence and/or discussion. If there is discussion and/or changes required to consolidated results and proposed preferred alternative, the AoA Team must accomplish and document those changes. If there is still disagreement about the selected alternative, the VCI Team Leader shall make the final decision on the recommended preferred alternative.

Once a decision has been reached on the recommended preferred alternative, the results will be incorporated into the CDR prior to final submission.

V. Cost Estimating Notes

Cost Estimates that supported the decision making process to identify the recommended preferred alternative were performed approximately 140 alternatives and the summary backup documentation is included in Volume VI – Cost Appendix. Several assumptions were made in the performance of these cost estimates as follows:

- All estimates assume the work proposed is to be performed on DOE sites or within an established DOE right of way. All costs related to land acquisition, permits, environmental impact studies, and any other administrative cost or schedule impact are assumed to be included in the estimate contingency costs.
- The construction estimates (TEC) are based on material being ready at the start of installation. The estimated durations for construction do not include time for procurement/fabrication of long lead items. The durations are for installation only.
- All construction estimates (TEC) were prepared and supported using industry wide accepted estimating techniques. These techniques include historical rough order of magnitude pricing, expert opinion rough order of magnitude pricing, parametric estimating using Aspen Tech Capital Cost Estimating program, Richardsons and R. S. Means pricing manuals, and vendor quotations.
- All construction estimates (TEC) are based on the same construction start date so as to ensure an objective comparison of costs for the purposes of the alternative analysis.
- All Life Cycle Cost (LCC) estimates are based on the same start date of the life cycle so as to ensure an objective comparison of costs for the purposes of the alternative analysis.
- An agreed preliminary percentage of changes and claims, design, construction management and program management was applied to each alternative's construction cost. Therefore, the Total Estimated Costs (TEC) shown in the Conceptual Design Report will be different than those shown in the CD-1 Document once those costs are estimated by others.

VI. Preliminary Hazard Reviews

Each recommended preferred alternative had a Preliminary Hazard Review conducted and included in this CDR. This initial review identified potential hazards associated with general construction efforts that may arise during the construction phase of the project. The review is designed to start the process of hazard identification at the earliest onset of the project, and is intended to be continued throughout the design and construction process. Contractors will be required to submit for approval a thorough Accident Prevention Program before beginning work on any of the identified tasks in Life Extension 2.

