Risk Management
WBS 2.1 – Site and Buildings

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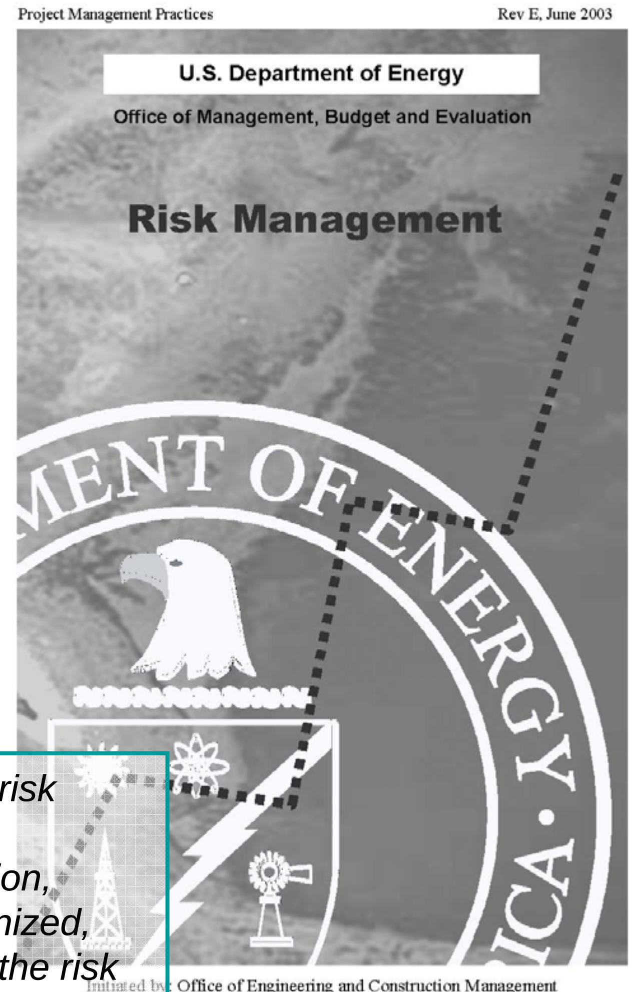
Agenda

- Methodology
- Identified Risks
- Risk Status
- What's Next

Methodology

- Done in compliance with:
  - DOE's Risk Management principals.
  - NOvA Project Guidelines



The Federal risk management concept is based on the principle that risk management must be forward-looking, structured, informative, and continuous. The key to successful risk management is early recognition, planning, and aggressive execution. Good planning ensures an organized, comprehensive, and iterative approach for identifying and assessing the risk and handling options necessary to refine a project's acquisition strategy. To support these efforts, assessments should be performed as early as possible in the life cycle to ensure that critical technical, schedule, and cost risks are addressed with mitigating actions incorporated into planning and budget projections.

Methodology

***Risk** is a measure of the potential inability to achieve overall project objectives within defined cost, schedule, and technical constraints. It has two components: (1) the probability/likelihood of failing to achieve a particular outcome, and (2) the consequences/impacts of failing to achieve that outcome.*

PDs/PMs should follow the guidelines below to ensure that a risk management program possesses the above characteristics.

- Assess project risks, using a structured process, and develop strategies to manage these risks throughout each acquisition phase.
- Identify early and intensively manage those design parameters that critically affect cost, capability, or readiness.
- Use technology demonstrations/modeling/simulation and aggressive prototyping to reduce risks.
- Use test and evaluation as a means of quantifying the results of the risk-handling process.
- Include industry and user participation in risk management.
- Use research and development, testing, and evaluation, as well as early operational assessments when appropriate.
- Establish a series of "risk assessment reviews" to evaluate the effectiveness of risk handling against clearly defined success criteria.
- Establish the means and format to communicate risk information and to train participants in risk management.
- Prepare an assessment training package for project personnel and others, as needed.
- Acquire approval of accepted risks at the appropriate decision level.

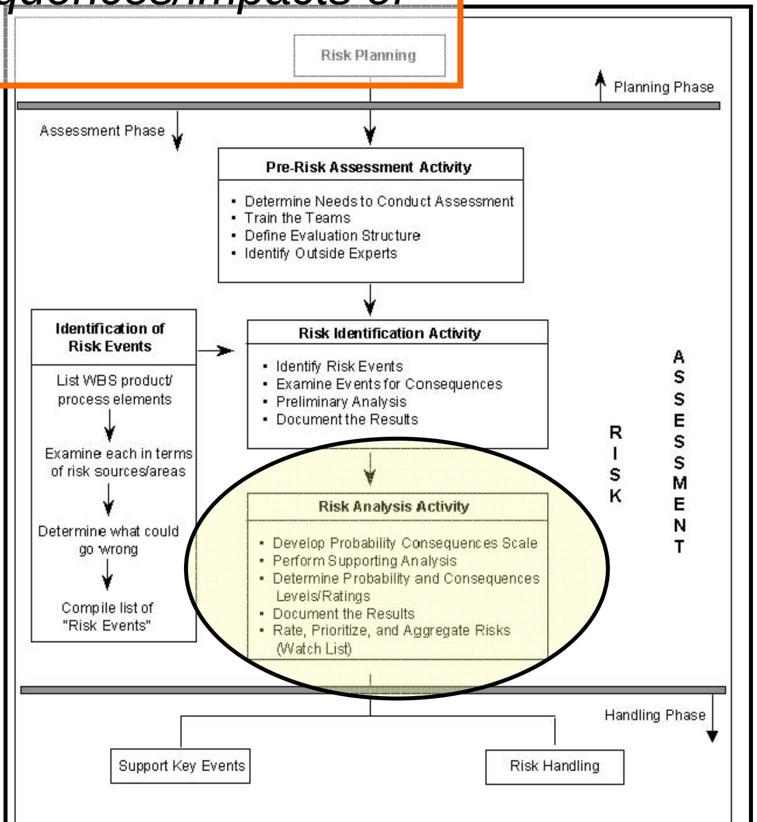


Figure 4. Risk Assessment

Risk Areas

Risk Area	Significant Risks
Design	• Design implications not sufficiently considered in concept exploration. • System will not satisfy user requirements. • Mismatch of user manpower or skill profiles with system design solution or human-machine interface problems. • Increased skills or more training requirements identified late in the acquisition. • Design not cost effective. • Design relies on immature technologies or "exotic" materials to achieve performance objectives. • Software design, coding, and testing.
Construction/ Production/ Facilities	• Construction/production implications not considered during concept exploration. • Construction/production not sufficiently considered during design. • Inadequate planning for long lead items and vendor support. • Construction/production processes not proven. • Contractors do not have adequate plans for managing subcontractors. • Sufficient facilities not readily available for cost-effective production. • Contract offers no incentive to modernize facilities or reduce cost.
Schedule	• Funding profile not stable from budget cycle to budget cycle. • Schedule not considered in trade-off studies. • Schedule does not reflect realistic acquisition planning. • PB schedule objectives not realistic and attainable. • Resources not available to meet schedule.

Excepts from PMP Risk Management, pages 42-32

Qualitative Analysis

Impact Risk Area	Low	Moderate	High
Cost	≤ $100K	≤$250K	>$500K
Schedule	Delays major milestone or Project critical path by < 1 month	Delays major milestone or Project critical path by <4 months	Delays major milestone or Project critical path by >4 months
Technical	Negligible, if any, degradation.	Significant technical degradation.	Technical performance effectively useless for attaining physics objectives.

	Impact		
Probability	**Low**	**Moderate**	**High**
High (p > 75%)	Low	Moderate	High
Moderate (25% < p < 75%)	Low	Moderate	High
Low (p < 25%)	Low	Low	Moderate

Identified Risks – High/Moderate

• Site Topography	NOVA-doc-1457
• Construction Cost	NOVA-doc-1461
• Wetlands	NOVA-doc-1459
• Subsurface Conditions	NOVA-doc-1458
• Spill Containment	NOVA-doc-1460
• Barite Supply	NOVA-doc-1485
• Sump Failure	NOVA-doc-1488
• WBS Interface Issues	NOVA-doc-1500
• Significant Injury	NOVA-doc-1502
• Environmental Assessment Worksheet	NOVA-doc-1510
• Environmental Conditions	NOVA-doc-1827
• Mechanical Systems Functions	NOVA-doc-1829
• Adhesive Ventilation Requirements	NOVA-doc-1828

Low Impact Risks – NOVA-doc-1491

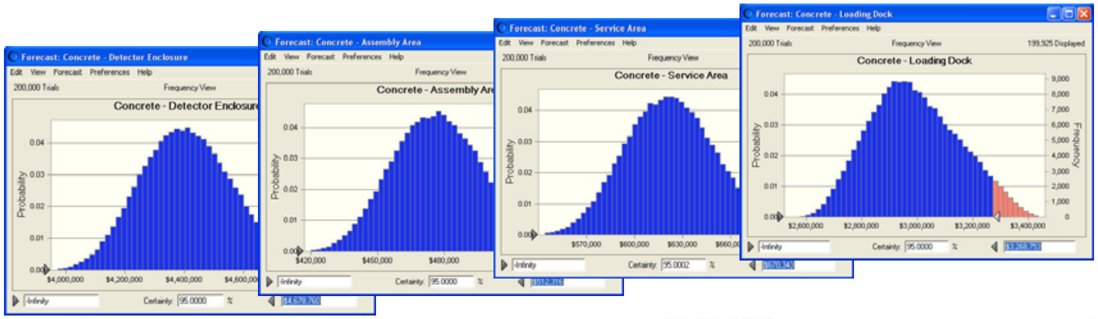
- **Forest Fire**
- **Blasting**
- **Site Access**
- **Fire Protection Water**
- **Electrical Outage**
- **Work Stoppages**
- **Permitting Delays**
- **Power Poles**
- **Concrete Source**
- **Excavation Water**
- **Complex Design**
- **Multiple Projects**
- **Loss of Key Personnel**
- **Excess Contingency**

Quantitative Analysis

- **Estimating** using **Risk Analysis**
  - ERA Method
    - Mak, S and Picken, D. 2000. **Using Risk Analysis to Determine Construction Project Contingencies**. *Journal of Construction Engineering and Management* March/April 2000:130-136.
    - Picken, D and Mak, S. 2001. **Risk Analysis in Cost Planning and its Effect on Efficiency in Capital Cost Budgeting**. *Logistics Information Management* 14(5/6):318-327.
    - Karlsen, J and Lereim, J. 2005. **Management of Project Contingency and Allowance**. *Cost Engineering* Sep 2005:24-29.
  - Risk Management and Contingency Analysis Methods for the NOvA Experiment
    - Concrete
    - Structural Steel

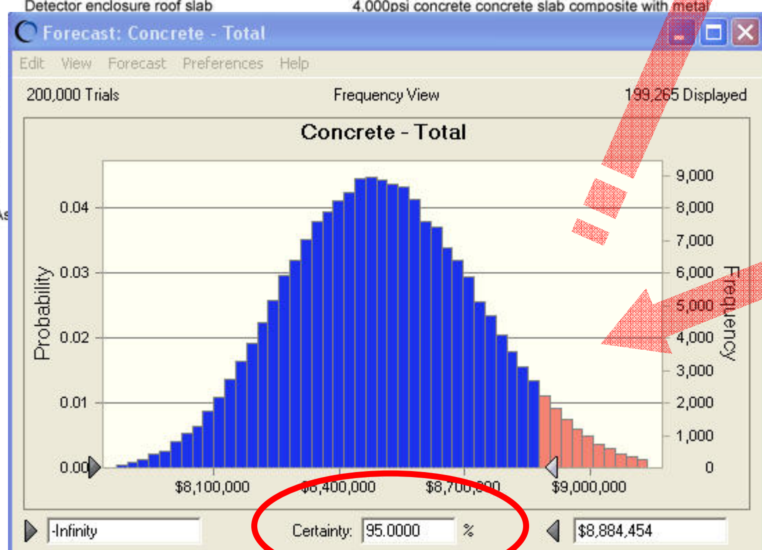
Based on CD-1 Design

Risk Analysis - Concrete



Concrete Minimum and Maximum Analysis	Minimum	Maximum
Concrete Demand	0.90	1.20
Steel Pricing	0.81	1.21
Diesel Fuel	0.80	1.40
Normal Factor	**0.84**	**1.27**
Concrete Overbreak	1.00	1.50
Overbreak Factor	**0.88**	**1.33**

WBS	Activity	WBS Dictionary	Cost					Basis
2.1.2.1.3	Concrete		$8,121,630					
2.1.2.1.3.1	Detector enclosure		$4,185,060					
2.1.2.1.3.1.1	Detector enclosure base slab	4,000psi concrete poured against rock base - including leveling, wall dowels and col. anchorbolts	$855,360.0	**$972,000**	$1,292,760		Overbreak factor	68'x535'x2'thk.=2700cy*$250=$675,000*20%OHP=$810,000 **Increase to $300/yd. = $972,000 per peer review**
2.1.2.1.3.1.2	Detector enclosure lower level walls against rock	4,000psi concrete walls poured against shear rock face - includes drainage mat	$792,000.0	**$900,000**	$1,197,000		Overbreak factor	1'thkx40'x1000'=1500cy*$500=$750,000*20%OHP=$900,000
2.1.2.1.3.1.3	Detector enclosure retaining wall base	4,000psi concrete poured against rock base - including leveling, rock dowels and wall dowels	$285,120.0	**$324,000**	$430,920		Overbreak factor	2'thkx12'x1000'=900cy*$300=$270,000*20%OHP=$324,000
2.1.2.1.3.1.4	Detector enclosure upper level retaining walls	4,000psi concrete retaining wall - formed both sides - includes beam pockets and embedded plates	$443,520.0	**$528,000**	$670,560			1.5'thkx20'x1000'=1,100cy*$450=$495,000*20%OHP=$594,000 **Decrease to $400/yd. = $528,000 per peer review**
2.1.2.1.3.1.5	Detector enclosure retaining wall counterforts	4,000psi concrete retaining wall support counterforts - formed both sides - stepped construction	$170,100.0	**$202,500**	$257,175			1.5'thkx20'x8'avg.=375cy*$450=$168,750*20%OHP=$202,500
2.1.2.1.3.1.6	Detector enclosure roof slab	4,000psi concrete concrete slab composite with metal	$635,040.0	**$756,000**	$960,120			1.5'thk.x68'x535'=2,100cy*$300=$630,000*20%=$756,000
2.1.2.1.3.1.7				**$502,560**				
2.1.2.1.3.1.7.1				$30,240.0	**$36,000**	$45,720		1.5'thkx450sf=100cy*$450=$45,000*20%OHP=$54,000 **Decrease to $300/yd. = $36,000 per peer review**
2.1.2.1.3.1.7.2				$222,264.0	**$264,600**	$336,042		1'thkx53'x62'x4ea=490cy*$450=$220,500*20%OHP=$264,600
2.1.2.1.3.1.7.3				$6,350.4	**$7,560**	$9,601		1'thkx275sf=14cy*$450=$6,300*20%OHP=$7,560
2.1.2.1.3.1.7.4				$163,296.0	**$194,400**	$246,888		90cyx4ea=360cy*450=$162,000*20%OHP=$194,400
2.1.2.1.3.2	As		$452,200					
2.1.2.1.3.2.1			$95,040.0	**$108,000**	$143,640		Overbreak factor	72'x56'x2'thk.=300cy*$250=$75,000*20%OHP=$90,000 **Increase to $300/yd. = $108,000 per peer review**
2.1.2.1.3.2.2			$110,880.0	**$126,000**	$167,580		Overbreak factor	1'thkx28'x200'=210cy*$500=$105,000*20%OHP=$126,000
2.1.2.1.3.2.3			$17,776.0	**$20,200**	$26,866		Overbreak factor	72'x7'x1.5'thk*2ea..=56cy*$300=$16,800*20%OHP=$20,200
2.1.2.1.3.2.4			$108,864.0	**$129,600**	$164,592			72'x30'x1.5'thk82ea.=240cy*$450=$108,000*20%OHP=$129,600
2.1.2.1.3.2.5			$57,456.0	**$68,400**	$86,868			5,100sf*1'thk.=190cy*$300=$57,000*20%OHP=$68,400

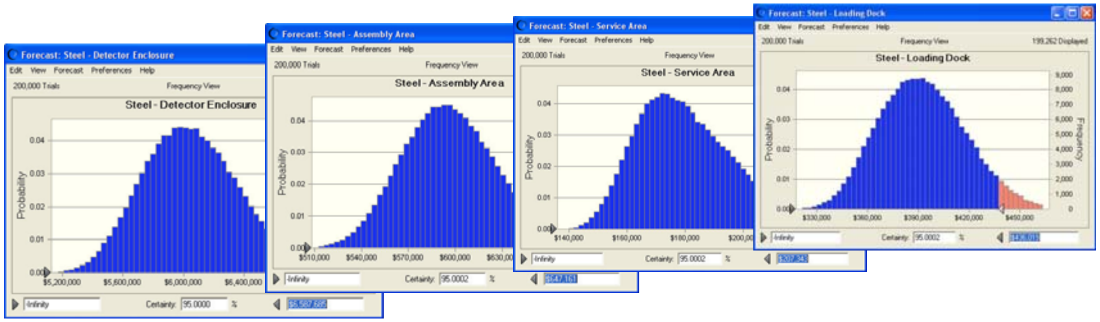


Contingency - Concrete

Concrete Contingency Determination - ERA Method

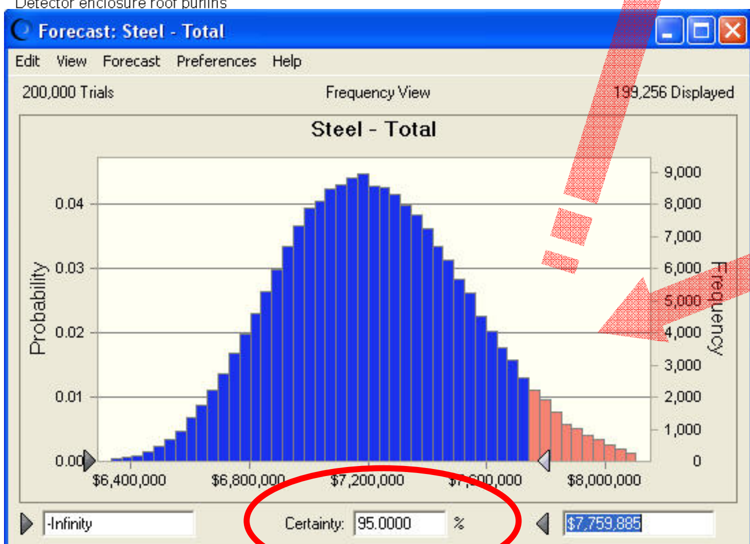
Risk Area	Expected Allowance	2-sigma (95%) Confidence	Spread ($1,000)	Spread Squared
Detector Enclosure	$4,185,060	$4,678,760	$494	$243,739.69
Assembly Area	$452,200	$512,316	$60	$3,613.93
Loading Dock	$2,883,650	$3,268,753	$385	$148,304.32
Service Area	$600,720	$670,343	$70	$4,847.36
	$8,121,630			$400,505.31
			Sq. Root	$632.85
		Maximum likely addition =		$632,855
Base Contingency =	12%			
Risk Allowance =	7.8%			
Total Contingency	**20%**	← Same as estimate		

Risk Analysis - Steel



Steel Minimum and Maximum Analysis	Minimum	Maximum
Steel Pricing	0.81	1.21
Diesel Fuel	0.80	1.40
Normal Factor	0.81	1.31
Escalation	---	1.18
Escalated Factor	**0.81**	**1.49**

WBS	Activity	WBS Dictionary		Cost			Basis
2.1.2.1.4.1	Structural Steel		$6,570,918				
2.1.2.1.4.1.1	Detector enclosure		$5,508,990				
2.1.2.1.4.1.1.1	Detector enclosure columns	Grade 50 steel columns w/base plates, beam and bracing conn's - includes cost of leveling and grouting		$481,140	**$594,000**	$885,060	74-W12x65x62'=150ton*10%*$3000=$495,000*20%OHP=$594,000
2.1.2.1.4.1.1.2	Detector enclosure column support beams	Grade 50 structural steel beams including connections		$449,064	**$554,400**	$826,056	9200'-W12x26=120ton*10%*$3500=$462,000*20%OHP=$554,400
2.1.2.1.4.1.1.3	Detector enclosure roof trusses	Grade 50 structural steel shop fabricated roof trusses - includes connections and crane installation		$1,207,224	**$1,490,400**	$2,220,696	37-6.5ton/truss=240ton*15%*$4500=$1,242,000*20%OHP=$1,490,400
2.1.2.1.4.1.1.4	Detector enclosure roof struts	Grade 50 structural steel struts connecting top of column to exterior wall		$44,906	**$55,440**	$82,606	74-W14x61x5'=12ton*10%*$3500=$46,200*20%OHP=$55,440
2.1.4.1.4.1.1.5	Detector enclosure roof purlins			$299,376	**$369,600**	$550,704	216-W14x61x12'=80ton*10%*$3500=$308,000*20%OHP=$369,600
2.1.4.1.4.1.1.5				$216,513	**$267,300**	$398,277	3700'x24#=45ton*10%*$4500=$222,750*20%OHP=$267,300
2.1.4.1.4.1.1.6				$204,120	**$252,000**	$375,480	30,000sf*$7/sf=$210,000*20%OHP=$252,000
2.1.4.1.4.1.1.7				$160,745	**$198,450**	$295,691	900'x100#/ft=45ton*5%*$3500=$165,375*20%OHP=$198,450
2.1.4.1.4.1.1.8				$96,228	**$118,800**	$177,012	360 risers*10%*$250per tread=$99,000*20%OHP=$118,800
2.1.4.1.4.1.1.9				$989,010	**$1,221,000**	$1,819,290	6'wide-440'long-7ea-2 sides*10%*$25=$1,070,500*20%OHP=$1,221,000
2.1.4.1.4.1.1.10				$218,700	**$313,200**	$466,668	22500sf*$10/sf=$225,000*20%OHP=$270,000 **Increase to $11.60/sf = $313,200 per peer review**
2.1.4.1.4.1.1.11				$60,264	**$74,400**	$110,856	6200lf*$10/lf=$62,000*20%OHP=$74,400



Contingency - Steel

Steel Contingency Determination - ERA Method				
Risk Area	Expected Allowance	2-sigma (95%) Confidence	Spread ($1,000)	Spread Squared
Detector Enclosure	$5,508,990	$6,587,685	$1,079	$1,163,582.90
Assembly Area	$542,028	$647,161	$105	$11,052.95
Loading Dock	$356,700	$436,019	$79	$6,291.50
Service Area	$163,200	$207,343	$44	$1,948.60
	$6,570,918			$1,182,875.96
			Sq. Root	$1,087.60
		Maximum likely addition =		$1,087,601
Base Contingency =	13%			
Risk Allowance =	16.6%			
Total Contingency	**30%**			

Estimate -20% & 30%

What’s next

- Track/Mitigate Identified Risk
- Quantitative Analysis of cost drivers based on latest estimates
- Iterate