CAPE
Independent Cost Assessment (ICA)
B61 LEP

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Bottom Line Up Front

OSD CAPE

All costs in TY$	WDCR	CAPE ICA
FPU date	FY19	FY22
Production schedule	FY20-25	FY23-28
To-Go program costs		
6.3 through FPU cost	$4.1B	$6.6B
Production cost	$2.4B	$3.5B
Total To-Go cost	**$6.5B**	**$10.1B**
Budget required above FY13 level in FY13-18	$1B	$1B

Additional estimate details

1. Bottoms-up estimate built by site contractor teams assuming an FY19 FPU date
2. Does not include management reserve
3. Includes $233M of "KCP Efficiencies"

1. ICA increases upfront system engineering and slows component design
2. ICA rephases FTE staffing for 2022 FPU date
3. ICA escalation labor costs at 4%
4. ICA funds a more robust Govt program office

Estimating Challenges/Issues

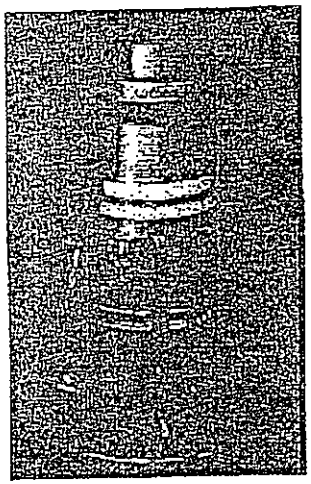
- Data issues
  - Minimal historical LEP/Alt information (costs, staffing, & schedule)
  - Initial B61 IMS and critical path just completed in late June
  - Detailed risk burn-down plan unclear
  - Site staffing plans do not identify source of staffing (i.e., new hire, transfer-in, existing), so executability of staffing ramp-up is unknown
  - No formal Forward Price Rate Agreements to support labor cost estimate

- No documented detailed technical & programmatic definition of the program, e.g., a Cost Analysis Requirements Document (CARD)
  - Data from many different sources late in process (PM/site briefs, emails, handouts, discussions); need to validate internal consistency of data

- Not a full life cycle ICE
  - Estimates are limited to development & production costs, no estimate of sustainment/surveillance costs
  - Equivalent to an Independent Cost Assessment (ICA)

- Difficult to assess relative technical and programmatic complexity of B61 compared to prior LEPs
  - Sandia claims effort is 3 to 4 times the effort of W-76 LEP

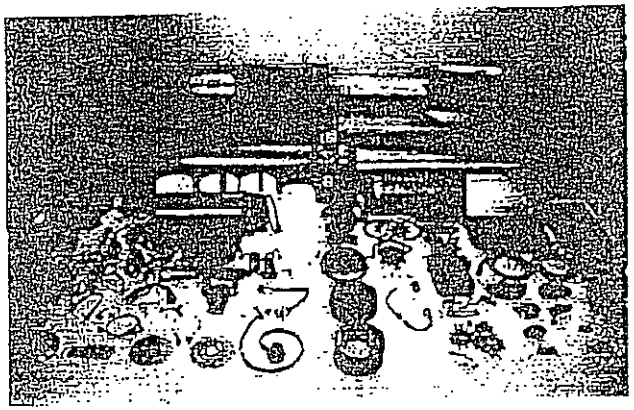
W76 and B61 Scope Comparison



18 major components

1. AF&F
2. AFS
3. Fireset
4. Poco Sprytron
5. Over voltage gap
6. Gel mylar capacitor
7. Terminal protection device
8. Intent Stronglink
9. Trajectory Stronglink
10. Launch accel
11. Thermal battery assembly
12. Igniter
13. Valve
14. Igniter
15. Preset cable
16. LAC
17. Thermal battery
18. Purge valve

- W76 scope
  - Full NEP & AF&F upgrade
  - 1 platform integration



29 major components

	TRL
1 Percussion battery assembly	
2 FusIII	4
3 Main battery assembly	
4 Pulse battery assembly	
5 Center bomb assembly	
6 Coded switch	4
7 Critical function control switch	5
8 Electronics assembly controller	
9 Firing set - CDU	4
10 Foams, pads, & O-rings	
11 Gas transfer system	5
12 Impact sensor	5
13 Junction box	4
14 Eletronic neutron generator	5
15 Nose bomb subassembly	
16 Preflight bomb subassembly	
17 Preflight controller	4
18 Primary	4+
19 Pullout switch assembly	
20 Radar system	4
21 Rolamite	
22 Secondary	5
23 Spin rocket motor	
24 Stronglink CDU - ISL	4
25 Stronglink CDU - TSL	3
26 Component suite	
27 System cables + LACS	
28 Weapon control unit	2
29 System 1/2 adapter	

- B61 scope
  - Full NEP & AF&F upgrade, replace most non-nuclear components
  - 5 platform integrations, requiring much more system integration, qualification, & certification activities

B-61 ICA Development Cost Estimate Methodology

- Cost Estimate = Schedule × FTEs/yr × annual Labor $/FTE + Material $

- Schedule evaluation
  - Comparison to historical programs
  - Assessment of program plan
  - Modeling of program schedule

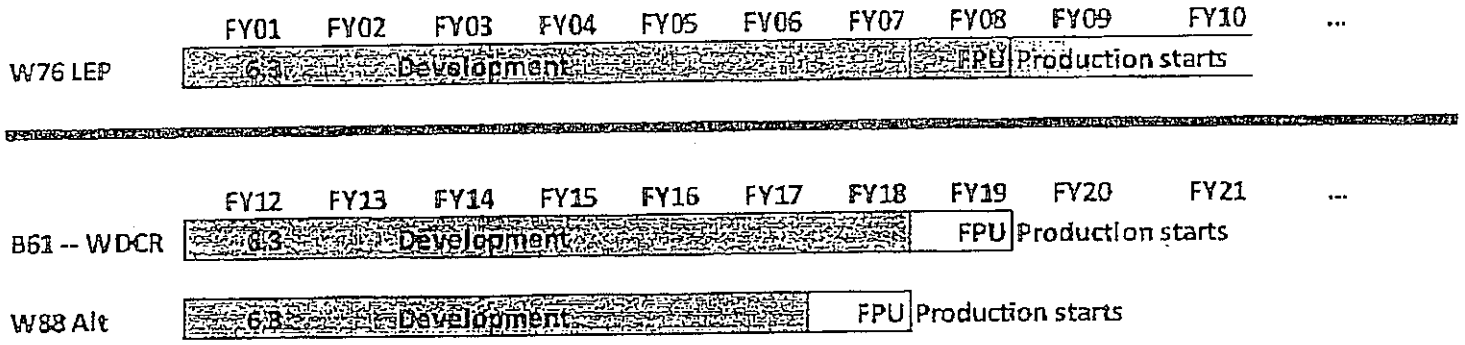
- Labor costs
  - Assessment/adjustment of staffing plans and labor rate

- Material
  - % of labor costs by phase

- Many embedded assumptions due to sparse data
  - Material costs as function of labor costs
  - Labor rate cost growth
  - Executability of staffing plans
  - Production schedule, production staffing levels, & fixed costs

W76 & B61 Schedule Comparison

OSD CAPE



- W76
  - 7 day work weeks (via OT) for 4 years on critical components
  - 2002 Planning Estimate projected 2007 FPU; actual FPU in 2008
  - 18+ months of development required post-FPU to correct issues due to low tech maturity/concurrency
- B61 – WDCR
  - 5 day work weeks
  - Constrained by FY19 due date
  - Initial IMS & critical path just finished
  - Sandia estimates B61 is 3X-4X more complex than W76, but WDCR projects a shorter development schedule with more concurrency
  - Concurrent with W88 Alt (new AF&F) ~ ½ the scope of B61

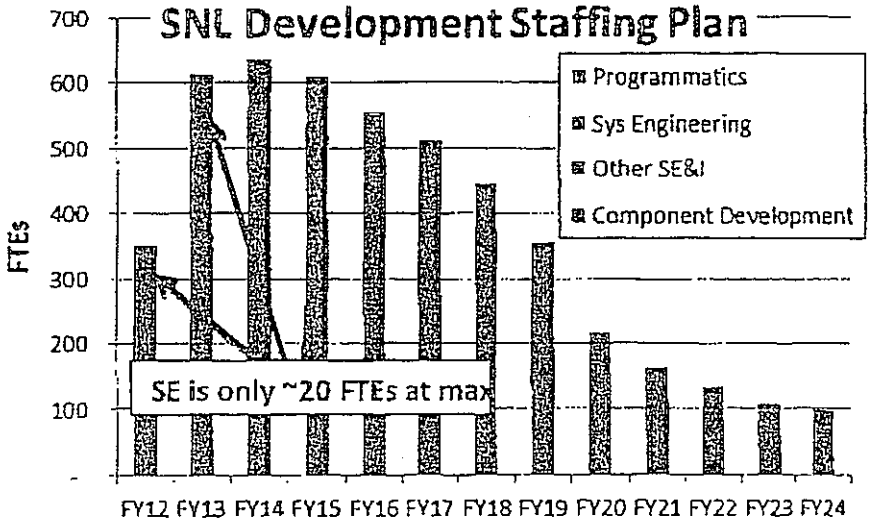
Top-Level Comparison to W76 LEP actual schedule indicates B-61 LEP execution assumptions are very aggressive to meet 2019

Sandia B61 Systems Engineering

OSD CAPE

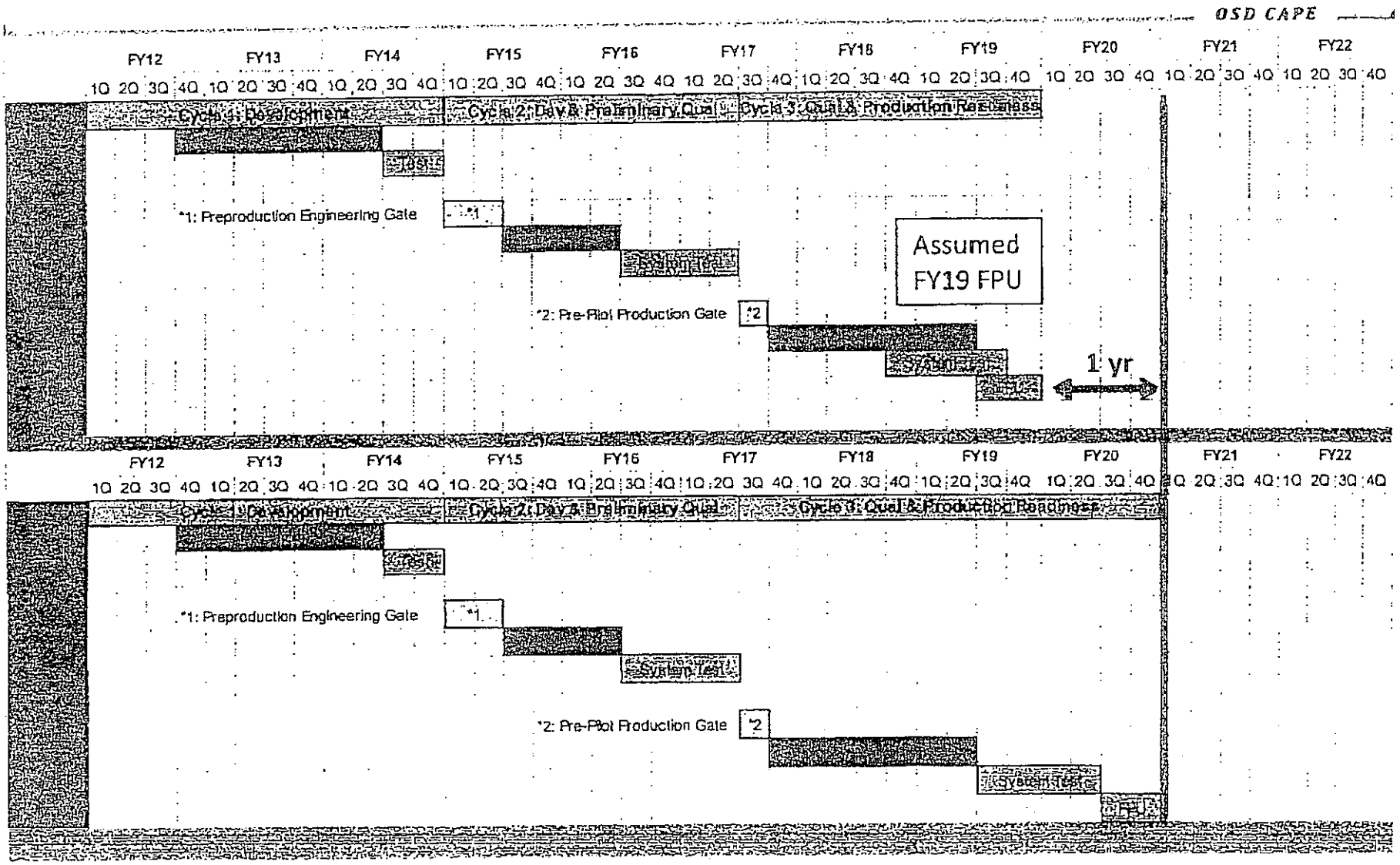
		FY12	FY13	FY14	FY15
	TOTALS	349.94	612.97	635.49	609.12
01.01	System Engineering	16.94	21.30	21.10	20.07
01.02	System Production and Integration	13.14	26.00	28.41	21.80
01.03	System Design Support	45.89	72.99	77.95	71.61
01.04	Surveillance	2.09	2.61	3.70	5.50
01.05	Technical Basis	17.36	45.81	57.61	51.76
01.06	Laboratory Operations	6.28	19.25	20.75	18.50
01.07	Joint Test Assembly	15.04	42.25	36.02	28.18
01.08	Production Assembly Activities	0.00	0.60	0.60	0.90
01.09	System HW Cost	0.09	0.27	0.17	0.09
02	Bomb Components Development	5.06	18.85	18.85	20.10
02.02	Center Case	5.38	18.10	18.10	20.10
02.03	Coded Switch	20.12	25.91	24.40	22.21
02.04	Critical Function Switch	9.09	8.96	10.68	9.26
02.08	Firing Set – CDU	22.89	31.76	33.18	29.85
02.10	Foam, Pads & Rings	1.43	2.75	3.40	3.40
02.12	Impact Sensor	1.60	2.94	2.93	2.99
02.13	Junction Box	0.90	2.21	2.37	2.66
02.14	Neutron Generator	1.21	7.10	12.60	12.25
02.15	Nose	6.35	6.38	6.73	5.98
02.16	Preflight Bomb Subassembly	4.22	8.70	8.00	8.45
02.17	Preflight Controller	9.57	8.31	8.00	8.92
02.19	Pullout Switch Assy	1.16	1.21	1.29	1.05
02.20	Radar System	20.36	53.15	53.97	54.76
02.22	Rolamite	2.47	1.46	1.19	1.09
02.24	Spin Rocket Motor	2.88	5.19	6.21	5.76
02.25	Stronglink CDU – ISL	9.62	17.21	15.81	15.50
02.26	Stronglink CDU – TSL	15.94	15.68	16.60	17.06
02.30	System Cables & LAC	9.89	17.16	17.17	15.79
02.31	Tail Kit Assembly	0.00	2.20	2.20	2.20
02.33	Weapon Control Unit	13.91	26.00	25.37	25.58
02.35	Fuzing	14.99	15.76	13.62	11.98
02.36	Main Battery Assembly	2.26	5.23	4.81	6.64
02.37	Percussion Battery Assembly	2.01	4.11	3.93	5.25
02.38	Pulse Battery Assembly	1.64	3.38	3.63	4.58
02.39	System 1-2 Adapters	1.15	1.93	2.12	3.11
02.41	Subsystem A	18.06	38.11	37.38	40.31
03	Programmatic Integration	34.02	51.00	52.50	54.00
03.01	Project Controls	14.61	15.20	15.20	15.20
03.02	Risk Management	3.34	4.25	4.25	4.25
03.03	B61 LEP Project Management	8.50	17.05	17.05	17.05
03.04	Information & Communication	7.46	14.50	16.00	17.50
03.05	Special Studies	0.10			
03.06	Capital Equipment	0.00			

Sandia component design staffing plan (02) appears to lead System Engineering (01) effort & requirements flow-down SE staffing (01.01)



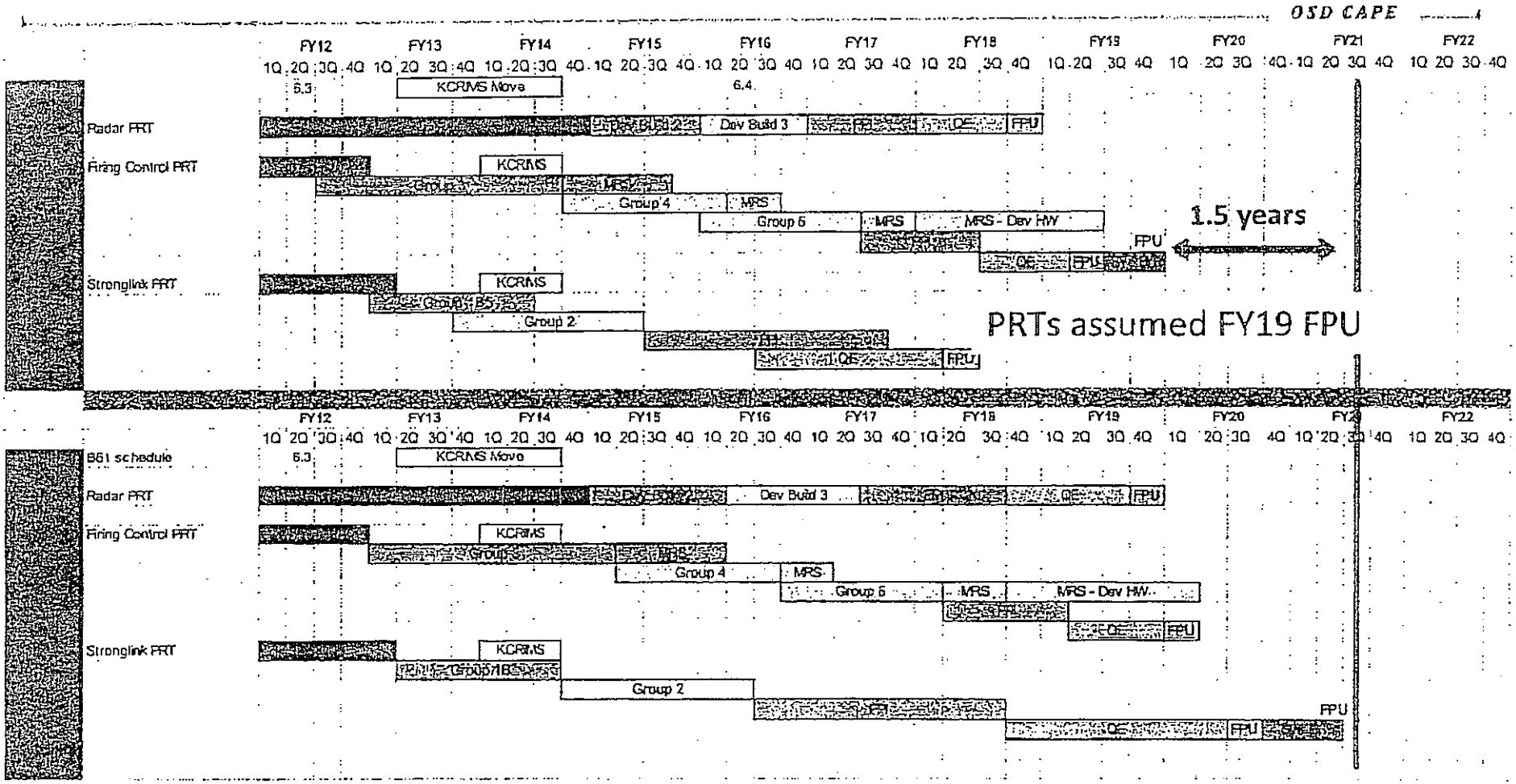
SE(01.01) effort is unusually low for a program of this size

WDCR Plan: 3 Major Dev Cycles



At least one year slip due to reducing the concurrency in Cycle 3

PRT Concurrency in Cycle 1 & 2



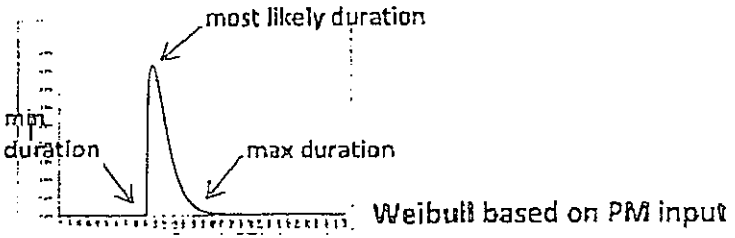
Reducing PRT concurrency in Cycle 1 & 2 results in additional 1.5 year slip

Assessment of B61 program plan shows 2.5 year slip without additional margin for integration & test scope

Modeling FPU Completion Date

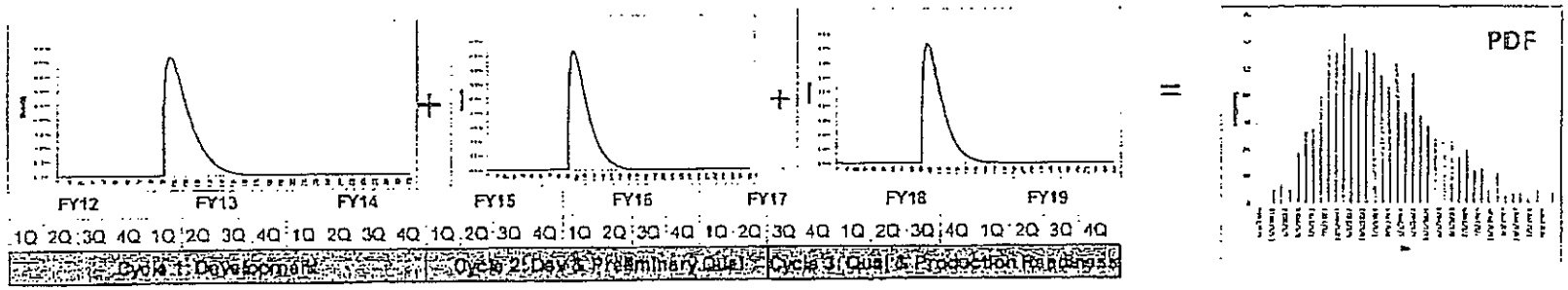
Step 1: Use PM input to fit a Weibull distribution

- Start with PM estimates of PRT min/most likely/max costs
- Convert to schedule duration (Time = $), e.g., max duration = 125% of PM duration if max cost = 125% of PM most likely costs
- Fit a Weibull distribution using derived min/most likely/max durations



Step 2: Model B61 3-cycle development with Weibulls

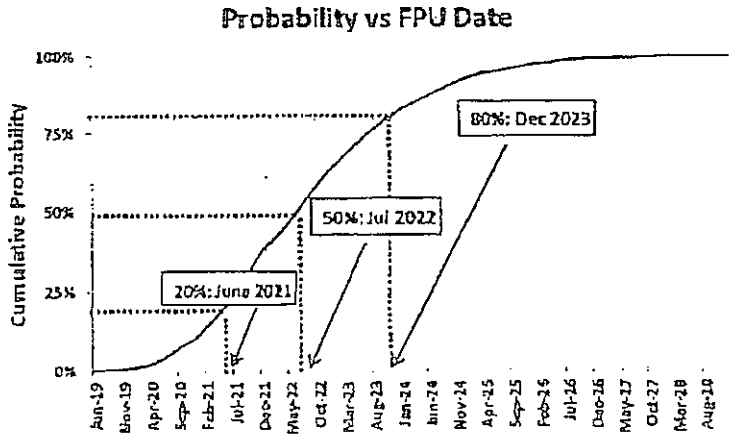
- Use fitted Weibull from Step 1 for each development cycle, using PM cycle duration as input for most likely
- Stochastically sum up results of each distribution to get aggregate distribution (probability distribution function – PDF)



PM B61 Plan

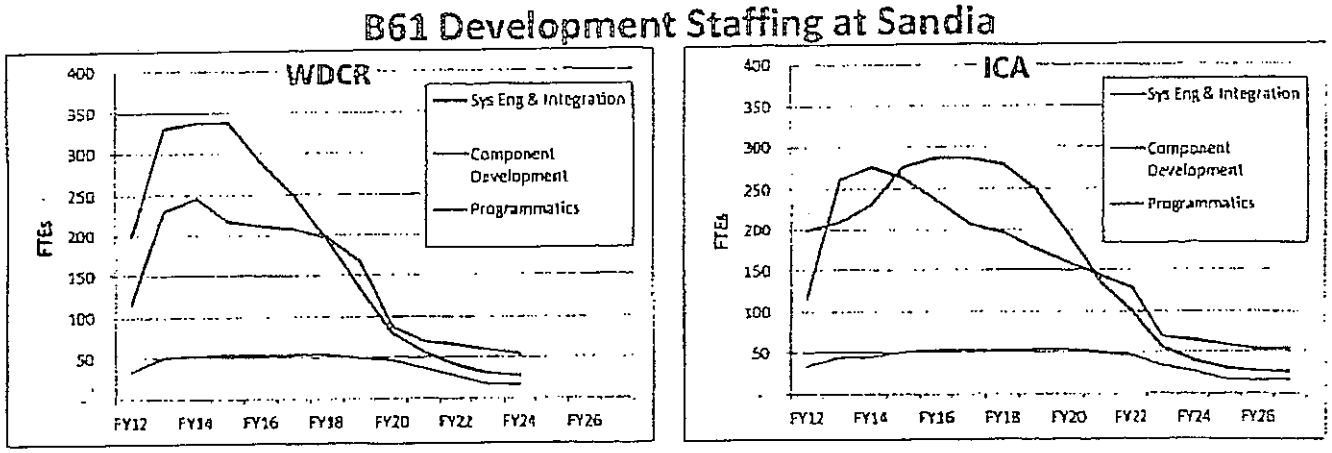
Step 3: Convert PDF to CDF (cumulative distribution function) to show cumulative probability of FPU for a given date

Modeling, based on PM inputs, projects a 3 year slip to FPU



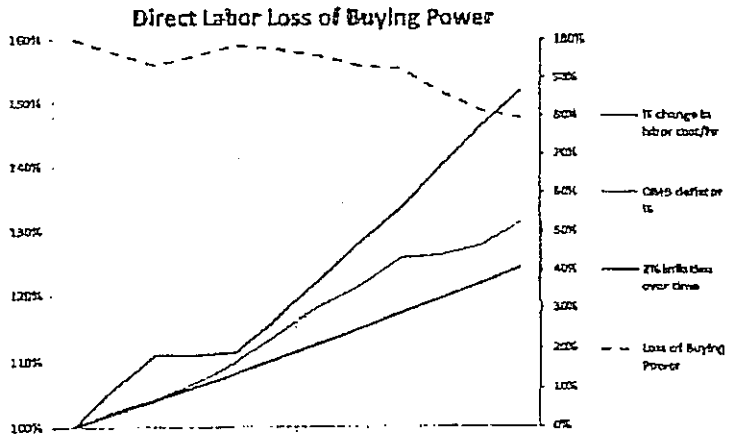
ICA Labor Cost Estimate

- Staffing Plan

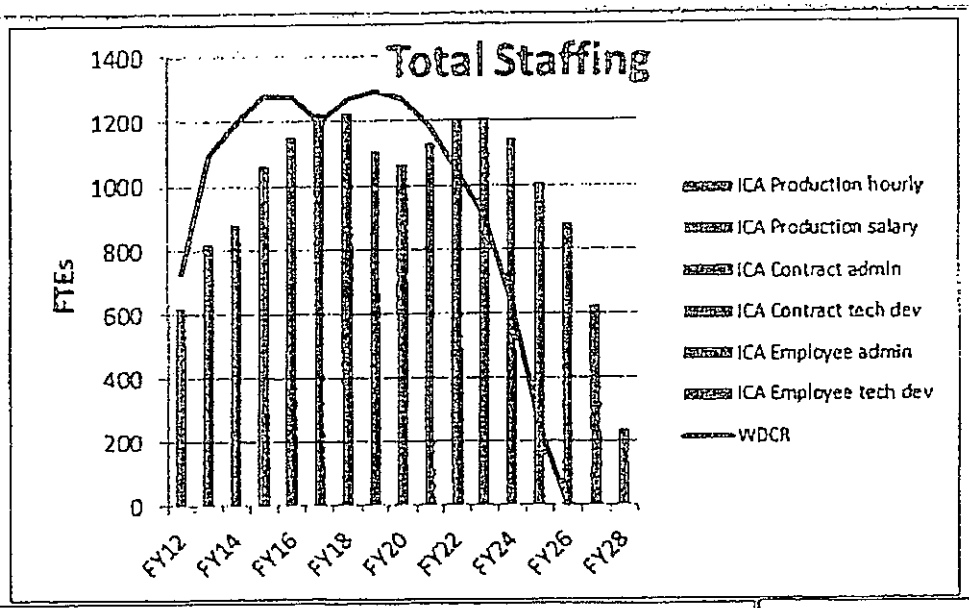


  - ICA adjusts Sandia B61 development staffing to achieve moderate risk FY22 FPU
  - ICA increases SE in FY13-22 and slows component design staffing relative to WDCR
  - Other site's staffing plans shifted by 3 years to tie into SNL effort

- Realistic labor cost growth
  - In general, NNSA labor cost has grown at twice the OMB inflation rate, resulting in significant loss of buying power over the past decade
  - ICA reflects 4% per annum labor cost growth
  - Assuming only 2% annual labor cost growth results in a 16% loss of buying power ($1.7B)

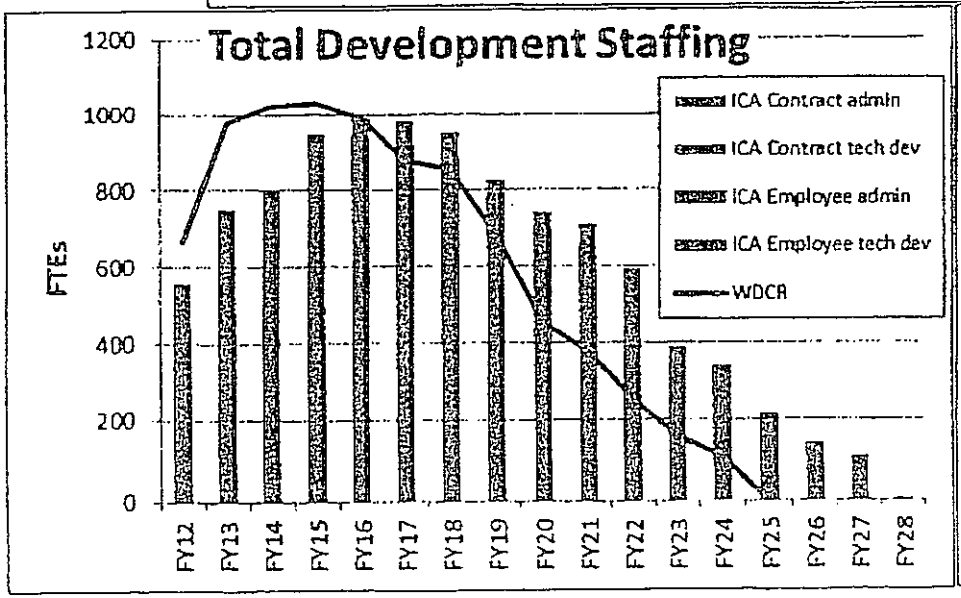


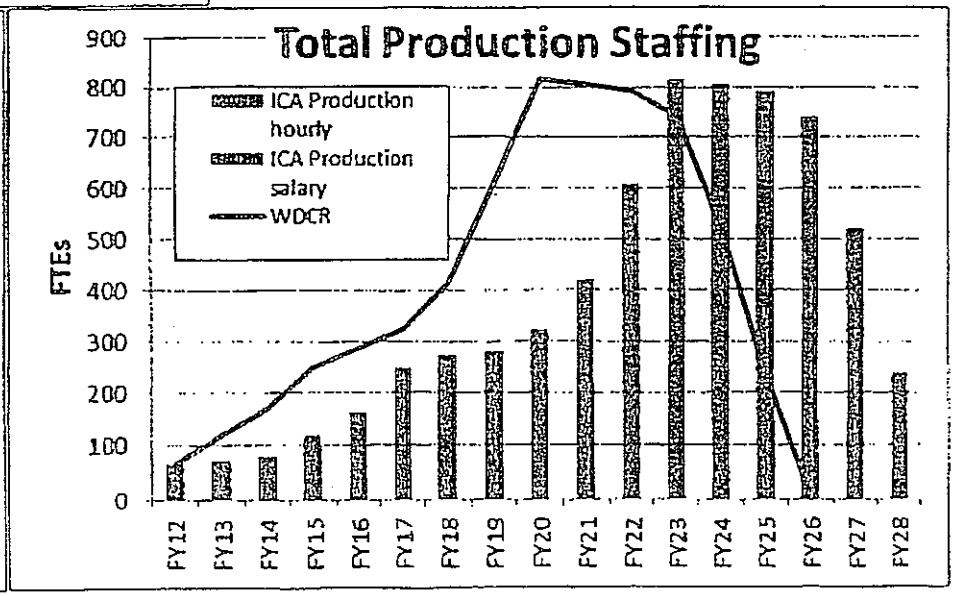
Comparison of ICA and WDCR Staffing Profiles



Total contractor staffing at:

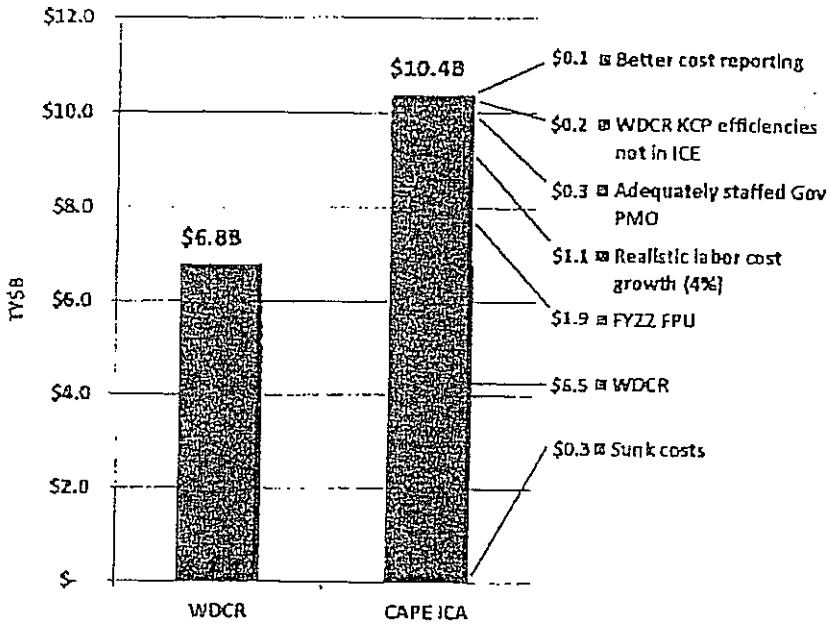
- Sandia
- Los Alamos
- Kansas City Plant
- Pantex
- Y-12
- Savannah River





Summary & Recommendations

All in TY$	WDCR	ICA
Sunk (FY09-11)	$0.3B	$0.3B
6.3 thru FPU	$4.1B	$6.6B
Production	$2.4B	$3.5B
Subtotal	$6.8B	$10.4B
Sustainment	?	?



Recommendations:

- Federal PM office needs growth above current size (3 FTE) to reasonably manage a $10B B61 program
  - ICA estimated 45 FTEs by FY15
- FY13 Program Review should include
  - Presentation of detailed risk burn down plans
  - Risk mitigation plans and decision points
  - Completion of a written program definition (e.g., CARD)
  - Review of Earned Value metrics and status of contractual data requirements on cost data reporting
- New CAPE ICA should be requested prior to 6.4 authorization