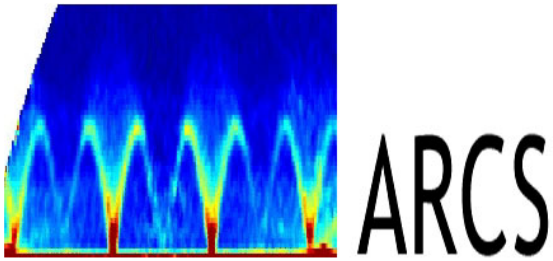


Baseline Cost and Schedule for the ARCS Instrument

Doug Abernathy

ARCS Project Manager

Methods used for development – SNS model

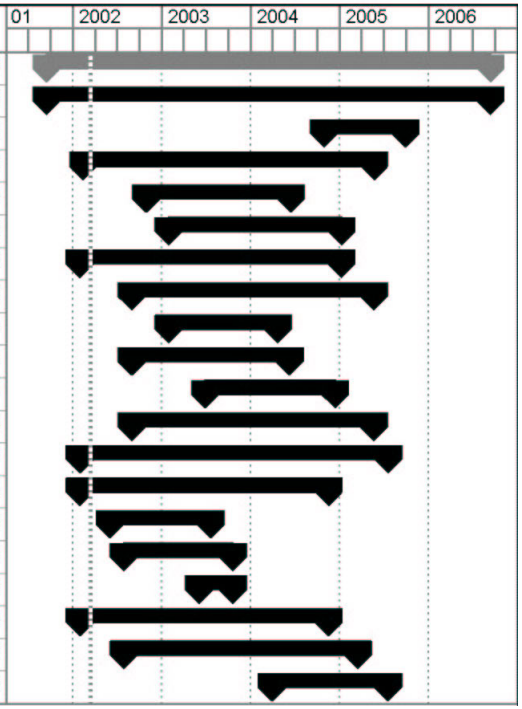
- Process has been guided by the experience with the first 5 SNS instruments
  - Same basic WBS structure
    - *Enables later inclusion of tasks for general SNS planning, e.g. planning for installation*
  - Scientist and engineer identify tasks
    - *Uses previous models but is specialized to the instrument*
  - Scientist, engineer and SNS scheduling engineer sit together to assign resources and discuss details of cost estimates, task durations, etc.
    - *Institutional knowledge from previous plans is passed along*
  - Costs are rolled up to provide totals; schedule (Gantt chart) is produced; backup information is kept in a costbook

Methods used for development – ARCS specific

- Some aspects of the cost and schedule development are specific to ARCS
  - Used Microsoft Project 2000 to record tasks, resources and do rollups
    - *More accessible and convenient for changes*
    - *Resources have rate tables with 2.7% escalation; rates are the same as SNS categories*
  - Contingency
    - *Estimate percentage needed by task for procurements and effort (standards 20% and 35% respectively)*
    - *Estimates rolled up to give higher level contingency for top WBS levels and overall project*
  - Reporting
    - *Need to set requirements with DOE; plan on using SNS resources to produce standard monthly earned value reports*

Overall WBS

WBS	Task Name	Duration	Start	Finish
0	ARCS (early)	1306 days	Mon 9/17/01	Fri 9/15/06
1	System Integration	1306 days	Mon 9/17/01	Fri 9/15/06
2	Data Acquisition	240 days	Mon 11/1/04	Fri 9/30/05
3	Detectors	855 days	Fri 2/15/02	Wed 5/25/05
4	Choppers	426 days	Fri 11/1/02	Thu 6/17/04
5	Sample Environment	507 days	Sat 2/1/03	Mon 1/10/05
6	Optical Elements	768 days	Fri 2/1/02	Mon 1/10/05
7	Shielding	712 days	Mon 9/2/02	Mon 5/23/05
7.1	Incident Beamline Shielding	321 days	Sat 2/1/03	Fri 4/23/04
7.2	Instrument Enclosure Shielding	466 days	Mon 9/2/02	Fri 6/11/04
7.3	Vessel Internal Shielding	382 days	Tue 7/1/03	Wed 12/15/04
7.4	Beam Stop	712 days	Mon 9/2/02	Mon 5/23/05
8	Instrument Specific	906 days	Fri 2/1/02	Thu 7/21/05
8.1	Vacuum Chamber	732 days	Fri 2/1/02	Fri 11/19/04
8.1.1	Sample Goniometer	300 days	Mon 6/3/02	Thu 7/24/03
8.1.2	Radial Collimator	320 days	Thu 8/1/02	Tue 10/21/03
8.1.3	Detector Frame	100 days	Thu 6/5/03	Wed 10/22/03
8.1.4	Chamber Procurement	732 days	Fri 2/1/02	Fri 11/19/04
8.2	Vacuum Systems	688 days	Thu 8/1/02	Fri 3/18/05
8.3	Instrument Services	341 days	Thu 4/1/04	Thu 7/21/05



Cost estimation example - vacuum vessel

- Expect to use a design/fabricate/install contract with a vendor
  - Have already identified some candidates and are starting discussions
- Cost estimation is notoriously difficult (we are told)
  - Use scaling by volume from existing vessels, get wildly different results
    - *NIST backscattering spectrometer - $234,500*
    - *MAPS at ISIS - $959,000*

- *Cost taken to be 1 M$ + 30% contingency*
- *Schedule : ~1 year for early design choices; ~15 months for detailed design and manufacturing (based on conversations with vendors)*

Cost estimation example - guide

- Tapered m=3.6 neutron guide in steel vacuum jacket; includes installation at SNS
- Cost estimate based on previous vendor quotes and rules-of-thumb
  - Scaling of budgetary estimates from two companies for the SNS magnetism reflectometer: $113,000 and $198,000
  - Rules-of-thumb: $144,700

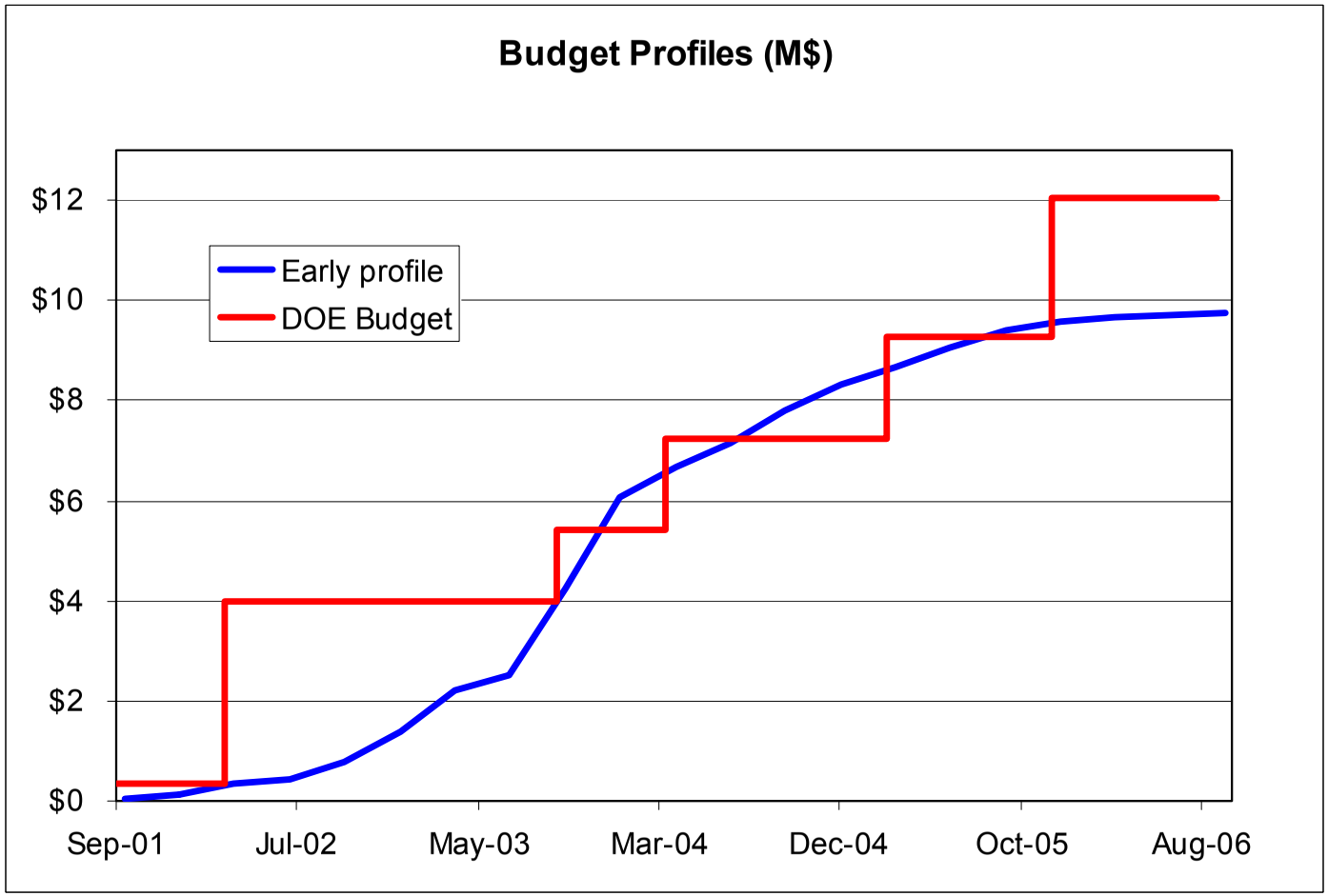
- *Cost taken to be $155,000 + 30% contingency*
- *Schedule: fabrication ~18 months (based on vendor estimates)*

Cost summary

WBS	Task/Component	Total Cost (k$)	Procurement Cost (k$)	Effort Cost (k$)	Effort (hours)	Estimated Contingency (k$)	Estimated % Contingency
1.2	System Interface/Project Management Tasks	1,030	51	979	10,880	0	0
1.3	Instrument Installation	799	86	713	13,256	267	33
2	Data Acquisition	242	108	133	1,350	58	24
3	Detectors	2,456	2,179	277	4,488	786	32
4	Choppers	877	750	127	1,720	144	16
5	Sample Environment	290	243	47	592	65	22
6	Optical Elements	622	422	200	2,792	172	28
7	Shielding	1,222	889	332	4,344	356	29
8.1	Vacuum Chamber	1,690	1,474	215	3,172	476	28
8.2	Vacuum Systems	239	166	73	974	59	25
8.3	Instrument Services	299	196	104	1,369	75	25
	Total	9,764	6,564	3,200	44,937	2,457	25

Actual DOE budget for the instrument = 12,059 k$
Actual contingency = 2,295 k$
Actual percentage contingency = 24%

Budget profile for first ARCS schedule



Budget outlay exceeds budget authority!

Solution - delay procurements

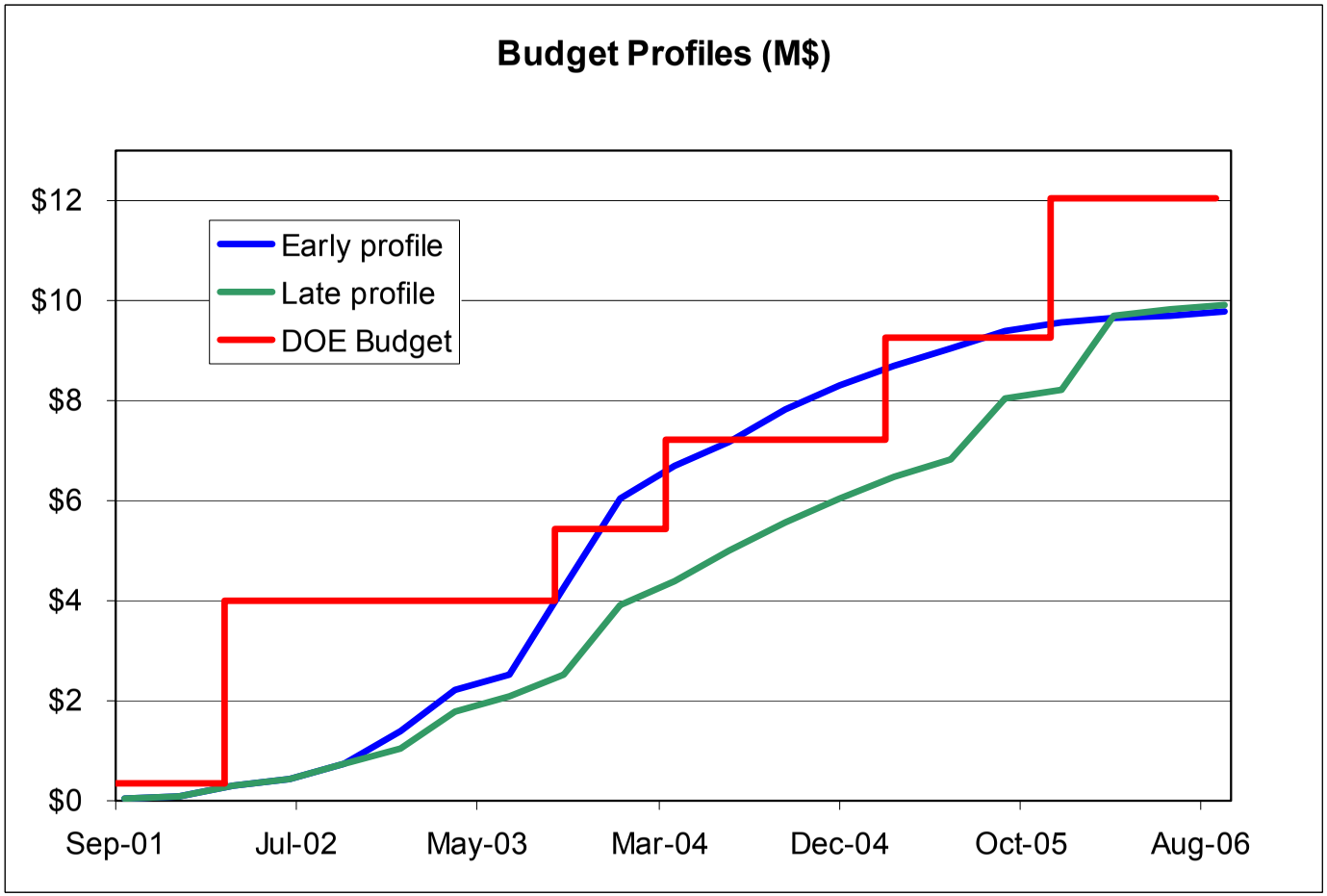
- In order to stay within the budget, need to delay procurements. However, some things should be respected
  - Logic and lead times for items must be correct
  - Try to keep installation of major items at the same time as other instruments
    - *Maximizes efficiency of installation tasks, reduce costs*
    - *Best chance to keep an early finish if some savings are found*
- One solution: delay the purchase and installation of detectors until last year of project
  - *Most spectrometers have been built this way*
  - *As project progresses, may be able to make a partial installation*
  - *This delays final installation from 1/06 to 8/06*
  - *No commissioning time*

Cost summary - late detector purchase

WBS	Task/Component	Total Cost (k$)	Procurement Cost (k$)	Effort Cost (k$)	Effort (hours)	Estimated Contingency (k$)	Estimated % Contingency
1.2	System Interface/Project Management Tasks	1,030	51	979	10,880	0	0
1.3	Instrument Installation	799	86	713	13,256	267	33
2	Data Acquisition	242	108	133	1,350	58	24
3	Detectors	2,576	2,295	281	4,488	827	32
4	Choppers	881	753	128	1,720	144	16
5	Sample Environment	298	250	48	592	67	22
6	Optical Elements	622	422	200	2,792	172	28
7	Shielding	1,222	889	332	4,344	356	29
8.1	Vacuum Chamber	1,698	1,482	216	3,172	479	28
8.2	Vacuum Systems	239	166	73	974	59	25
8.3	Instrument Services	299	196	104	1,369	75	25
	Total	9,905	6,698	3,207	44,937	2,502	25

Actual DOE budget for the instrument = 12,059 k$
Actual contingency = 2,154 k$
Actual percentage contingency = 22%

Budget profiles for two schedules



Key dates in schedules

	Early	Late
• Project start	9/01	9/01
• Detector in vacuum decision	9/02	9/02
• Guide procurement	9/02	9/02
• First detector module procurement	8/03	9/05
• Vessel procurement	9/03	10/03
• Target inserts needed	6/04	6/04
• Target Building occupancy date	6/04	6/04
• Start installation	6/04	6/04
• End detector module assembly and testing	5/05	7/06
• SNS project early completion	12/05	12/05
• End installation	1/06	8/06
• Project end	9/06	9/06

Risks and risk management

- Large uncertainties in big ticket items
  - Vessel
    - *Get order of magnitude costs from vendors*
    - *Continue to define requirements so that contract can be in place in a year*
  - Detectors
    - *Sign MOU to give ARCS ^{3}He from SNS*
    - *Prototype module with electronics will set firmer costs*
  - Installation costs
    - *More detail in design will allow better understanding (possibly)*
- B.A. profile is driving schedule later than ideal
  - Manage project to minimize the disturbance and get some detectors purchased