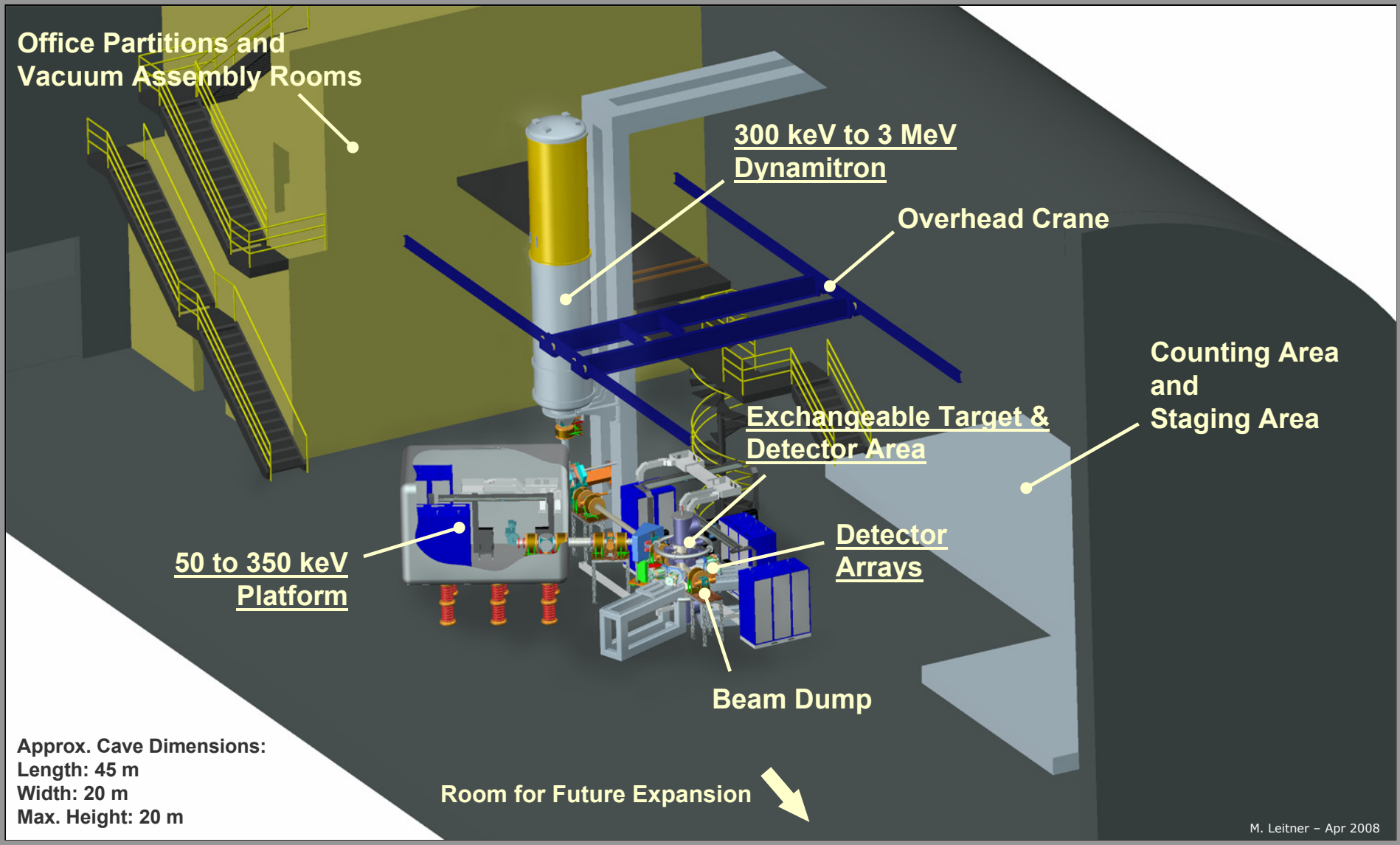
Next Steps for the DUSEL Underground Accelerator Laboratory

M. Leitner • DUSEL-ISE Workshop in Lead, SD • April 21-26, 2008

UNDERGROUND ACCELERATOR LABORATORY
CAVE MODULE LAYOUT



CONTENTS

- The NSF MREFC Process (*)
- Project Management Fundamentals
- Implications for the Underground Accelerator Laboratory

(*) **Source:**
J. Kotcher et al, P5 Meeting, SLAC, Feb. 21-23, 2008

PREPARING FOR DUSEL

- Expenses for the acquisition, construction, commissioning, and upgrading of major research equipment, facilities, and other such capital assets by the National Science Foundation (NSF) is funded by the "**Major Research Equipment and Facilities Construction**" (**MREFC**) appropriation by Congress.
- Pre-construction planning and development for MREFC candidate projects progress through a sequence of stages of increasing investment, planning, assessment and oversight. These stages involve rigorous technical and managerial reviews and ensure that the technical evolution of a candidate project progresses appropriately, thus increasing the likelihood that it will be able to qualify for funding for further planning and eventual construction.
- The **DUSEL MREFC package** consists of two major parts:
  - DUSEL facility design
    and
  - Initial Suite of Experiments (ISE) design
- Resources required to realize both parts must be clarified:
  - Cost, schedule, staffing requirements, risks, etc.
- NSF solicitations are being developed to accommodate this process ("*S-4*", "*S-5*")

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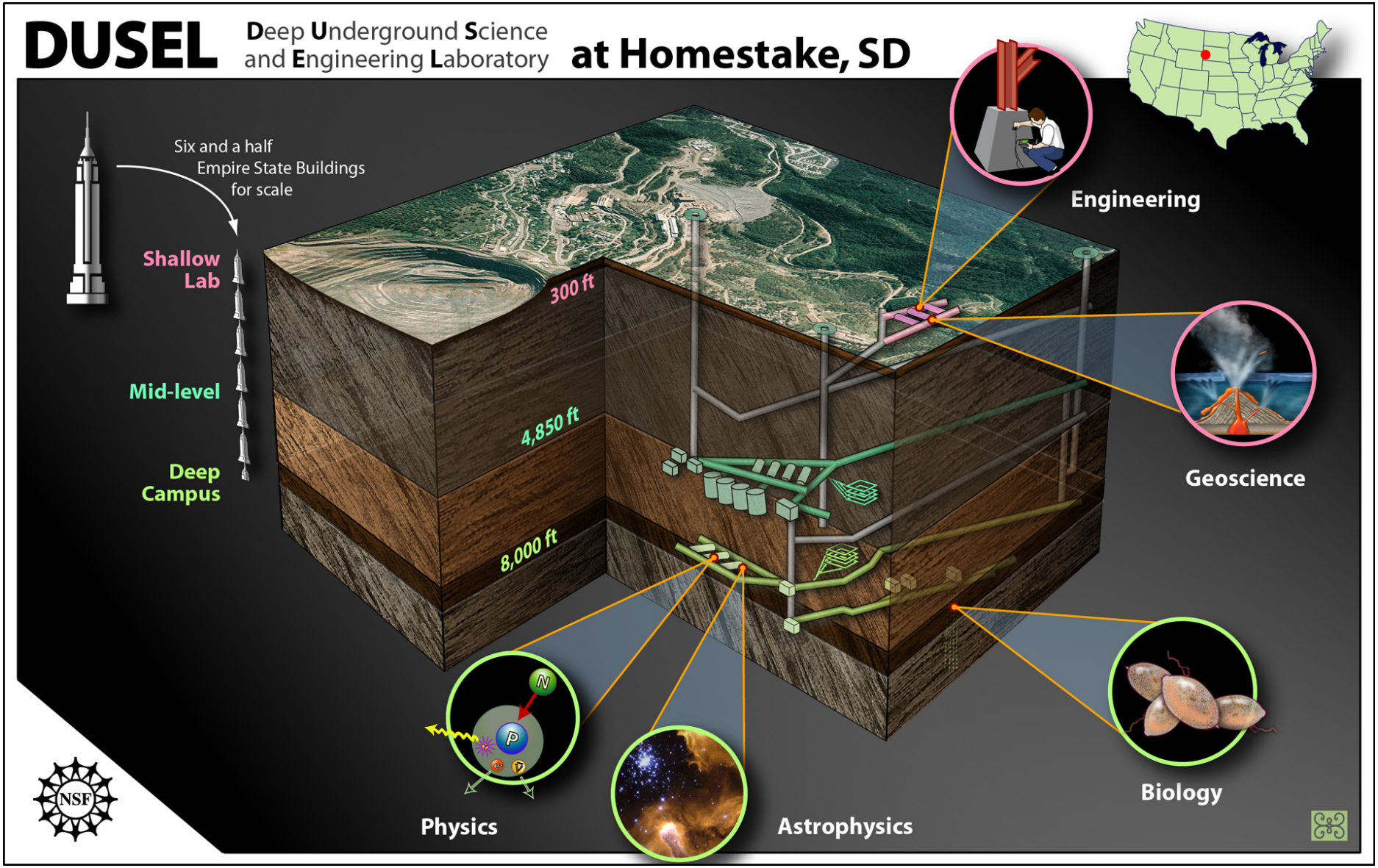
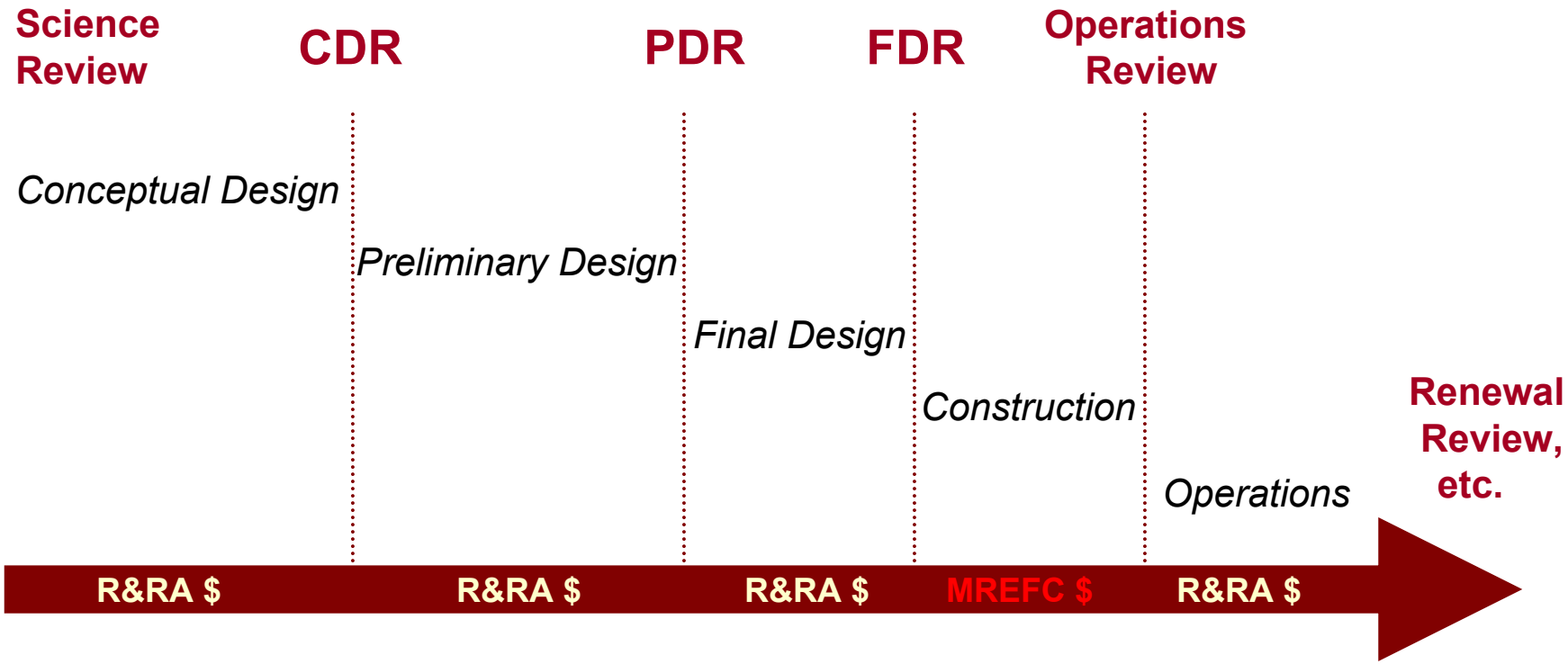

DUSEL
Deep Underground Science and Engineering Laboratory
at Homestake, SD
Six and a half Empire State Buildings for scale
Shallow Lab
Mid-level
Deep Campus
300 ft
4,850 ft
8,000 ft
Engineering
Geoscience
Biology
Physics
Astrophysics
NSF

THE "ROLLING WAVE" PLANNING APPROACH



DOE Translation ("Critical Decisions"):

CD 0	*CD 1*	*CD 2*	*CD 3*	*CD 4*
Approve mission need	Approve alternate selection and cost range	Approve performance baseline	Approve construction start	Approve operations start

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	Conceptual Design Stage	Readiness Stage	Board Approved Stage	Construction
Budget evolution	Concept development **Expend approximately 1/3 of total pre-construction planning budget** Develop construction budget based on conceptual design Develop budget requirements for advanced planning, Estimate ops $	Preliminary design **Expend approx 1/3 of total pre-construction planning budget** Construction estimate based on prelim design Update ops $ estimate	**Final design over ~ 2 years** **Expend approx 1/3 of total pre-construction planning budget** **Construction-ready budget & contingency estimates**	**Expenditure of budget and contingency per baseline** Refine ops budget
	Funded by R&RA or EHR $			**MREFC $**
Project evolution	***CONCEPTUAL DESIGN*** Formulation of **science questions** **Requirements definition, prioritization, and review** Identify critical enabling technologies and high risk items (**R&D needs**) **Development of conceptual design** Top down parametric cost and contingency estimates Formulate initial risk assessment Initial proposal submission to NSF Initial draft of Project Execution Plan	***PRELIMINARY DESIGN*** Develop **site-specific preliminary design**, environmental impacts Develop enabling technology **Bottoms-up cost and contingency estimates**, updated risk analysis Develop preliminary operations cost estimate **Develop Project Management Control System** Update of Project Execution Plan	***FINAL DESIGN*** **Development of final construction-ready design and Project Execution Plan** Industrialize key technologies **Refine bottoms-up cost and contingency estimates** Finalize Risk Assessment and Mitigation, and Management Plan **Complete recruitment of key staff**	***CONSTRUCTION PER BASELINE***
	Proponents development strategy defined in Project Development Plan			Described by Project Execution Plan
	NSF oversight defined in Internal Management Plan, updated by development phase			
Oversight evolution	Merit review, apply 1st and 2nd ranking criteria MREFC Panel briefings Forward estimates of Preliminary Design costs and schedules **Establishment of interim review schedules and competition milestones** Forecast international and interagency participation and constraints Initial consideration of NSF risks and opportunities **Conceptual design review**	**MREFC Panel recommends and NSF Director approves advance to Readiness** NSF Director approves Internal Management Plan Formulate/approve Project Development Plan & budget; include in NSF Facilities Plan **Preliminary design review and integrated baseline review** Evaluate ops $ projections Evaluate forward design costs and schedules Forecast interagency and international decision milestones NSF approves submission to NSB	**NSF approves submission to NSB** Apply 3rd ranking criteria NSB prioritization OMB/Congress budget negotiations based on Prelim design budget **Semi-annual reassessment of baseline and projected ops budget for projects not started construction** Finalization of interagency and international requirements	**Congress appropriates funds** Final design review, fix baseline Congress appropriates MREFC funds & NSB approves obligation **Periodic external review during construction** **Review of project reporting** **Site visit and assessment**

NSF S-4 SOLICITATION

Proposals due June 2008!

- Solicitation 4 (S-4): call for proposals to develop project plans for potential candidates for the ISE
- S-4 funds to address: what do you need to execute the experiment you propose?
  - Will include opportunity for limited, targeted R&D
- S-4 provides design & development funds for experiments that might be included in ISE
- Open to all disciplines
- Up to $15M total from Physics/MPS, over 3 years
  - Primarily for physics experiments
  - Independent of '08 DUSEL R&D

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Design due May 2009!

- Solicitation 5 (S-5): will call for proposals from which final selection of ISE will be made
- Must allow sufficient time to review, develop final MREFC package
  - Facility + Experiments, Interfaces
- Current plan has publication in **Winter '09**
- Funding recommendations for both S-4 & S-5 will be obtained via peer review through NSF panels

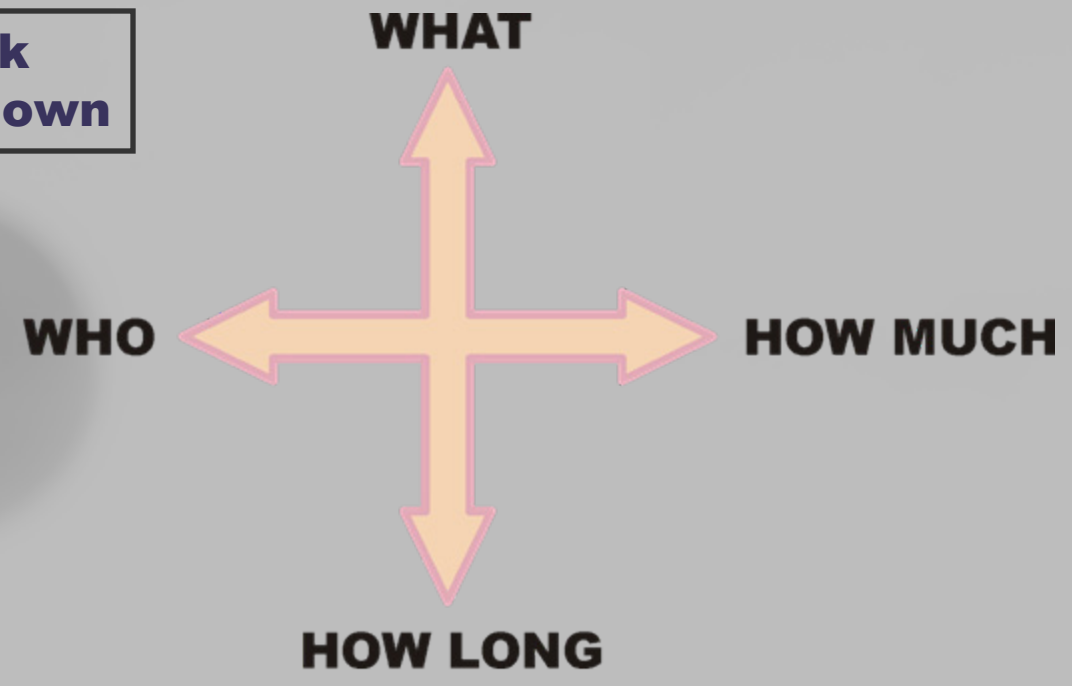
CURRENT NSF DUSEL PLANNING

- At this early stage, Physics Division uses following rough planning targets:
  - $500M for initial phase MREFC, split evenly between facility and experiments
    - Not etched in stone – will be responsive to project plan, compelling nature of case, etc.
  - 7-8 year construction period, experiments interleaved as they are ready
  - **Preliminary Design Review end FY09**
  - **Earliest construction start FY12**

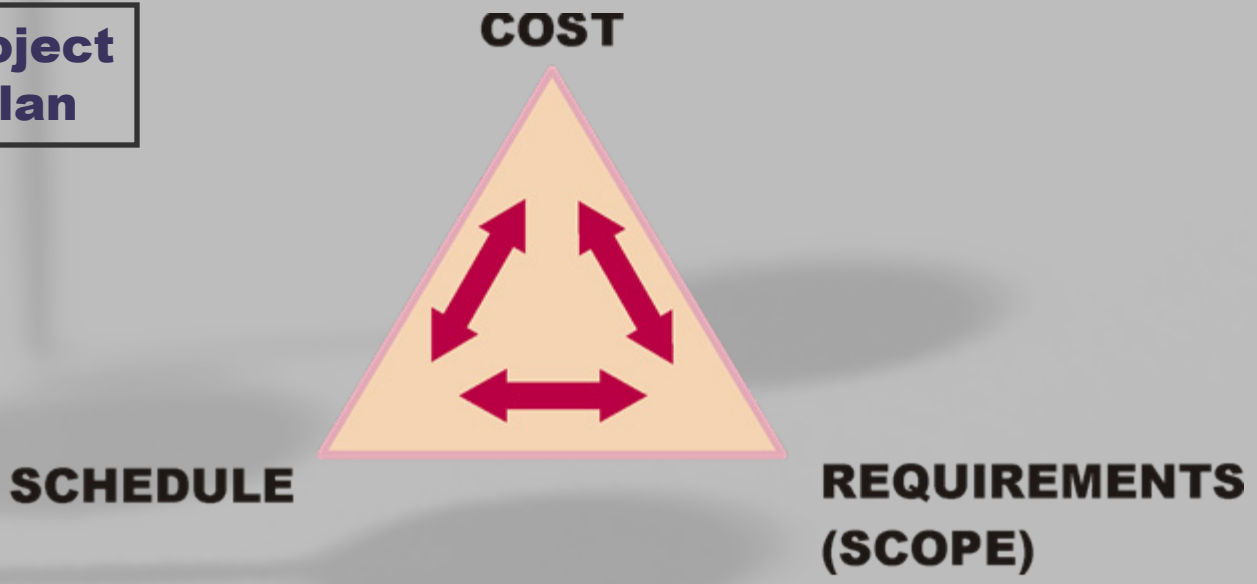
Project Management Fundamentals

DISCIPLINED PLANNING

Work Breakdown

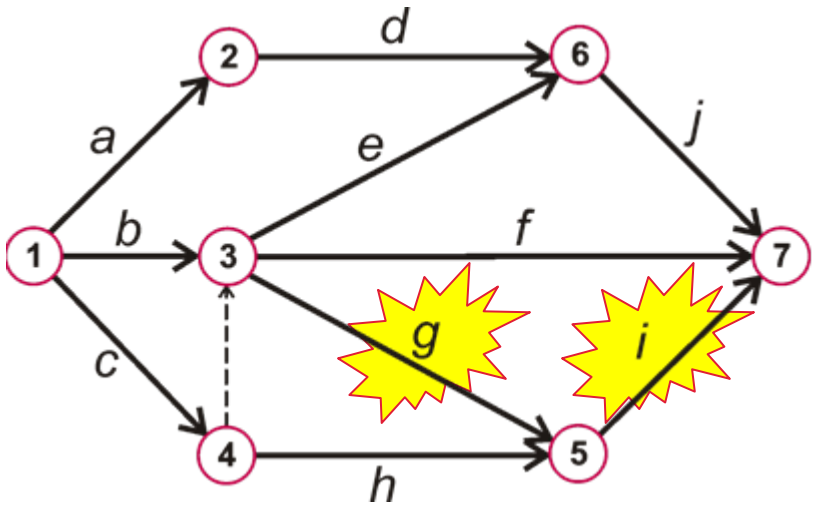


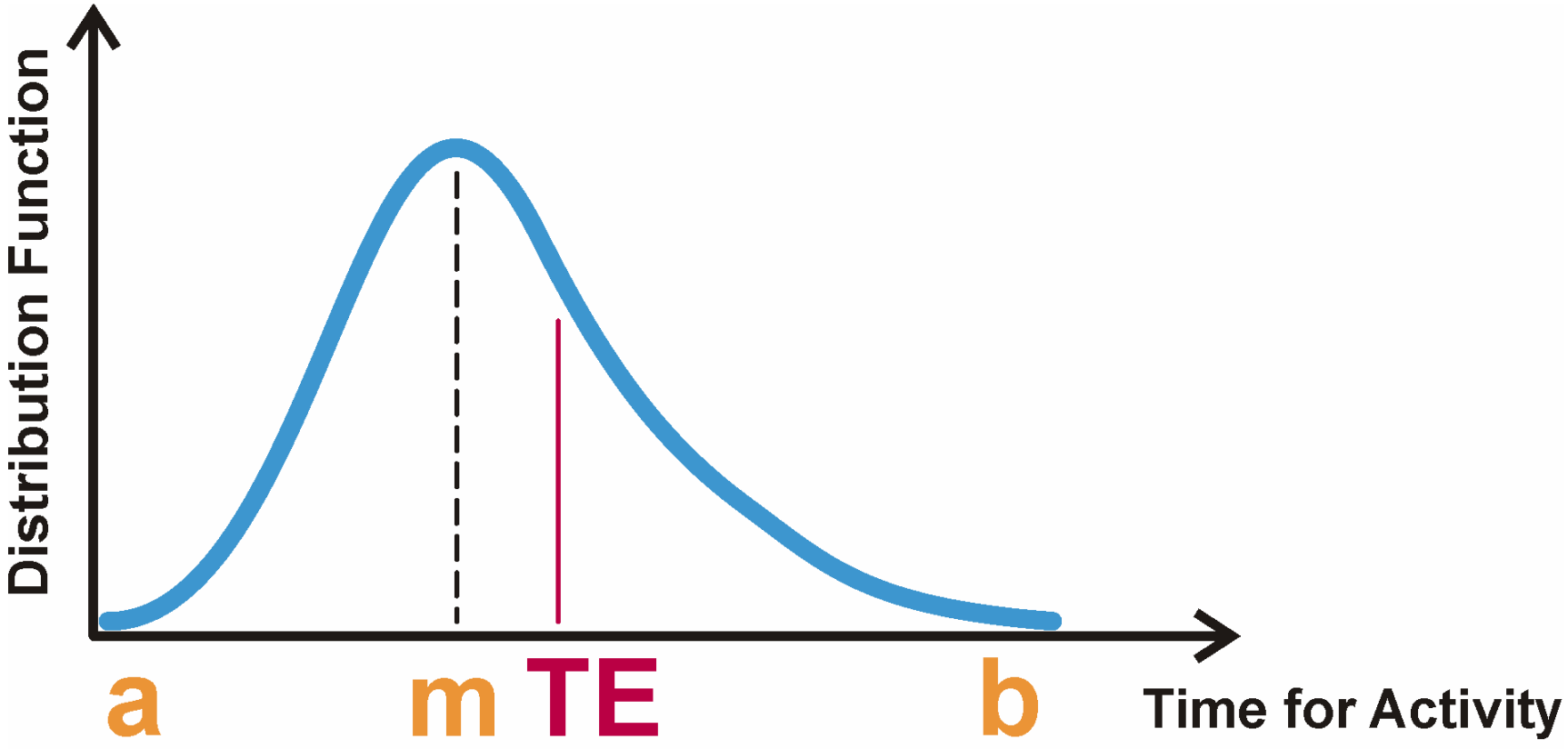
Project Plan



Project Activity Times and Precedences

Activity	*Optimistic Time*	*Most Likely Time*	*Pessimistic Time*	*Immediate Predecessor Activities*
a	10	22	22	-
b	20	20	20	-
c	4	10	16	-
d	2	14	32	*a*
e	8	8	20	*b,c*
f	8	14	20	*b,c*
g	4	4	4	*b,c*
h	2	12	16	*c,*
i	6	16	38	*g,h*
j	2	8	14	*d,e*





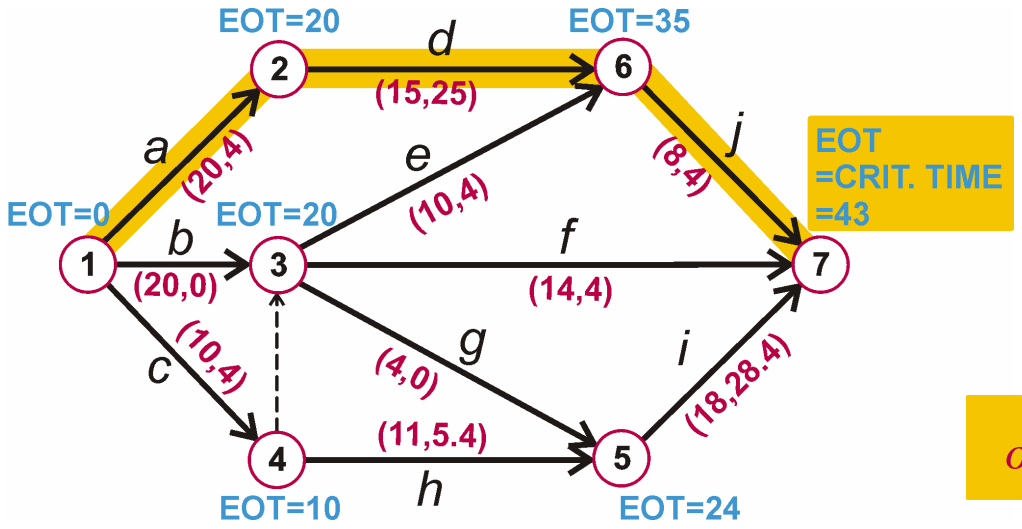
TE = (a + 4m + b) / 6 ... for beta distribution

$$\sigma^2 = \left(\frac{b - a}{6}\right)^2$$ ... variance of a beta distribution

Project Activity Times

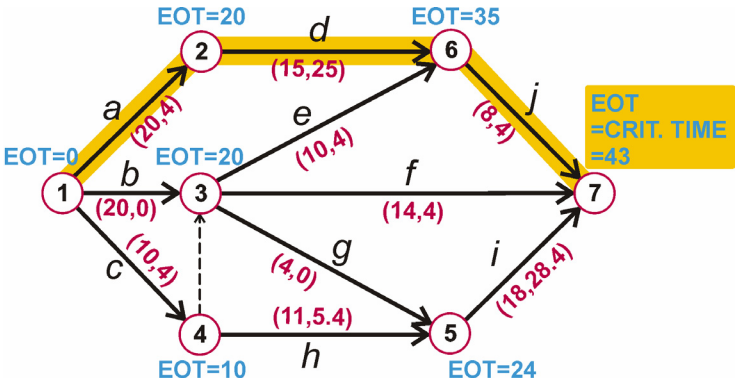
Expected Activity Times (TE), Variances (σ^2), and Standard Deviations (σ)

Activity	Optimistic Time	Most Likely Time	Pessimistic Time	Expected Time TE	Variance σ^2	Standard Deviation σ
a	10	22	22	20	4	2
b	20	20	20	20	0	0
c	4	10	16	10	4	2
d	2	14	32	15	25	5
e	8	8	20	10	4	2
f	8	14	20	14	4	2
g	4	4	4	4	0	0
h	2	12	16	11	5.4	2.32
i	6	16	38	18	28.4	5.33
j	2	8	14	8	4	2



TE=43
Variance=33
Standard Dev. = 5.745

$$\sigma^2_{Total} = \sigma^2_{Task\ 1} + \sigma^2_{Task\ 2} + \sigma^2_{Task\ 3}$$



TE=43

Variance=33

Standard Dev. = 5.745

e.g.

95% chance of completion:

Need 1.645 standard dev.

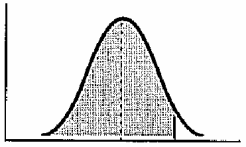
Time to Complete = 52.5

e.g.

zero standard dev.

50% chance of completion!

Table 8-4. Cumulative (Single Tail) Probabilities of the Normal Probability Distribution (Areas under the Normal Curve from $-\infty$ to Z)



Example: the area to the left of Z = 1.34 is found by following the left Z column down to 1.3 and moving right to the .04 column. At the intersection read .9099. The area to the right of Z = 1.34 is 1 − .9099 = .0901. The area between the mean (dashed line) and Z = 1.34 = .9099 − .5 = .4099.

z	00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8880
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9932	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

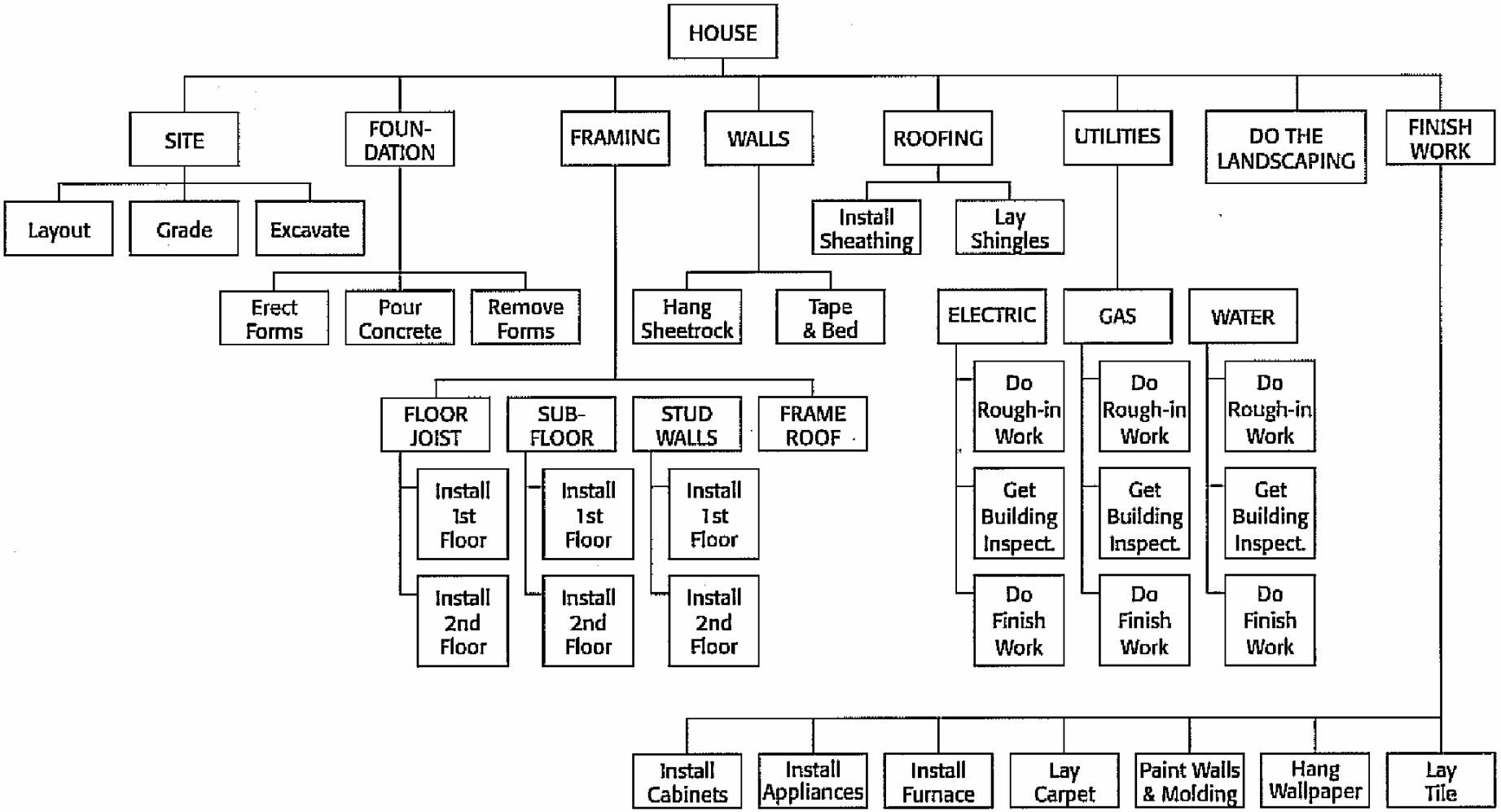
THE NEED FOR CONTINGENCY AND GOOD PROJECT PLANNING

- **If schedule and budget are based on point estimates ("most likely cost and time"), the chance of on-time and on-budget completion is less than 50 %**
- **The managerial implications are all too clear.**
- If the project manager wants a reasonable chance of meeting a project deadline, there must be some slack in the project schedule.
- When preparing a project budget, it is necessary to include some allowance for contingencies.

THE WORK BREAKDOWN STRUCTURE AS BASIS FOR PLANNING

- Break down **ALL** of the work required to complete the project. Include all physical deliverables. Include R&D, design, prototyping, fabrication, assembly, installation, acceptance testing leading to a deliverable product.
- A work breakdown structure does not yet show the sequence in which work is performed. Such sequencing is determined when a schedule is developed.
- Don't plan in more detail than you can manage. Maintain a balance of details.
- No task should have a duration greater than four to six weeks.
- Engineering and technical tasks should have durations no greater than one to three weeks.
- The work breakdown structure provides a tool for identifying **WHAT** must be done, **WHO** will do it, **HOW LONG** it will take, and **HOW MUCH** it will cost.
- **EACH WORK BREAKDOWN ITEM IS DESCRIBED AS A RECORD IN THE WORK BREAKDOWN STRUCTURE DICTIONARY.**

EXAMPLE OF A GENERIC WORK BREAKDOWN STRUCTURE (WBS)



CLAIRE
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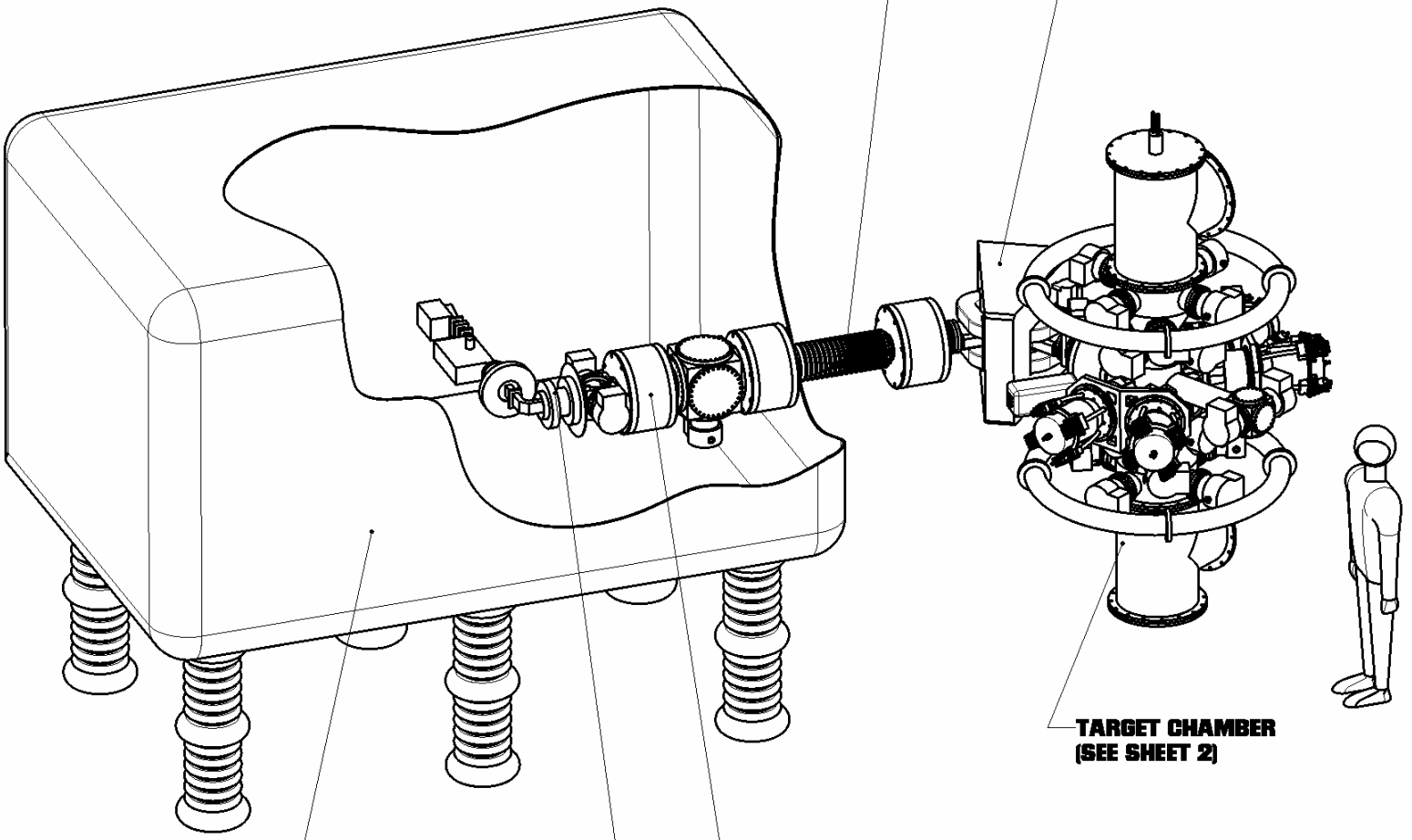

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UNLESS OTHERWISE SPECIFIED
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TOLERANCES
DO NOT SCALE PRINT
THIRD ANGLE PROJECTION
BREAK SHARP EDGES
REMOVE BURRS
INTERPRET GEOMETRIC TOLERANCING PER ASME Y14.5M-1994

SHOP ORDERS

ERNEST ORLANDO LAWRENCE BERKELEY NATIONAL LABORATORY
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CLAIRE
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MAIN ASSEMBLY

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SHEET 1 OF 2
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REV.: -

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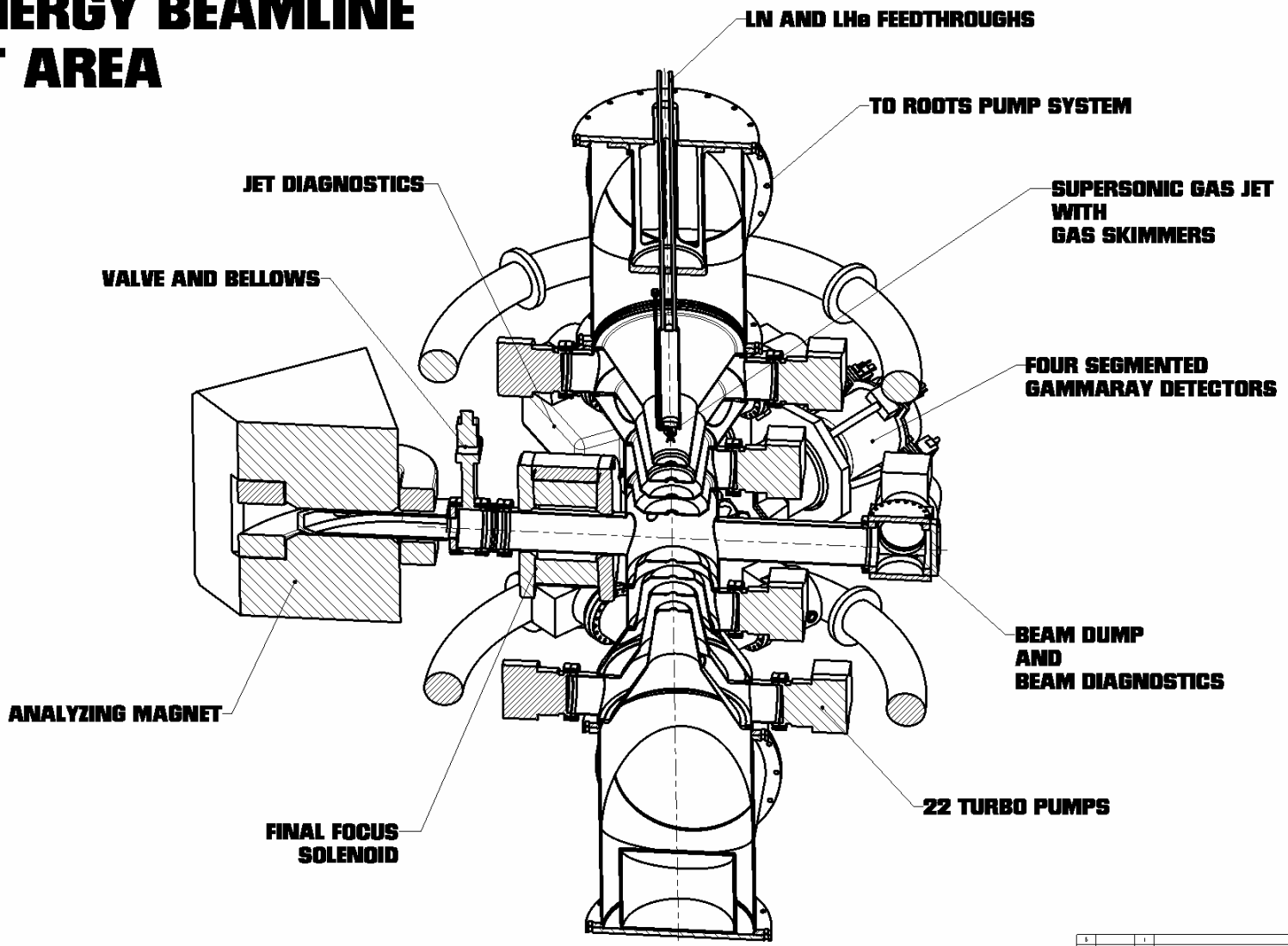

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CLAIRE
ACCELERATOR LAYOUT
MAIN ASSEMBLY

DWG. TYPE	SHEET
ASSEM	2 OF 3

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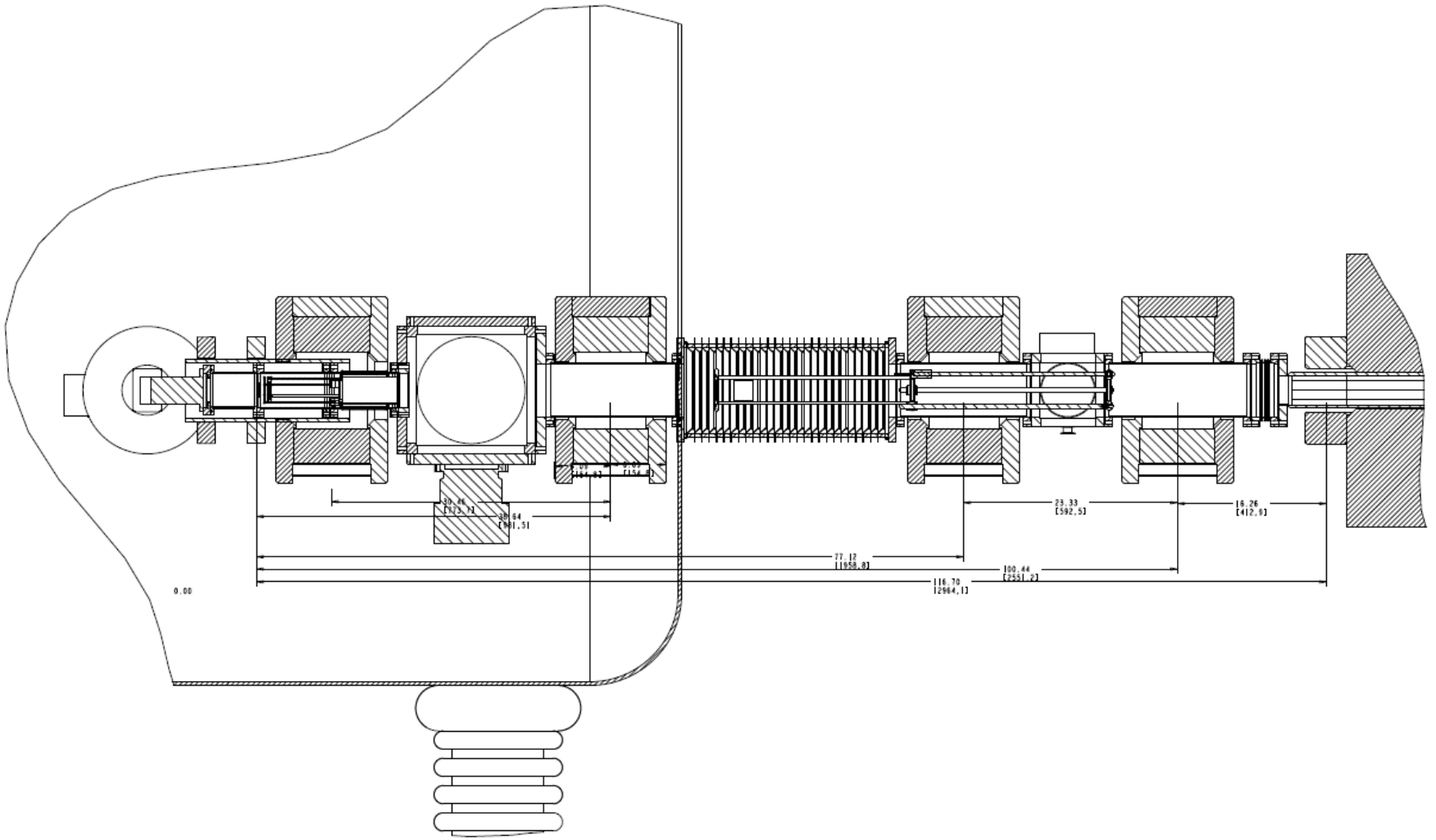

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UNLESS OTHERWISE SPECIFIED
DO NOT SCALE PRINT

SHOP ORDERS

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UNIVERSITY OF CALIFORNIA - BERKELEY

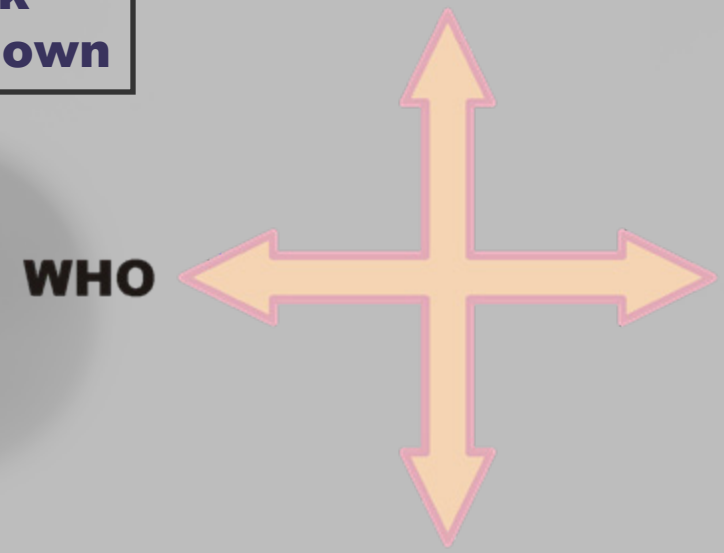
FIRST LINE TITLE
SECOND LINE TITLE
THIRD LINE TITLE

SCALE 0.020
SHEET 1 OF 1
SIZE D

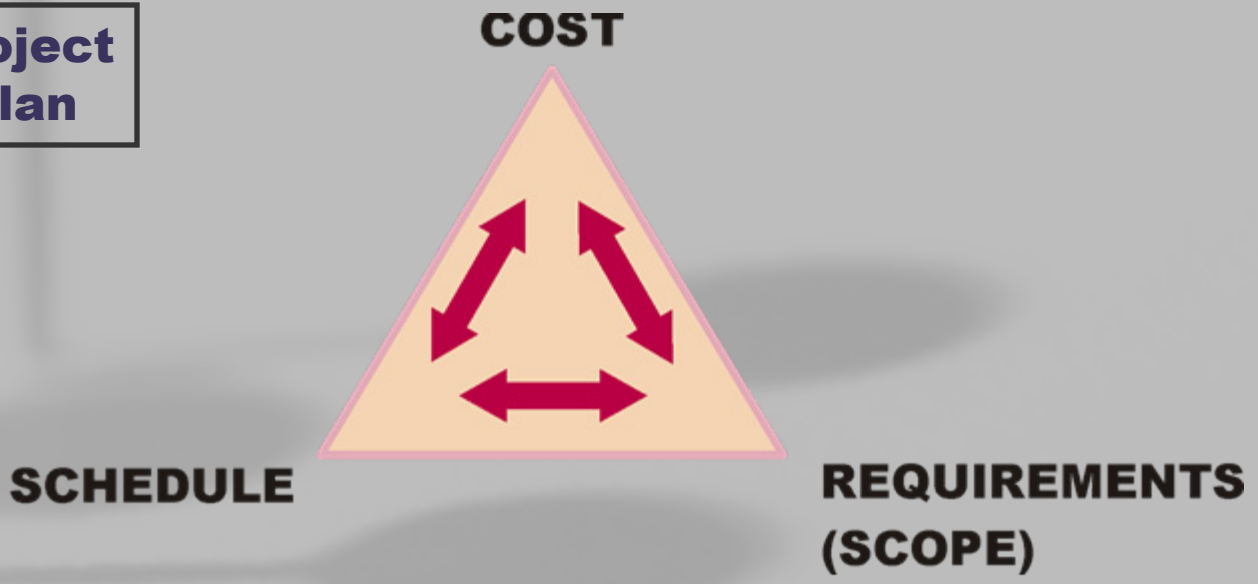
WBS	Name
0	LOW ENERGY BEAMLINE
1	PRE-CONCEPTUAL R&D AND DESIGN
1.1	R&D
1.1.1	BEAM NEUTRALIZATION EXP. ON VENUS
1.2	PRE-CONCEPTUAL DESIGN
1.2.1	BEAMLINE PHYSICS DESIGN
1.2.2	GAS JET COMPRESSIBLE FLOW SIMULATIONS
1.2.3	VACUUM CALCULATIONS
2	CONCEPTUAL DESIGN
2.1	HV PLATFORM
2.2	SOURCE
2.3	EXTRACTION SYSTEM
2.4	SOLENOID LENSES
2.5	PUMPING SPOOLS
2.6	HV COLUMN
2.7	MOVABLE HV ELECTRODE
2.8	ANALYZING MAGNET
2.9	GAS JET
2.10	GAS JET BAFFLES AND VACUUM PUMPING
2.11	GAS JET DIAGNOSTICS
2.12	GE DETECTORS
2.13	BEAM DUMP
2.14	BEAM DIAGNOSTICS
2.15	ROOTS BLOWERS
2.16	STEERING COILS
2.17	BEAMLINE ELEMENTS
2.18	BEAMLINE HARDWARE
2.19	HV PLATFORM SUPPORTS
2.20	GROUND SUPPORTS
2.21	GAS JET SUPPORT
2.22	DETECTOR SUPPORT
2.23	SAFETY ENCLOSURE
2.24	EH&S SURVEILLANCE SYSTEMS
2.25	PLUMBING
2.26	ELECTRICITY
2.27	WIRE WAYS
2.28	CONTROL ROOM
2.29	CONTROLS LAYOUT
2.30	CONCEPTUAL DESIGN REVIEW PREPARATION
3	CONCEPTUAL DESIGN REVIEW
4	EDIA
4.1	PRELIMINARY (TITLE-1) & FINAL (TITLE-2)
4.1.1	HV PLATFORM
4.1.2	SOURCE
4.1.3	EXTRACTION SYSTEM
4.1.4	SOLENOID LENSES
4.1.5	PUMPING SPOOLS
4.1.6	HV COLUMN
4.1.7	MOVABLE HV ELECTRODE
4.1.8	ANALYZING MAGNET
4.1.9	GAS JET
4.1.10	GAS JET BAFFLES AND VACUUM PUMPING
4.1.11	GAS JET DIAGNOSTICS
4.1.12	GE DETECTORS
4.1.13	BEAM DUMP
4.1.14	BEAM DIAGNOSTICS
4.1.15	ROOTS BLOWERS
4.1.16	STEERING COILS
4.1.17	BEAMLINE ELEMENTS
4.1.18	BEAMLINE HARDWARE
4.1.19	HV PLATFORM SUPPORTS
4.1.20	GROUND SUPPORTS
4.1.21	GAS JET SUPPORT
4.1.22	DETECTOR SUPPORT
4.1.23	SAFETY ENCLOSURE
4.1.24	EH&S SURVEILLANCE SYSTEMS
4.1.25	PLUMBING
4.1.26	ELECTRICITY
4.1.27	WIRE WAYS
4.1.28	CONTROL ROOM
4.1.29	CONTROLS LAYOUT
4.1.30	ENGINEERING SUPPORT
4.1.31	PHYSICS SUPPORT
4.1.32	FINAL DESIGN REVIEW PREPARATION
5	FINAL DESIGN REVIEW
6	CONSTRUCTION
6.1	FABRICATION
6.1.1	HV PLATFORM
6.1.2	SOURCE
6.1.3	EXTRACTION SYSTEM
6.1.4	SOLENOID LENSES
6.1.5	PUMPING SPOOLS
6.1.6	HV COLUMN
6.1.7	MOVABLE HV ELECTRODE
6.1.8	ANALYZING MAGNET
6.1.9	GAS JET
6.1.10	GAS JET BAFFLES AND VACUUM PUMPING
6.1.11	GAS JET DIAGNOSTICS
6.1.12	GE DETECTORS
6.1.13	BEAM DUMP
6.1.14	BEAM DIAGNOSTICS
6.1.15	ROOTS BLOWERS
6.1.16	STEERING COILS
6.1.17	BEAMLINE ELEMENTS
6.1.18	BEAMLINE HARDWARE
6.1.19	HV PLATFORM SUPPORTS
6.1.20	GROUND SUPPORTS
6.1.21	GAS JET SUPPORT
6.1.22	DETECTOR SUPPORT
6.1.23	SAFETY ENCLOSURE
6.1.24	EH&S SURVEILLANCE SYSTEMS
6.1.25	PLUMBING
6.1.26	ELECTRICITY
6.1.27	WIRE WAYS
6.1.28	CONTROL ROOM
6.1.29	BEAMLINE POWER SUPPLIES & ELECTRONICS
6.1.30	VACUUM PUMPS BEAMLINE
6.1.31	VACUUM PUMPS GAS JET
6.1.32	ROOTS PUMPS GAS JET
6.1.33	GAS RECIRCULATION SYSTEM
6.1.34	GAS JET ELECTRONICS
6.1.35	CONTROLS HARDWARE
6.1.36	CONTROLS PROGRAMMING
6.2	INSTALLATION
6.2.1	PLATFORM INSTALLATION
6.2.2	BEAMLINE INSTALLATION
6.2.3	GAS JET INSTALLATION
6.2.4	CONTROLS INSTALLATION
6.3	EDIA (TITLE-3)
6.3.1	DESIGN & ENGINEERING SUPPORT
7	CONSTRUCTION COMPLETE
8	MANAGEMENT
8.1	PROJECT MANAGEMENT

STRATEGIC PLANNING

Work Breakdown

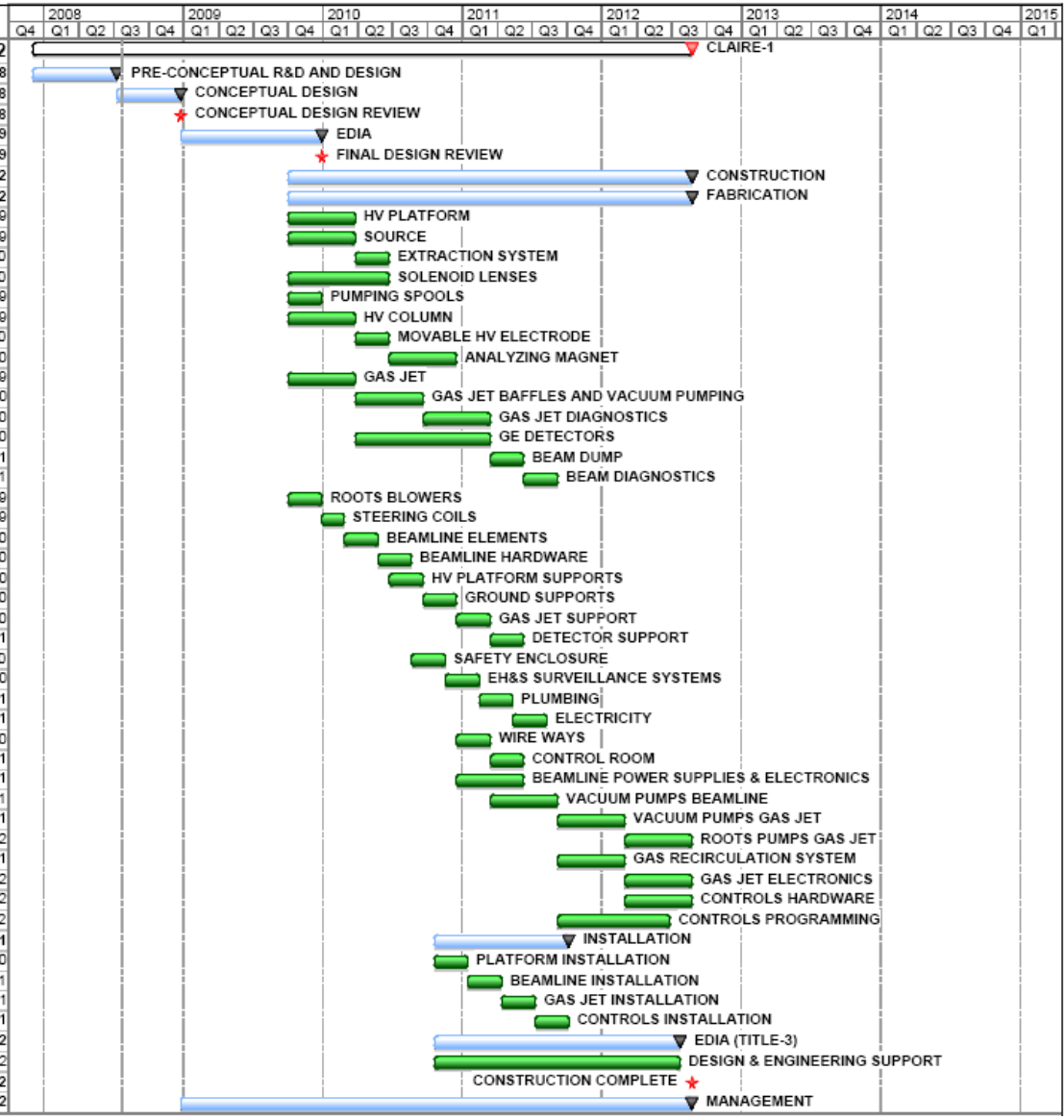


Project Plan

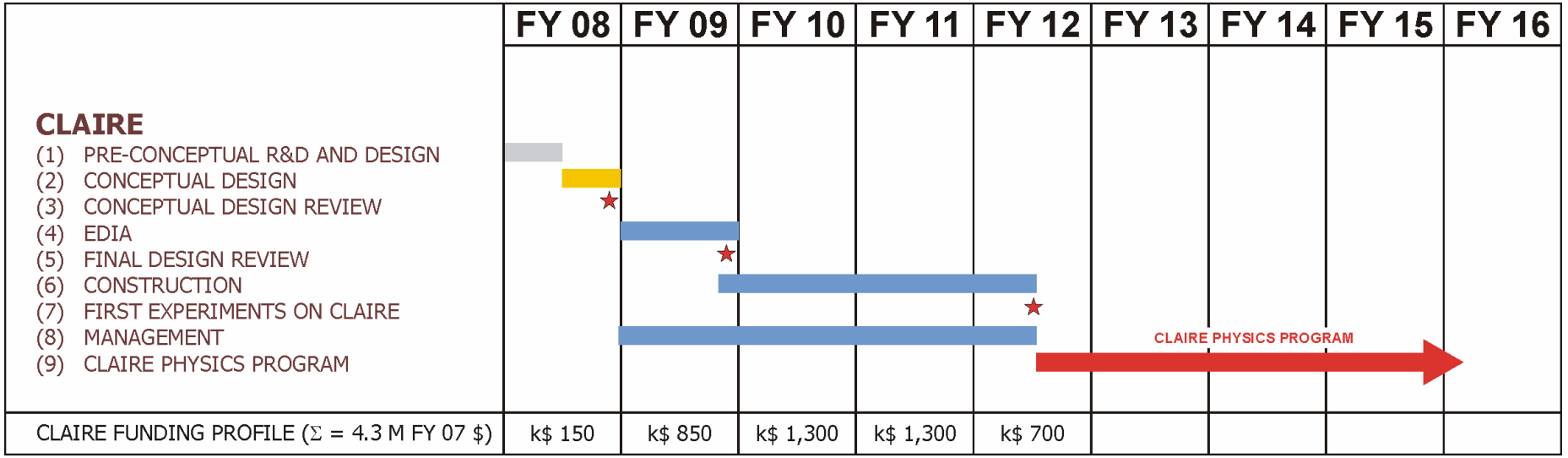


Underground Accelerator Laboratory
Low Energy Beamline Construction

WBS	Task Name	Cost	Start	Finish
0	CLAIRE-1	$4,296,028.57	Mon 9/3/07	Fri 5/25/12
1	PRE-CONCEPTUAL R&D AND DESIGN	$0.00	Mon 9/3/07	Thu 4/10/08
2	CONCEPTUAL DESIGN	$149,809.52	Thu 4/10/08	Wed 9/24/08
3	CONCEPTUAL DESIGN REVIEW	$0.00	Wed 9/24/08	Wed 9/24/08
4	EDIA	$390,314.29	Wed 9/24/08	Tue 9/29/09
5	FINAL DESIGN REVIEW	$0.00	Tue 9/29/09	Tue 9/29/09
6	CONSTRUCTION	$3,538,904.76	Thu 7/2/09	Fri 5/25/12
6.1	FABRICATION	$3,090,000.00	Thu 7/2/09	Fri 5/25/12
6.1.1	HV PLATFORM	$90,000.00	Thu 7/2/09	Fri 12/25/09
6.1.2	SOURCE	$90,000.00	Thu 7/2/09	Fri 12/25/09
6.1.3	EXTRACTION SYSTEM	$20,000.00	Fri 12/25/09	Wed 3/24/10
6.1.4	SOLENOID LENSES	$200,000.00	Thu 7/2/09	Wed 3/24/10
6.1.5	PUMPING SPOOLS	$40,000.00	Thu 7/2/09	Tue 9/29/09
6.1.6	HV COLUMN	$100,000.00	Thu 7/2/09	Fri 12/25/09
6.1.7	MOVABLE HV ELECTRODE	$30,000.00	Fri 12/25/09	Wed 3/24/10
6.1.8	ANALYZING MAGNET	$150,000.00	Wed 3/24/10	Thu 9/16/10
6.1.9	GAS JET	$40,000.00	Thu 7/2/09	Fri 12/25/09
6.1.10	GAS JET BAFFLES AND VACUUM PU	$60,000.00	Fri 12/25/09	Mon 6/21/10
6.1.11	GAS JET DIAGNOSTICS	$25,000.00	Mon 6/21/10	Tue 12/14/10
6.1.12	GE DETECTORS	$650,000.00	Fri 12/25/09	Tue 12/14/10
6.1.13	BEAM DUMP	$20,000.00	Tue 12/14/10	Fri 3/11/11
6.1.14	BEAM DIAGNOSTICS	$30,000.00	Fri 3/11/11	Wed 6/8/11
6.1.15	ROOTS BLOWERS	$140,000.00	Thu 7/2/09	Tue 9/29/09
6.1.16	STEERING COILS	$20,000.00	Tue 9/29/09	Thu 11/26/09
6.1.17	BEAMLINE ELEMENTS	$20,000.00	Thu 11/26/09	Tue 2/23/10
6.1.18	BEAMLINE HARDWARE	$20,000.00	Tue 2/23/10	Fri 5/21/10
6.1.19	HV PLATFORM SUPPORTS	$15,000.00	Wed 3/24/10	Mon 6/21/10
6.1.20	GROUND SUPPORTS	$15,000.00	Mon 6/21/10	Thu 9/16/10
6.1.21	GAS JET SUPPORT	$15,000.00	Thu 9/16/10	Tue 12/14/10
6.1.22	DETECTOR SUPPORT	$15,000.00	Tue 12/14/10	Fri 3/11/11
6.1.23	SAFETY ENCLOSURE	$10,000.00	Fri 5/21/10	Wed 8/18/10
6.1.24	EH&S SURVEILLANCE SYSTEMS	$10,000.00	Wed 8/18/10	Mon 11/15/10
6.1.25	PLUMBING	$25,000.00	Mon 11/15/10	Thu 2/10/11
6.1.26	ELECTRICITY	$25,000.00	Thu 2/10/11	Tue 5/10/11
6.1.27	WIRE WAYS	$15,000.00	Thu 9/16/10	Tue 12/14/10
6.1.28	CONTROL ROOM	$20,000.00	Tue 12/14/10	Fri 3/11/11
6.1.29	BEAMLINE POWER SUPPLIES & ELE	$200,000.00	Thu 9/16/10	Fri 3/11/11
6.1.30	VACUUM PUMPS BEAMLINE	$100,000.00	Tue 12/14/10	Wed 6/8/11
6.1.31	VACUUM PUMPS GAS JET	$300,000.00	Wed 6/8/11	Thu 12/1/11
6.1.32	ROOTS PUMPS GAS JET	$100,000.00	Thu 12/1/11	Fri 5/25/12
6.1.33	GAS RECIRCULATION SYSTEM	$100,000.00	Wed 6/8/11	Thu 12/1/11
6.1.34	GAS JET ELECTRONICS	$100,000.00	Thu 12/1/11	Fri 5/25/12
6.1.35	CONTROLS HARDWARE	$150,000.00	Thu 12/1/11	Fri 5/25/12
6.1.36	CONTROLS PROGRAMMING	$230,000.00	Wed 6/8/11	Wed 3/28/12
6.2	INSTALLATION	$312,000.00	Tue 7/20/10	Thu 7/7/11
6.2.1	PLATFORM INSTALLATION	$78,000.00	Tue 7/20/10	Fri 10/15/10
6.2.2	BEAMLINE INSTALLATION	$78,000.00	Fri 10/15/10	Wed 1/12/11
6.2.3	GAS JET INSTALLATION	$78,000.00	Wed 1/12/11	Mon 4/11/11
6.2.4	CONTROLS INSTALLATION	$78,000.00	Mon 4/11/11	Thu 7/7/11
6.3	EDIA (TITLE-3)	$136,904.76	Tue 7/20/10	Mon 4/23/12
6.3.1	DESIGN & ENGINEERING SUPPORT	$136,904.76	Tue 7/20/10	Mon 4/23/12
7	CONSTRUCTION COMPLETE	$0.00	Fri 5/25/12	Fri 5/25/12
8	MANAGEMENT	$217,000.00	Wed 9/24/08	Thu 5/24/12



Underground Accelerator Laboratory
Low Energy Beamline Construction



STRATEGIC PLANNING

BASIC ELEMENTS OF PROJECT MANAGEMENT METHODOLOGY

- Work Breakdown Structure (Scope)
- Scheduling
- Costing
- Resource Planning
- Contingency Planning (Risk Planning)
- Organization Planning
- Change Control

- LARGE PROJECT:
  - + Project Controls
  - + Baselining
  - + Reporting
  - + Earned Value Analysis

Implications for the Underground Accelerator Laboratory

CONCEPTUAL DESIGN NEEDS (Topics To Be Covered)

- **SCIENCE CASE**
  - Mission and science goals (incl. relationship to existing and other programs)
  - Definition and relative prioritization of the research objectives and science questions
- **DESIGN & ENGINEERING**
  - Description of the research infrastructure and technical requirements needed to meet the science
  - Budget and contingency estimates appropriate to a conceptual design
    - The budget information should be provided using a Work Breakdown Structure (WBS) format, identifying the basis for estimates and including a WBS dictionary that defines the scope associated with each WBS element. Contingency estimates should include an explanation of the methodology used to calculate the estimate.
    - Will lead to detailed bottom-up cost estimating during the preliminary design phase
  - Initial construction and commissioning schedule
- **PROJECT MANAGEMENT**
  - Plan for project management
  - Production of a draft Project Execution Plan (PEP)
  - Initial risk analysis and mitigation strategy for construction, identifying enabling technologies, high-risk or long-lead items, and Research and Development (R&D) needed to reduce project risk to acceptable levels;
  - Potential environmental and safety impacts to be considered in site selection
  - Initial estimate of annual operations and maintenance funding that will be needed if the facility is constructed and operated
- **S-4 SOLICITATION RESPONSE:**
  - Description of the scope of work, budget and schedule needed to continue planning the project to bring it to the next stage: **Requires Significant Engineering To Derive Objective Cost Estimates**

CONCEPTUAL DESIGN REPORT
TABLE OF CONTENTS

SCIENCE CASE

REQUIREMENTS

DESIGN & ENGINEERING

SITE INTEGRATION

PROJECT MANAGEMENT

M. Leitner – Apr 2008

NEXT STEPS

- Pre-CDR Document for S-4 Proposal
  - Responsibilities
  - Assignments
- Request Funds for CDR work