Absorber-Focus Coil Safety Working Group Update

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CENTER FOR BEAM PHYSICS

MICE Collaboration Meeting-Cosener's House
November 2, 2003

Outline

- Design status
- Work in progress
- Parallel meetings summary
- December review
- Acknowledgments

Design Status

- Adopted removable absorber configuration to decouple design of absorber from that of focus coil
  - this boundary condition forms the basis of all subsequent work
- In view of safety mandate, most of our recent work has focused on the absorber and hydrogen system
  - focus coil design is being optimized for cost and performance
    - does not affect us as long as interface (warm bore dimensions) unchanged
- We use updated BSC numbers from Palmer
  - requires vacuum window aperture slightly larger than had been assumed (r = 15 cm $\rightarrow$ 16 cm)
    - accommodated in subsequent design iterations
- Eliminated third window and Ar jacket from our design
  - we believe these unnecessary, except for Ar in selected locations

Design Status

- We continue to work toward Preliminary Safety Review
  - December 9–10 in Berkeley
  - review document in preparation
- We had briefing meeting with the RAL safety group on Thursday morning
- We (⇒ Black, with some help from Lau) are working toward "official" drawings with "official" dimensions

see http://hep04.phys.iit.edu/cooldemo/afcswg/review/layouts/overalllayout.pdf

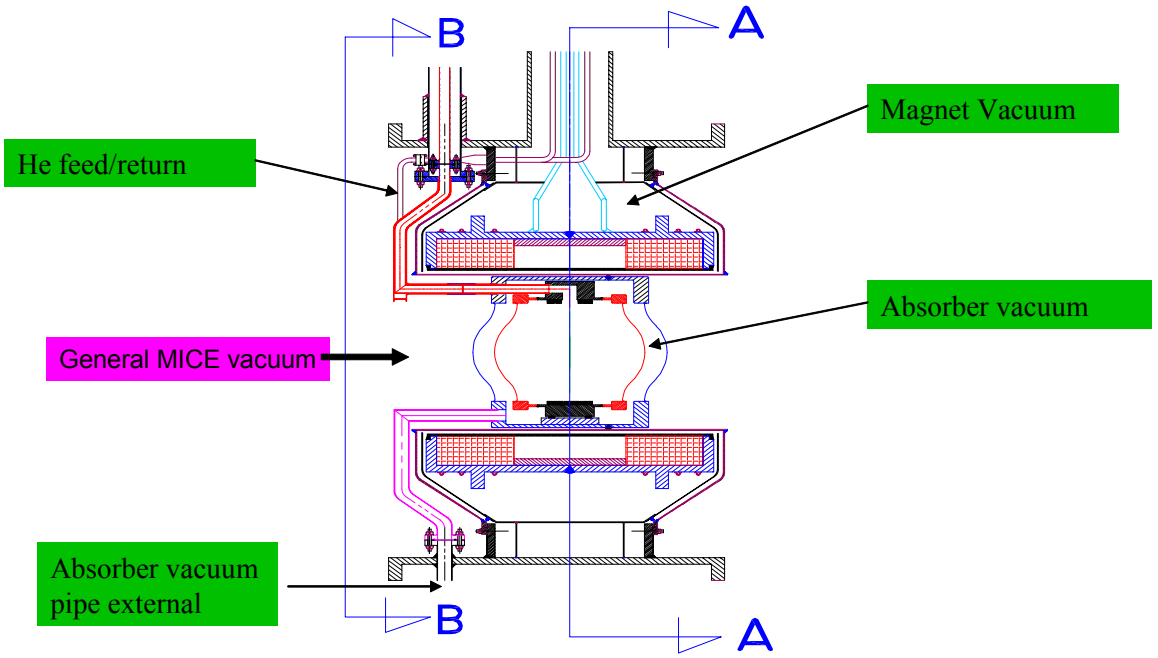
  - these will be approved by project management
- After the dimensions settle down (soon!), we propose to follow change control procedures on the drawings and other parameters

Work in Progress

- Main issue: design of absorber and vacuum windows
  - window shape will be double-curved version described in proposal
  - window material will be 6061 aluminum
- "To weld or not to weld, that ~~is~~ was the question"
  - original absorber concept based on a bolted window design
  - alternative welded design uses grindable weld to attach windows
  - we believe either can be made to work
- There are pros and cons for both approaches
  - non-welded design easier to assemble and disassemble
    - more prone to a leak after thermally cycling
  - welded design must be assembled or disassembled on bench
    - less prone to leak after assembly; and more familiar at RAL

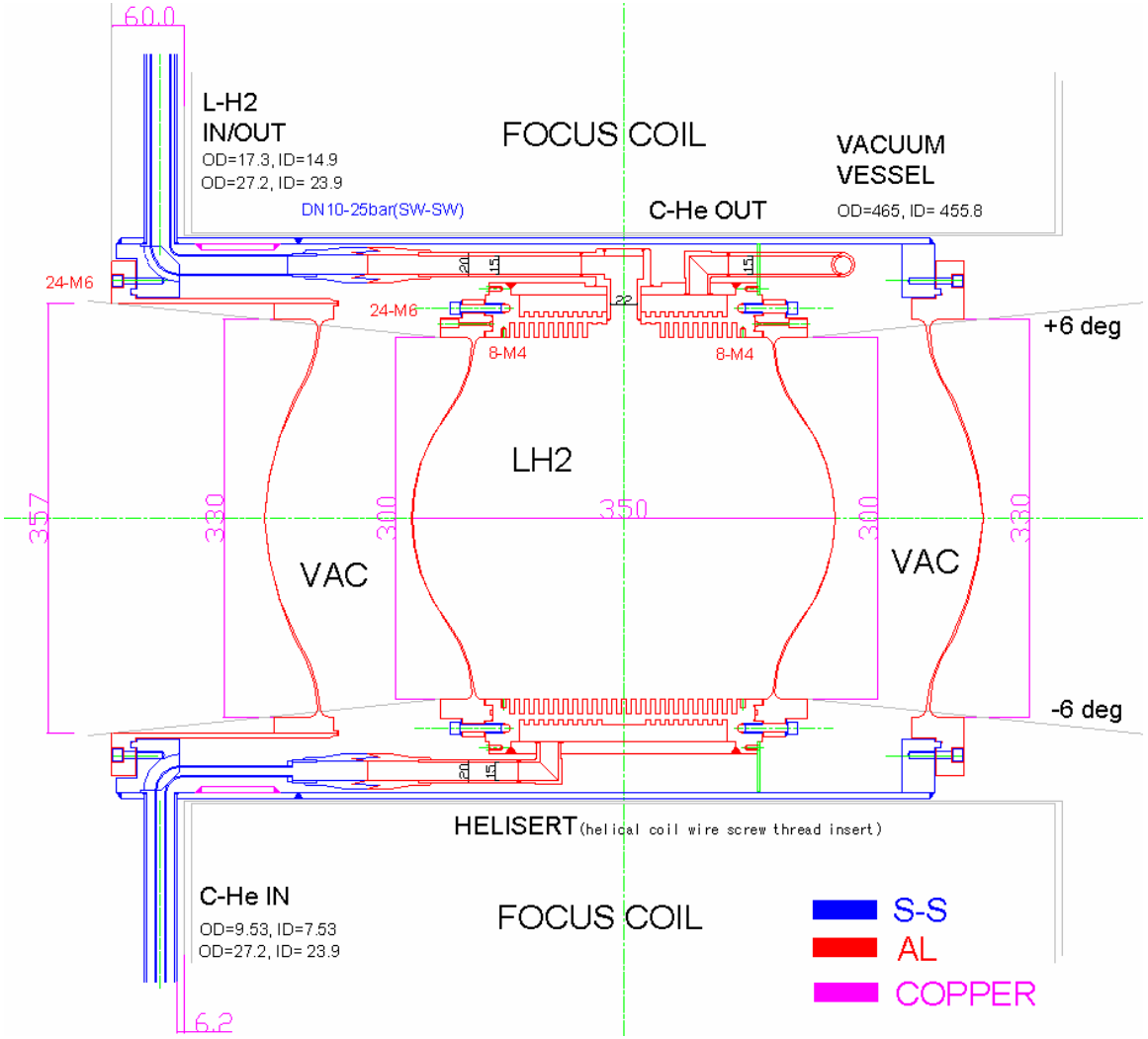
Work in Progress

- Basic design concept
  - the devil is in the details…and probably the costs too



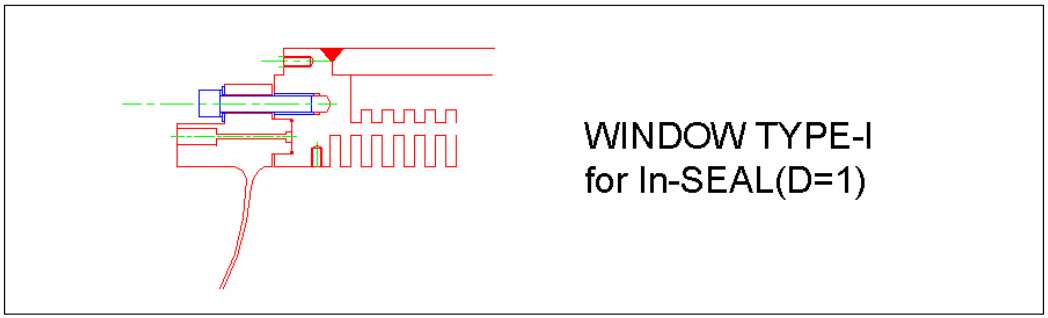
Work in Progress

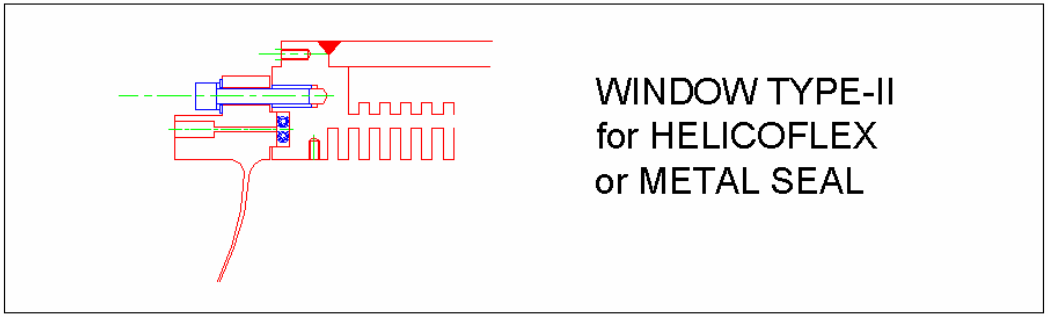
- **Bolted design concept**

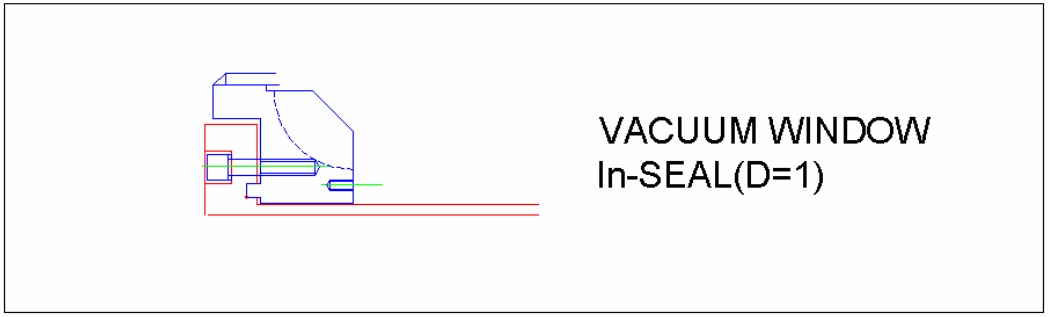


Work in Progress

- **Seal concepts**

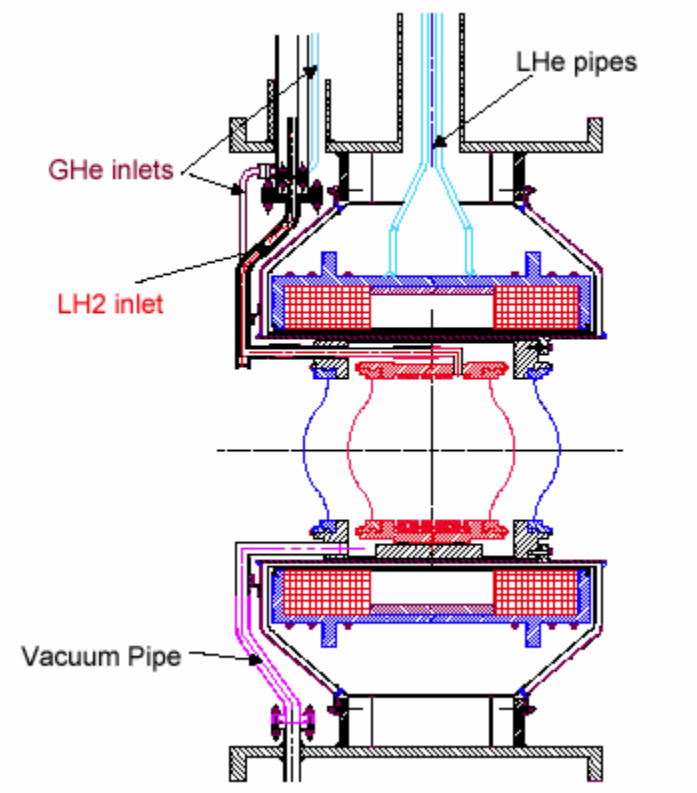






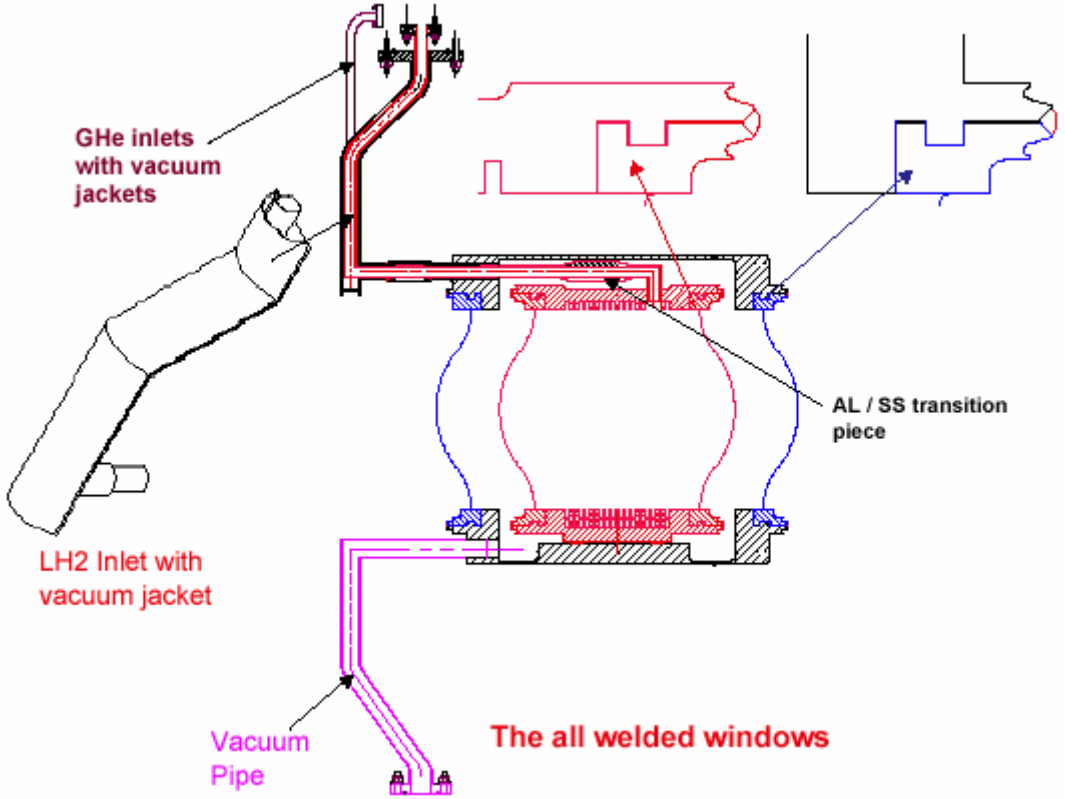
Work in Progress

- **Welded design concept**



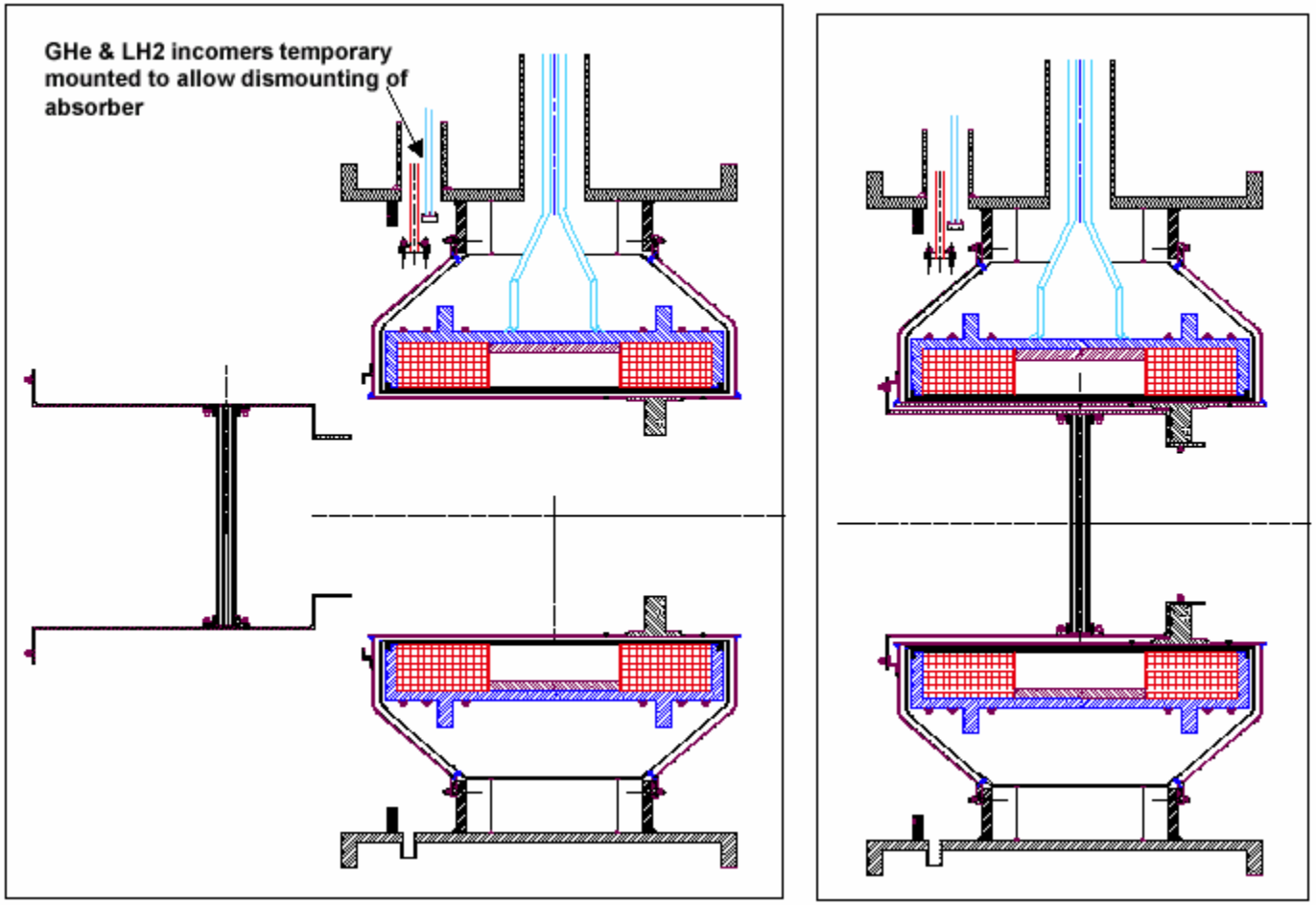
Work in Progress

- **Welded design details**



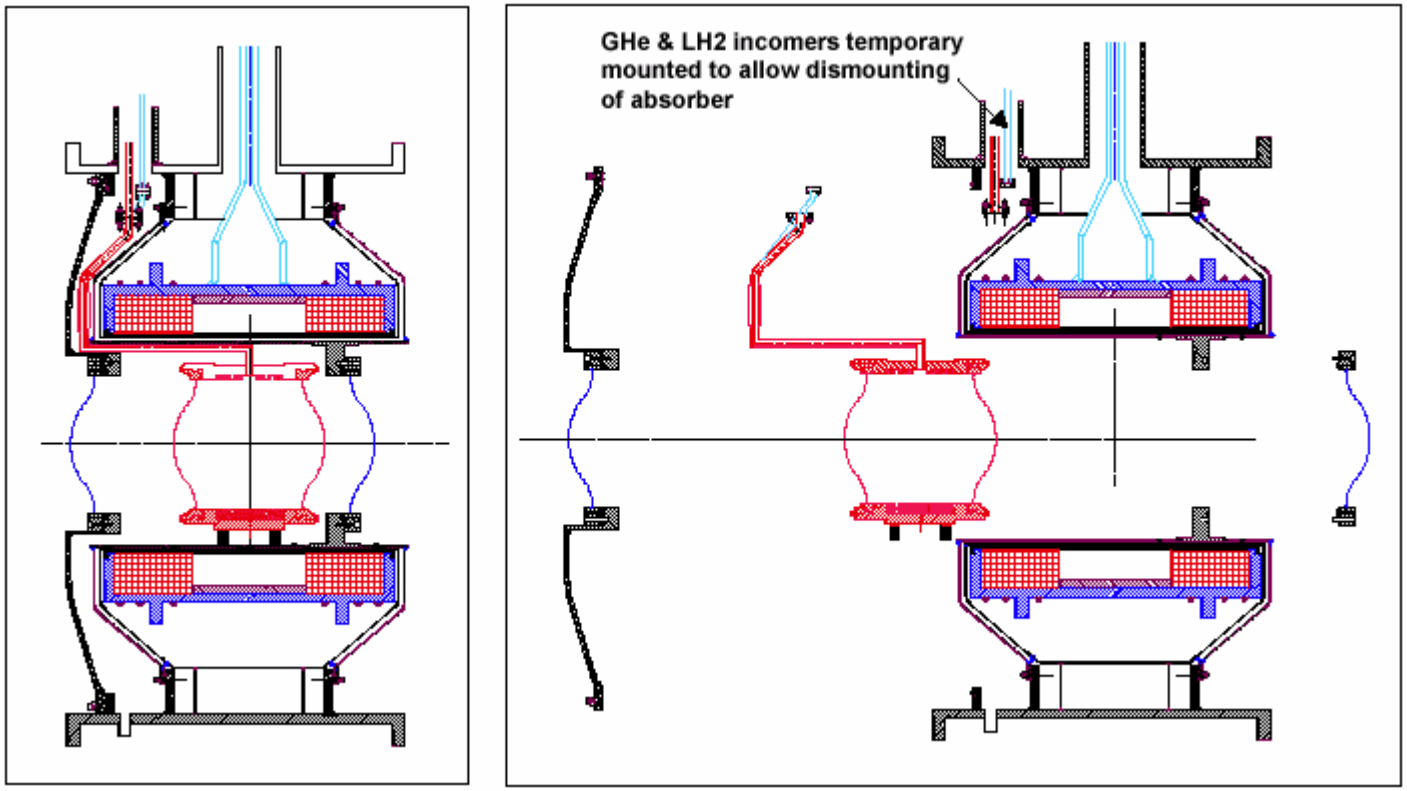
Work in Progress

- Solid absorber concept



Work in Progress

- Alternative concept for vacuum volume implementation



Work in Progress

- With alternative concept, focusing coil warm bore tube serves as absorber vacuum chamber
  - vacuum windows and "large vacuum dome" stay at room temperature
    - eases requirements for vacuum window and vacuum dome seals (no temperature cycling)
- Pros and cons
  - provides good access to absorber for installation and removal
  - contains all cold surfaces in absorber vacuum volume
  - eases evacuation of H_2 to buffer volume in event of absorber break
  - cannot check absorber and vacuum volume as a unit
  - must make up large sealing surface for testing

Work in Progress

- Evaluation of new warm-window idea requires additional "homework"
  - thermal shock effects on:
    - vacuum window
    - large vacuum dome seal
    - magnet warm-bore tube (sees cold H_2 if absorber window fails)
  - implications of one layer of MLI in front of window
  - size of vacuum relief pipe (more warm surface area to evolve H_2)
  - possibility for additional mechanical support from end of warm-bore tube to reduce deflections and stresses
- Evaluation of thermal shock on cold vacuum window due to "general vacuum" vent should also be checked
- Need for "shrapnel net" (and means to implement it) should be evaluated

Work in Progress

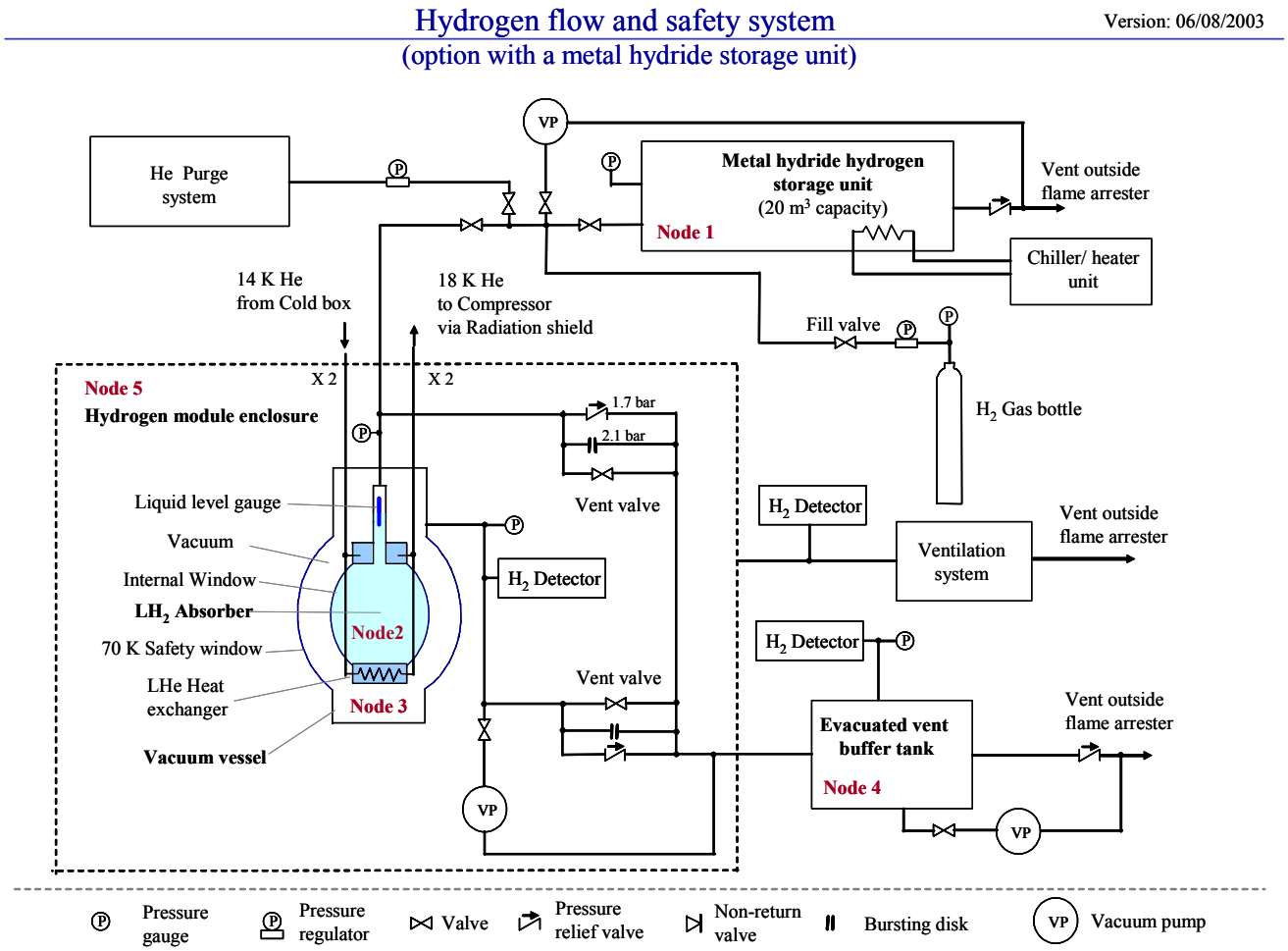
- Window parameters
  - can we get by with one window size and thickness?
    - single design to validate with R&D
    - need to check stay clear
    - need to slightly increase absorber volume
    - need to verify required safety margins (RAL cf. Fermilab)
- Pre-operation testing
  - to what pressure must we test a newly installed absorber prior to filling with H_2?

Work in Progress

- We examined alternative hydrogen storage schemes
  - three options considered
    - hydride beds to absorb gas and store it locally
    - large storage vessels to passively contain hydrogen
    - gas bottles, along with venting the hydrogen (safely) to air
- Preference is for hydride beds
  - technology commercialized (⇒ a number of possible suppliers)
    - technology could be used in hydrogen-powered cars
  - compact size makes it easy to enclose pipes with venting arrangement
  - this is baseline design approach

Work in Progress

- Block diagram of system based on metal hydride storage system



Parallel Meetings Summary

- We met with RAL safety folks and Paul Drumm on Thursday morning (October 30) to give them an update on:
  - where we are right now (~~Cummings~~→Zisman)
  - hydrogen system approach (Ivaniouchenkov)
  - what technical issues we are addressing (Baynham)
  - plans for the December review (Zisman)
  - R&D progress (Ishimoto, Black)
  - detector issues (Bross)
- Feedback we got was positive (Baynham's talk yesterday)
  - they are willing to work with us to arrive at solutions
  - they will help us decide what areas are "hydrogen areas" and how to deal with phototubes near absorbers
- They asked how can we check integrity of vacuum window in operation

Parallel Meetings Summary

- We also had a parallel session on Thursday afternoon (October 30) to converge on a design plan
- Given our mandate to make a final choice to pursue for detailed engineering, we arrived at the following:
  - adopt bolted design as baseline case; R&D to validate this will be highest priority
  - develop R&D program to validate welded design as a backup
- This is what we intend to present at the upcoming safety review
- This approach gives maximum flexibility in case of unanticipated problems with bolted design
  - or recommendation by reviewers that a welded design be adopted
- Either way, we recommend having complete spare absorber units tested and ready to go
  - absorber bodies cheap compared with cost of windows and especially compared with cost of beam time

December Review

- Dates: December 9–10
- Venue: LBNL
- Inputs (posted on web one week prior to review)
  - written design report (draft document in progress)
  - MICE technical proposal
  - technical notes referenced in design report
- Outputs
  - oral closeout with AFCSWG
  - oral closeout with MICE management
  - written report suitable for MICE management, RAL management and RAL safety group
- Charge to Committee being prepared for approval of Drumm and MICE management

December Review

- Proposed agenda (rough)
  - **Tuesday, December 9**

8:30 a.m.	Executive Session (Committee, Drumm, Spokesperson, Deputy Spokesperson)
9:00 a.m. to 3:15 p.m.	Presentations (AFCSWG members)
3:30 p.m. to 5:30 p.m.	Executive Session (Committee, Drumm,?) Additional questions given to AFCSWG

  - **Wednesday, December 10**

8:30 a.m.	Executive Session (Committee, Drumm,?)
9:00 a.m. to 10:15 a.m.	Responses to questions, if needed (AFCSWG members)
10:30 a.m. to 3:00 p.m.	Report Preparation (Committee)
3:15 p.m.	Closeout with AFCSWG
4:00 p.m.	Closeout with MICE management

December Review

- **Detailed agenda**

Tuesday, December 9

Time	Talk	Speaker
8:30 a.m. - 9:00 a.m.	EXECUTIVE SESSION	
9:00 a.m. - 9:20 a.m.	Context of Review: AFCSWG Task	Zisman
9:20 a.m. - 9:40 a.m.	Overview of Experiment and Parameter Choices	Barr
9:40 a.m. - 10:10 a.m.	Component Implementation: Magnets	Green
10:10 a.m. - 10 30 a.m.	BREAK	
10:30 a.m. - 11:00 a.m.	Component Implementation: Absorber	Cummings
11:00 a.m. - 11:30 a.m.	Component Implementation: LH_2 System	Bradshaw
11:30 a.m. - 11:55 a.m.	Component Implementation: RF System	Li
11:55 a.m. - 12:15 p.m.	Component Implementation: Detectors	Bross
12:15 p.m. - 1:15 p.m.	LUNCH	
1:15 p.m. - 1:45 p.m.	Magnetic Forces and Quench Issues	Baynham
1:45 p.m. - 2:45 p.m.	R&D, Testing and Certification Program	Lau
2:45 p.m. - 3:15 p.m.	Hazard Summary and Preliminary HAZOP	Ivaniouchenkov
3:15 p.m. - 3:30 p.m.	BREAK	
3: 30 p.m. - 5:30 p.m.	EXECUTIVE SESSION (preparation of additional questions)	
7:00 p.m.	DINNER (no host)	

December Review

Wednesday, December 10

Time	Talk	Speaker
8:30 a.m. - 9:00 a.m.	EXECUTIVE SESSION	
9:00 a.m. - 10:15 a.m.	Responses to Questions or REPORT PREPARATION	tbd
10:15 a.m. - 10 30 a.m.	BREAK	
10:30 a.m. - 12:00 p.m.	REPORT PREPARATION	
12:00 p.m. - 1:00 p.m.	LUNCH	
1:00 a.m. - 3:00 p.m.	REPORT PREPARATION	
3:00 p.m. - 3:15 p.m.	BREAK	
3:15 p.m. - 4:00 p.m.	CLOSEOUT with AFCSWG	
4:00 p.m. - 4:30 p.m.	CLOSEOUT with MICE management	
4:30 p.m.	ADJOURN	

December Review

- **Committee members**

Person	Institution	Accepted
Del Allspach	Fermilab	Yes
John Weisend*	SLAC	Yes
Mikell Seely	Jlab	Yes
Jim Wells	RAL	Yes
Gianpaolo Benincasa	CERN	Yes
Harold Beeson	NASA	Yes
Kimio Morimoto	KEK	Yes, but cannot attend

*Chairperson

Acknowledgments

- As always, my report represents the strong efforts of the AFCSWG members

Giles Barr (Oxford)
Elwyn Baynham (RAL)
Ed Black (IIT)
Tom Bradshaw (RAL)
Mary Anne Cummings (NIU)
Mike Green (LBNL)
Shigeru Ishimoto (KEK)
Iouri Ivaniouchenkov (RAL)
Wing Lau (Oxford)

Mike Zisman (LBNL), convener

"There they go, and I must hurry after them…for I am their leader"

- Link to our group activities, found on main MICE web site, is http://hep04.phys.iit.edu/cooldemo/afcswg/afcswg.html

  — meeting presentations are all available, thanks to Yağmur