

2008 Solar Annual Review Meeting

Session: PDIL/CIGS platform
Company or Organization: NREL
Funding Opportunity: EE&RE
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Design Team

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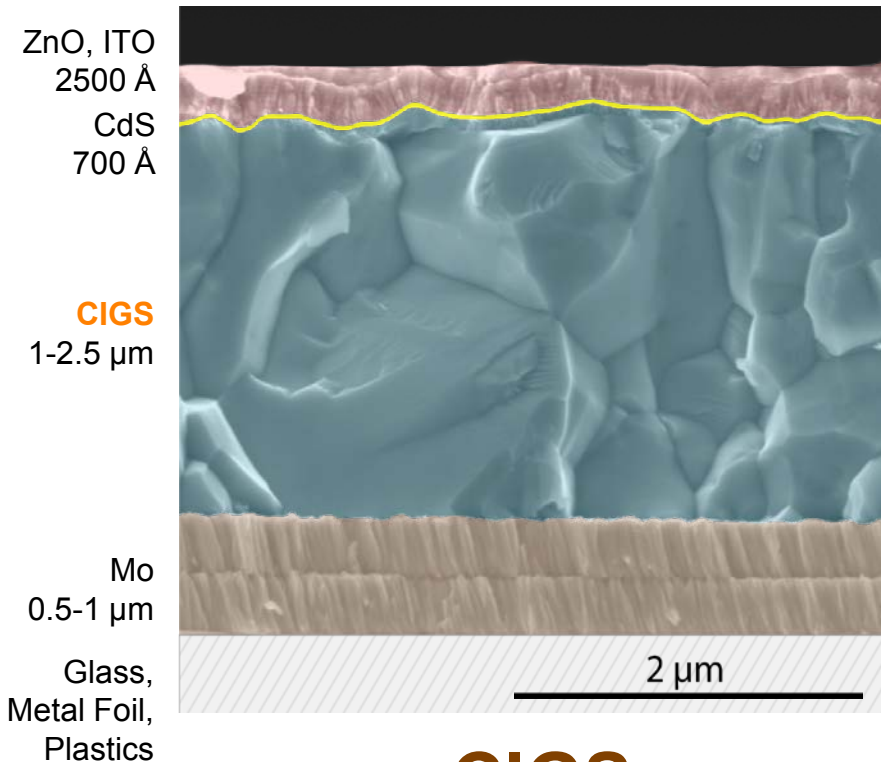
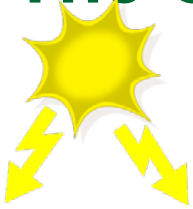
Kannan Ramanathan, David Young, Fallah Hasoon,
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Office of Energy Efficiency & Renewable Energy*

Innovation for Our Energy Future

The CIGS cell and its processing



CIGS

- layer 1: DC sputtering for back contacts
- layer 2: UHV CIGS evaporation
- layer 3: RF sputtering for “window” layers (CdS, ZnS, others)
- layer 4 : RF sputtering for TCO’s
- metallization or top contacts + AR coatings

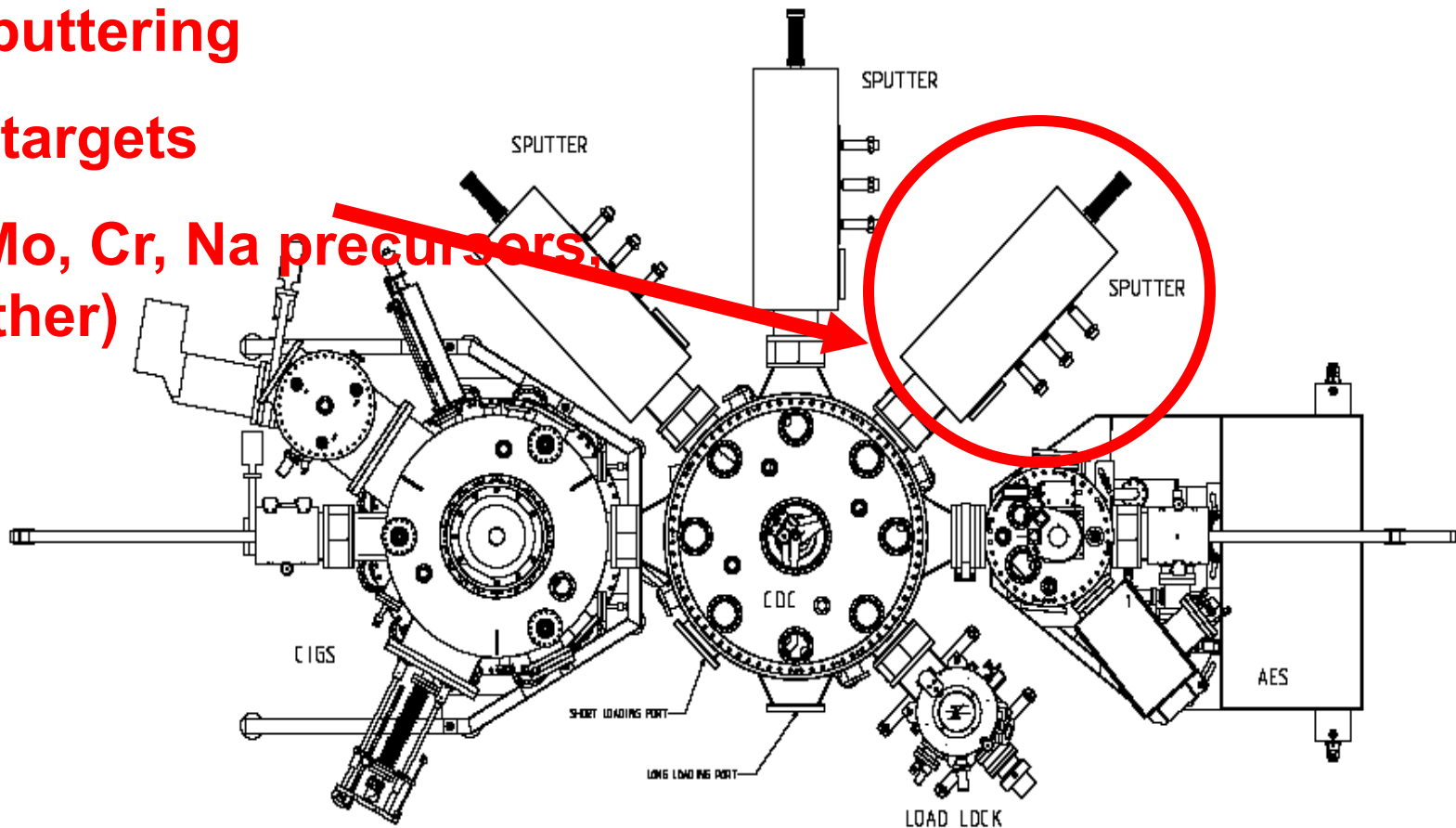
The CIGS Cluster Tool 1



Back Contacts by DC sputtering

3 targets

(Mo, Cr, Na precursors, other)

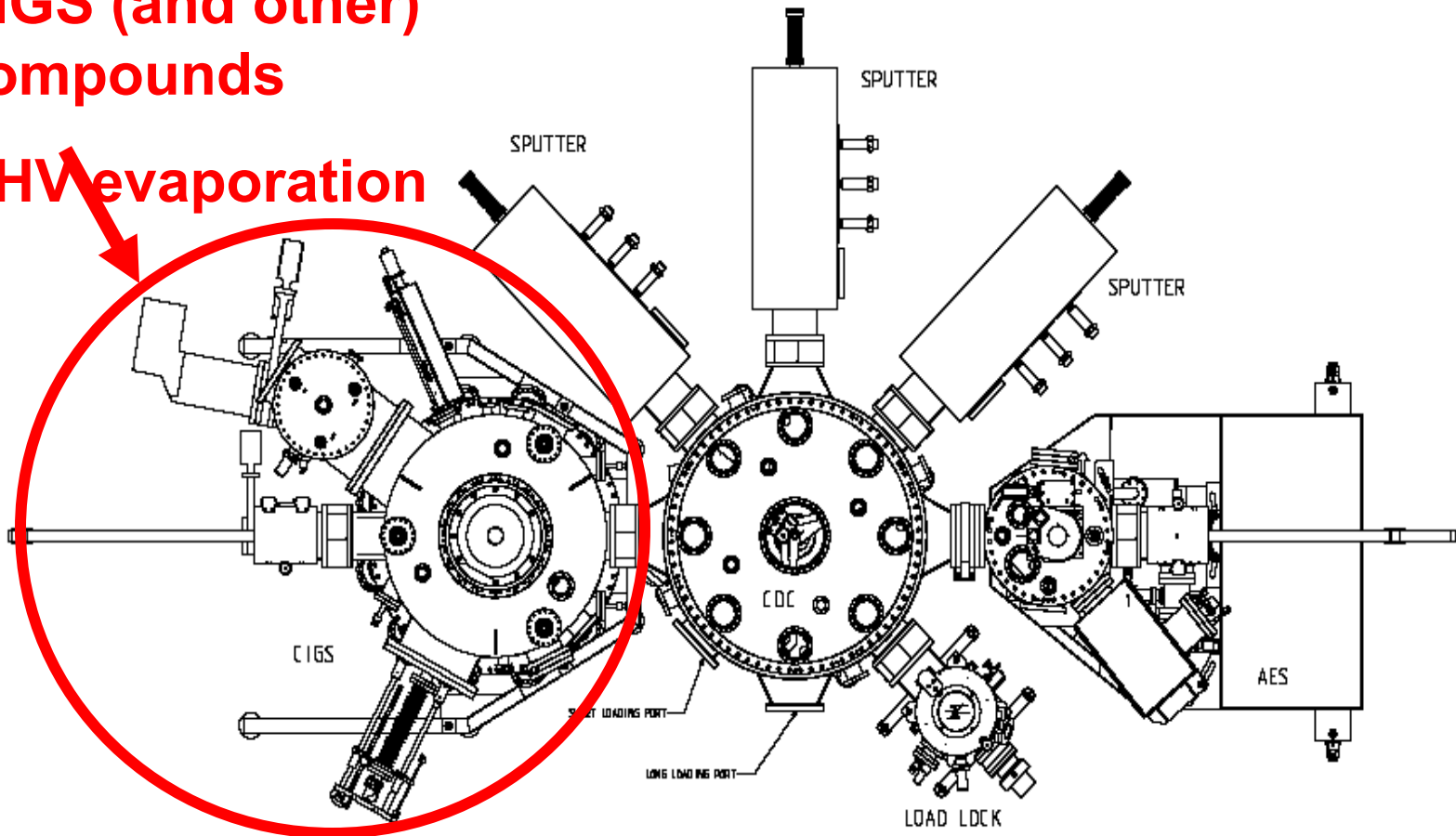


The CIGS Cluster Tool 2



**CIGS (and other)
compounds**

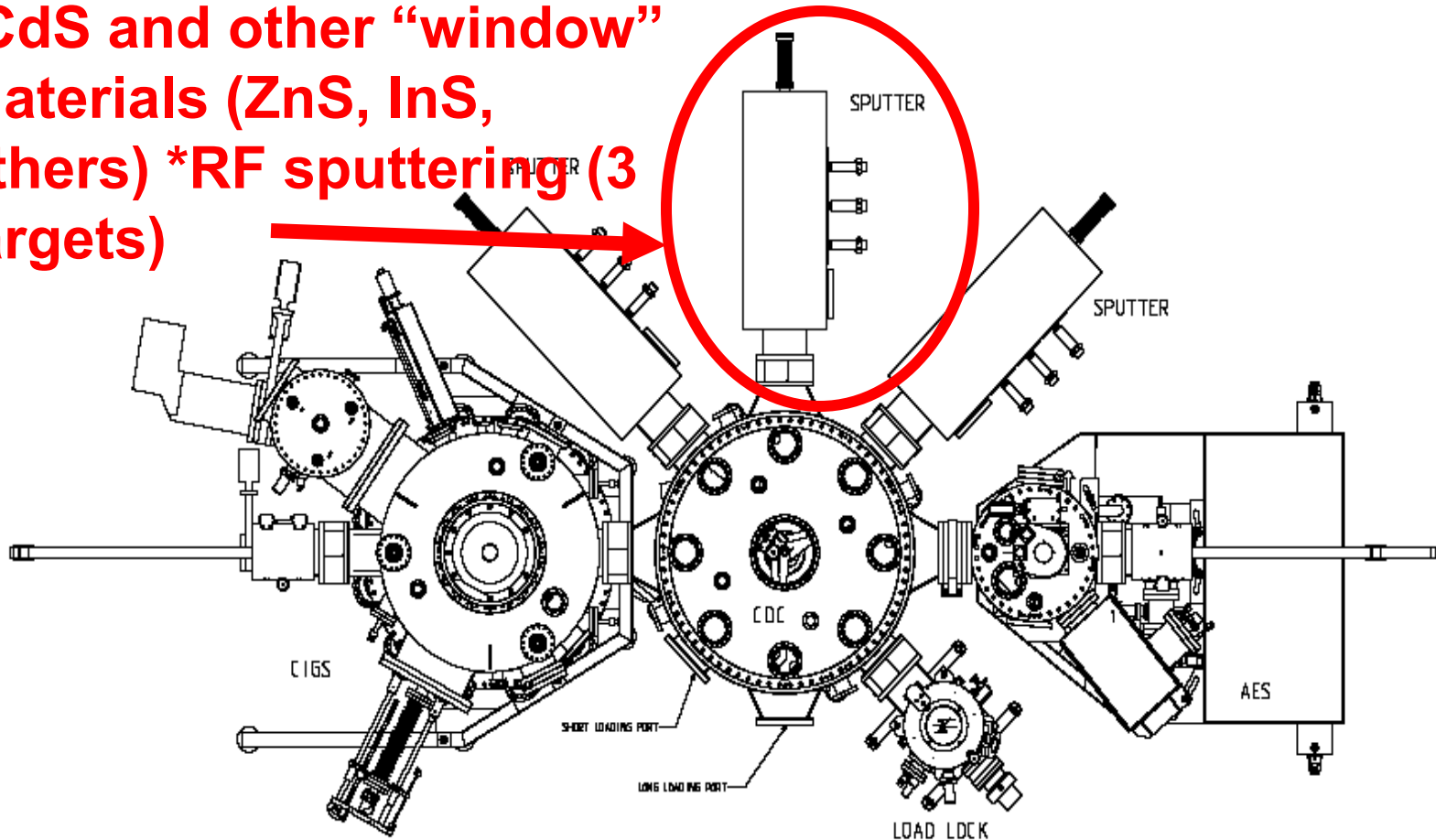
UHV evaporation



The CIGS Cluster Tool 3



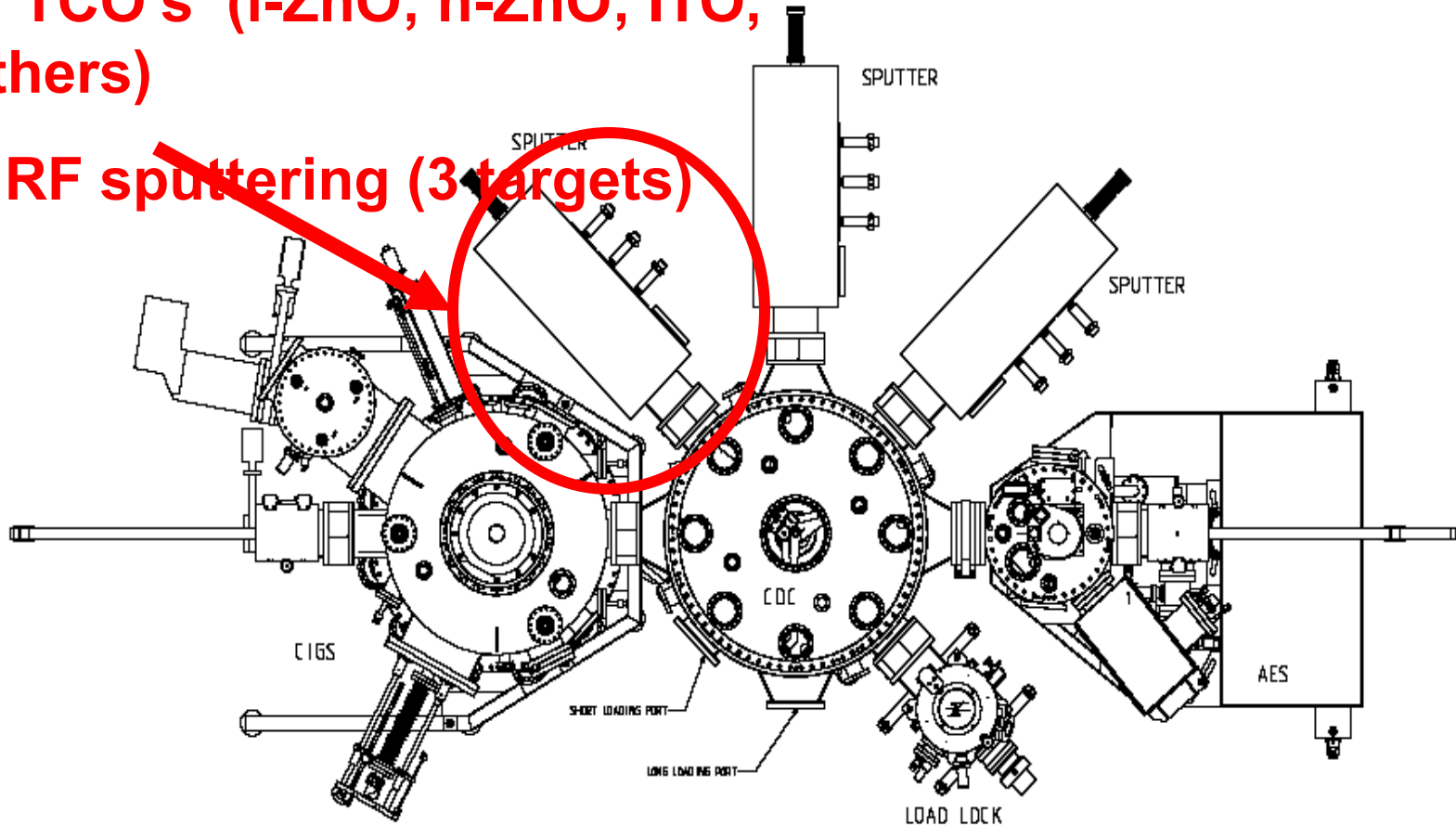
***CdS and other “window” materials (ZnS, InS, others) *RF sputtering (3 targets)**



The CIGS Cluster Tool 4



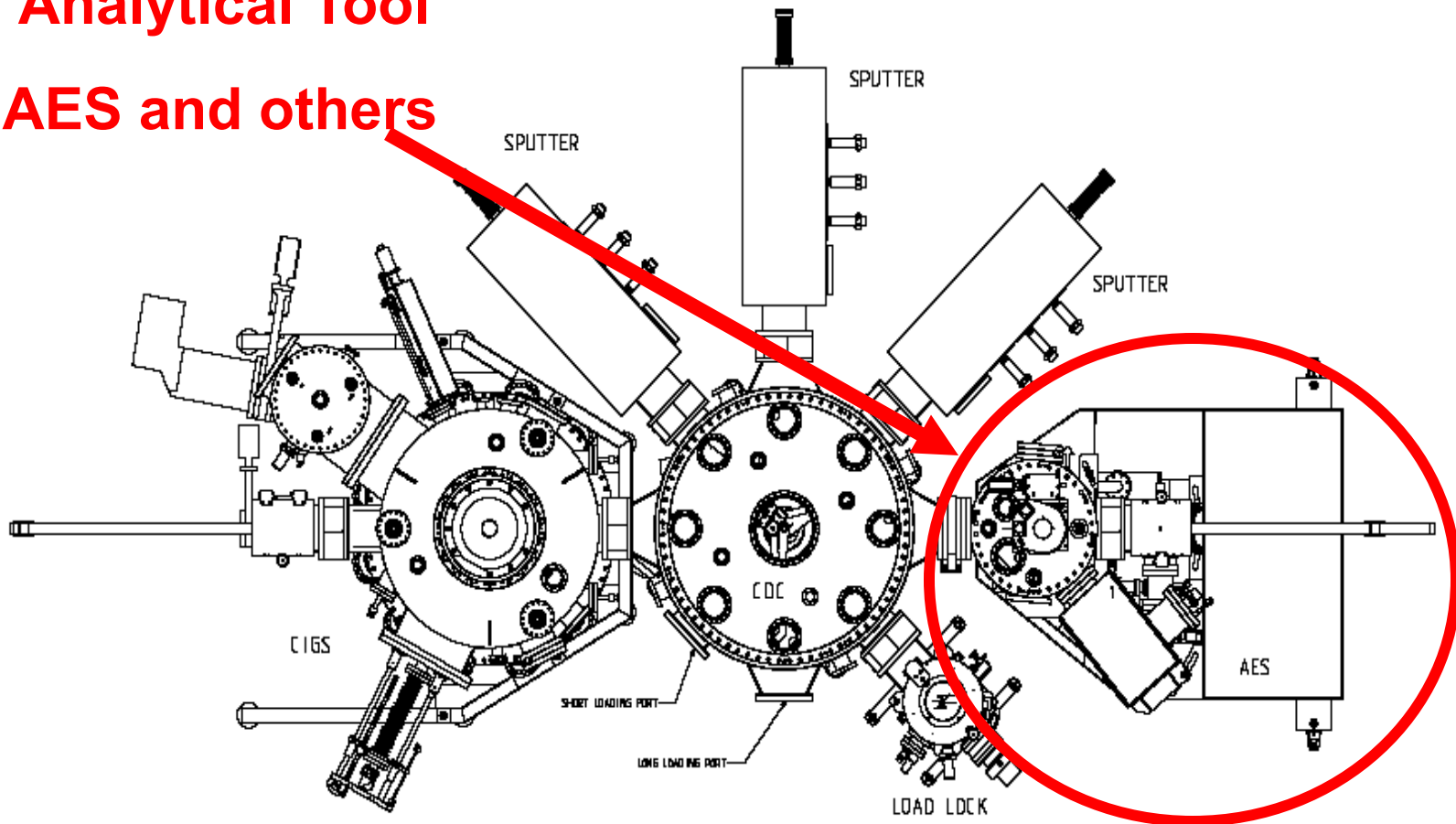
- TCO's (i-ZnO; n-ZnO; ITO, others)
- RF sputtering (3 targets)



The CIGS Cluster Tool 5



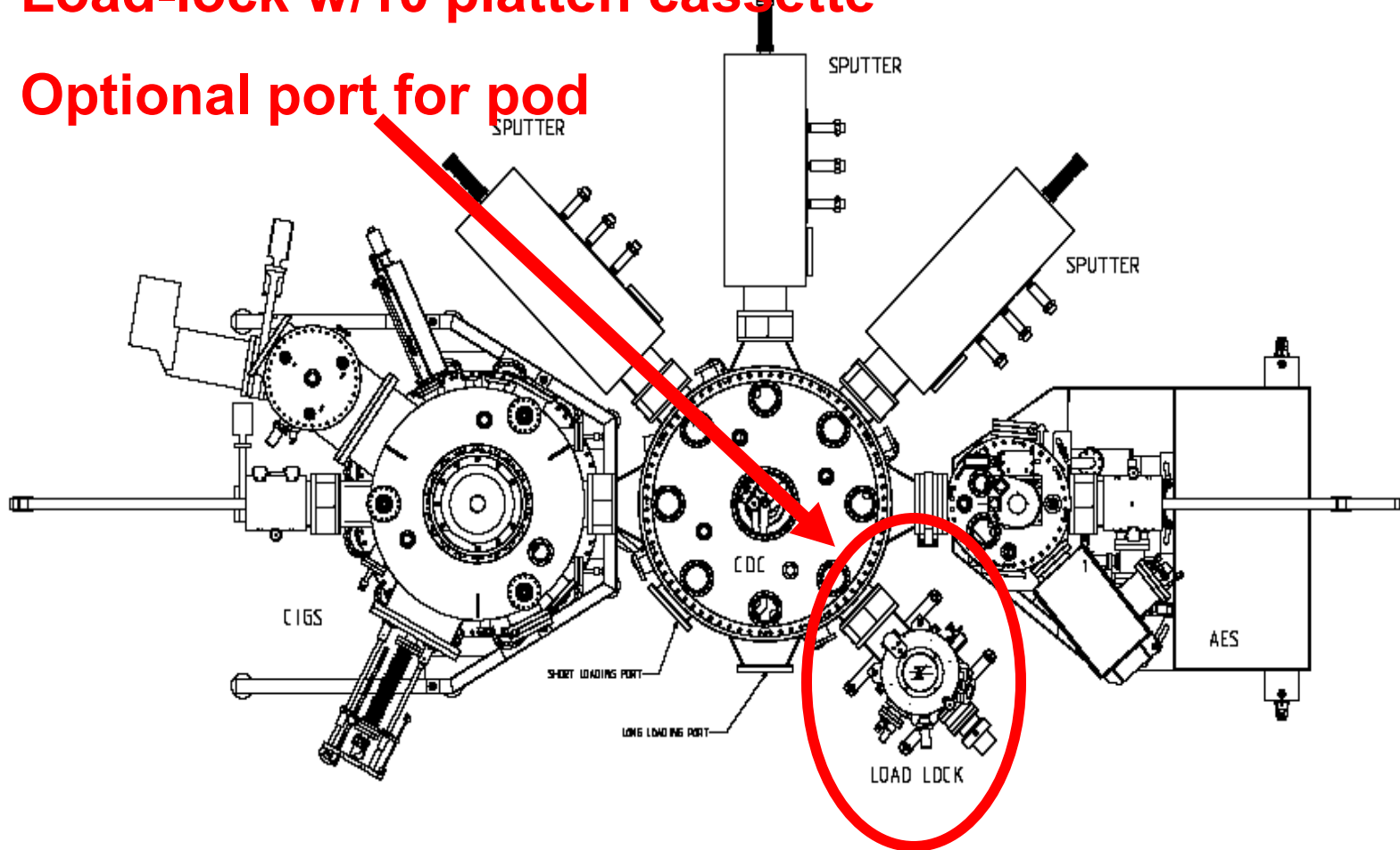
- Analytical Tool
- AES and others



The CIGS Cluster Tool 6



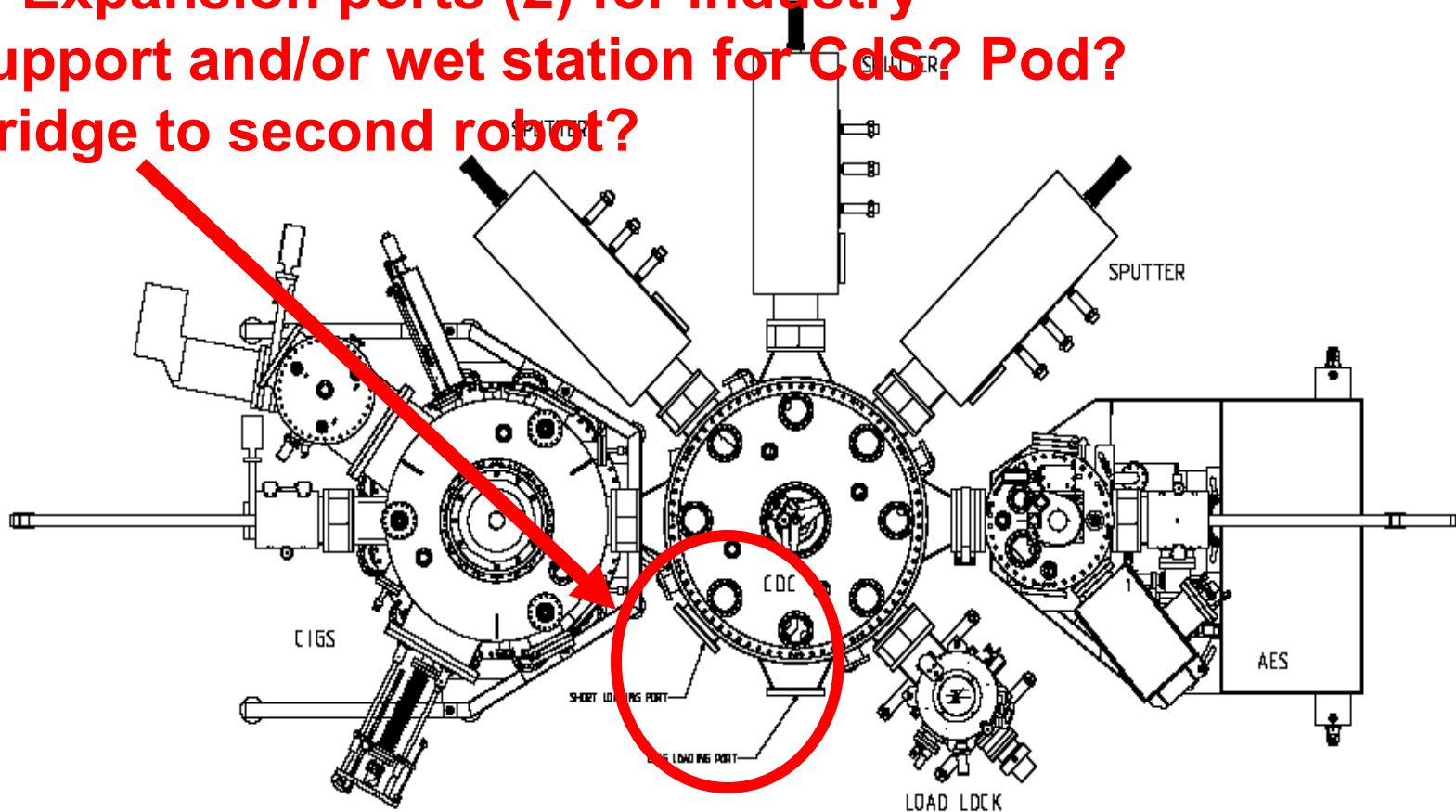
- Load-lock w/10 platten cassette
- Optional port for pod



The CIGS Cluster Tool 7



- Expansion ports (2) for industry support and/or wet station for CdS? Pod? Bridge to second robot?



Design Concepts



#1 Allows for state-of-the-art CIGS solar cell fabrication in an integrated fashion and enables new fundamental studies

#2 Allows all process steps to manufacture a CIGS coupon of 6" x 6" (PDIL std) adding new capabilities aimed at addressing relevant issues to industrial processes. Tool must also interface with other tools

#3 Supports commercialization efforts by US industry working in CIGS PV technology by addressing highly specific industrial issues

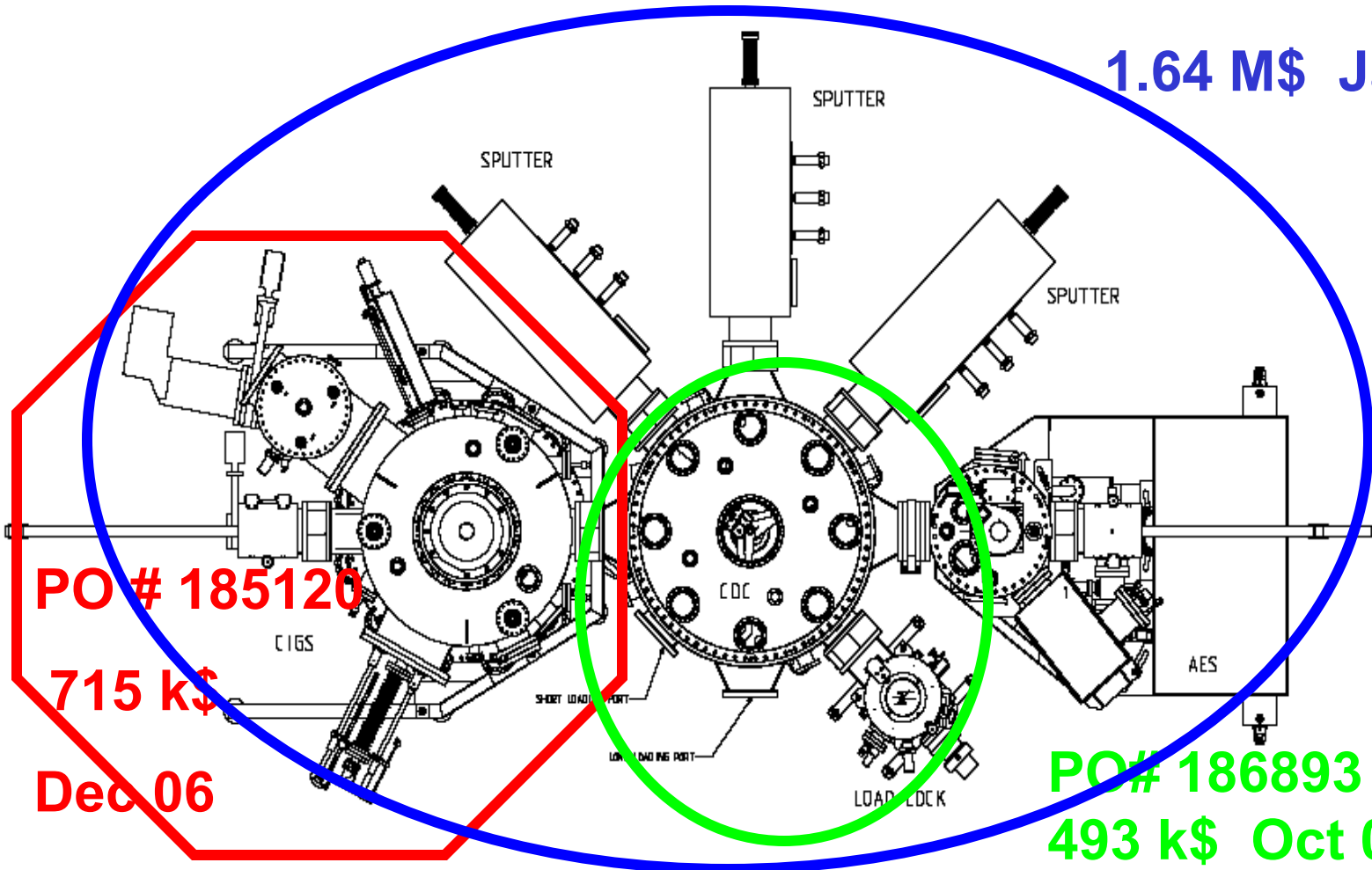
#4 Allows for future expansion (new processes, new compound semiconductor materials, etc.)

Cluster Tool costs/ordering



PO # 187426

1.64 M\$ Jan 08



PO # 185120

715 k\$

Dec 06

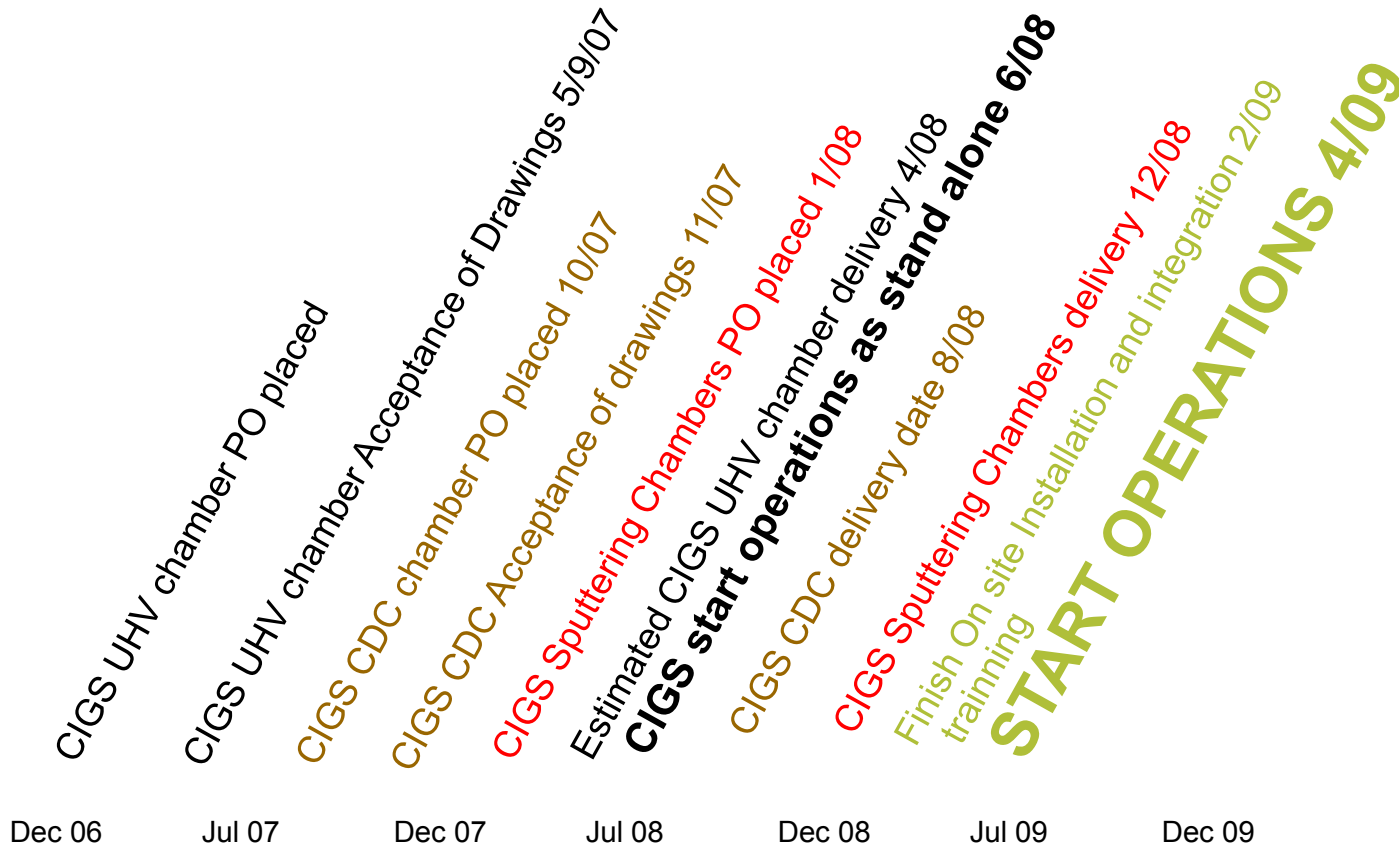
PO# 186893

493 k\$ Oct 07

The CIGS chamber



The CIGS Cluster Tool Timetable





- **Barriers encountered or anticipated that may inhibit success of programs**
 - The standard size of substrates (6"x6") will require the use of larger amounts of materials than we currently use: increase of operational costs to run the tool (true for all conversion technologies tools) => need for increased funding/support
 - The demand for steel (including that used in the fabrication of vacuum chambers) continues to increase to record levels worldwide. There is a possibility the construction of the sputtering modules (last items purchased to build the CIGS tool) may be delayed due to this current market situation in the steel industry.



CdTe Platform

Tim Gessert

		PV Technology Road Maps						
Platform		Wafer Si	Film Si	CPV	CdTe	CIGS	OPV	DSPV
	Thin Si							
	Wafer Rep.							
	CIGS							
	CdTe							
	Atm. Proc.							
	M&C Ind.							
	M&C Cluster							