
2008 Solar Annual Review Meeting

Session: CdTe - PDIL Platform

Company or Organization: National Center for Photovoltaics

Funding Opportunity: EE&RE



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Initial Identification of Potential CdTe Platform “Customers”

NREL

Identified Industrial Partners

First Solar

AVA Solar

Solar Fields

Primestar Solar

Canrom

Some Institutional/Academic Partners

Univ. South Florida

Inst. Energy Conversion / Univ. Delaware

Colorado School of Mines

Colorado State Univ.

Univ. Toledo

Univ. Texas El Paso

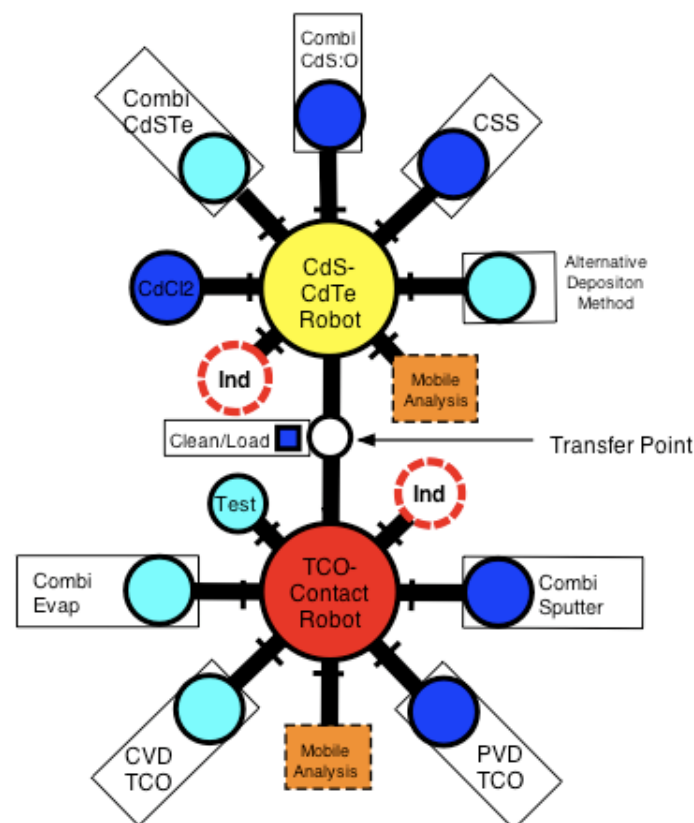
Others

CdTe PDIL Platform



Concept for 2-Robot CdTe Platform

1. Allows vacuum process CdTe PV devices from “Start-to-Finish”
2. Includes “baseline process” using NREL world-record process steps (6 ports)
3. Includes industry-consistent alternatives to NREL baseline process steps (5 ports)
4. Mobile Analysis (2 ports)
5. Ports for industry or expansion (2 ports)
6. Overall design consistent with later expansion



Approx. 30 feet

Approx. 25 Feet

CdTe PDIL Platform



Combinations of CdTe Device Fabrication Processes

Device Producer	TCO	CdS	CdTe	CdCl ₂	Pre-Contact	Contact
SMU/USF	D	W	D	W	W	W
Photon Energy/ Golden Photon	D	W	W	W	W	W
Industry 1	D	D	D	W	W	D
Industry 2	D	D	D	W	W	D
IEC	D	D	D	D	W	D
UT 1	D	D	D	W	W	D
UT 2	D	D	D	D	D	D
BP Solar	D	W	W	W	W	D
NREL 1	D	W	D	D	W	W
NREL 2	D	D	D	D	D	D
NREL 3	D	D	D	D	W	D
CSM 1 (Ametec)	D	W	W	W	W	D
CSM 2	D	D	D	D	W	D
Industry 3	D	D	D	D	D	W
Industry 4	D	D	D	?	?	D
Industry 5	D NREL3	D CSM2	D CSM2	D	D NREL2	D NREL2
Industry 6	D	D	D	W	W	D
Industry 7 (NREL 3)	D	D	D	D	?	D
Industry 8	D	W	W	W	?	D

Wet
Mostly
Dry
Dry



Re-Visit Potential Customer List

<u>Customer</u>	<u>Potential Value of Tool</u>
NREL	16-18% Industrially Relevant Processes (20%?)
Industrial Partners	
Established Companies	???General Understanding Process Variables???
Startup Companies	Available Designs for 10-12% Dry Process
Prospective Startups	Demo Dry Process @14%
Institutional/Academic Partners	Compact, <i>Cost-Defined</i> , 10%, Available Design
Glass Companies	CRADAs for Product Qualification Available Designs for 10-12% Dry Process
Chemical Companies	CRADAs for Product Qualification Available Designs for 10-12% Dry Process



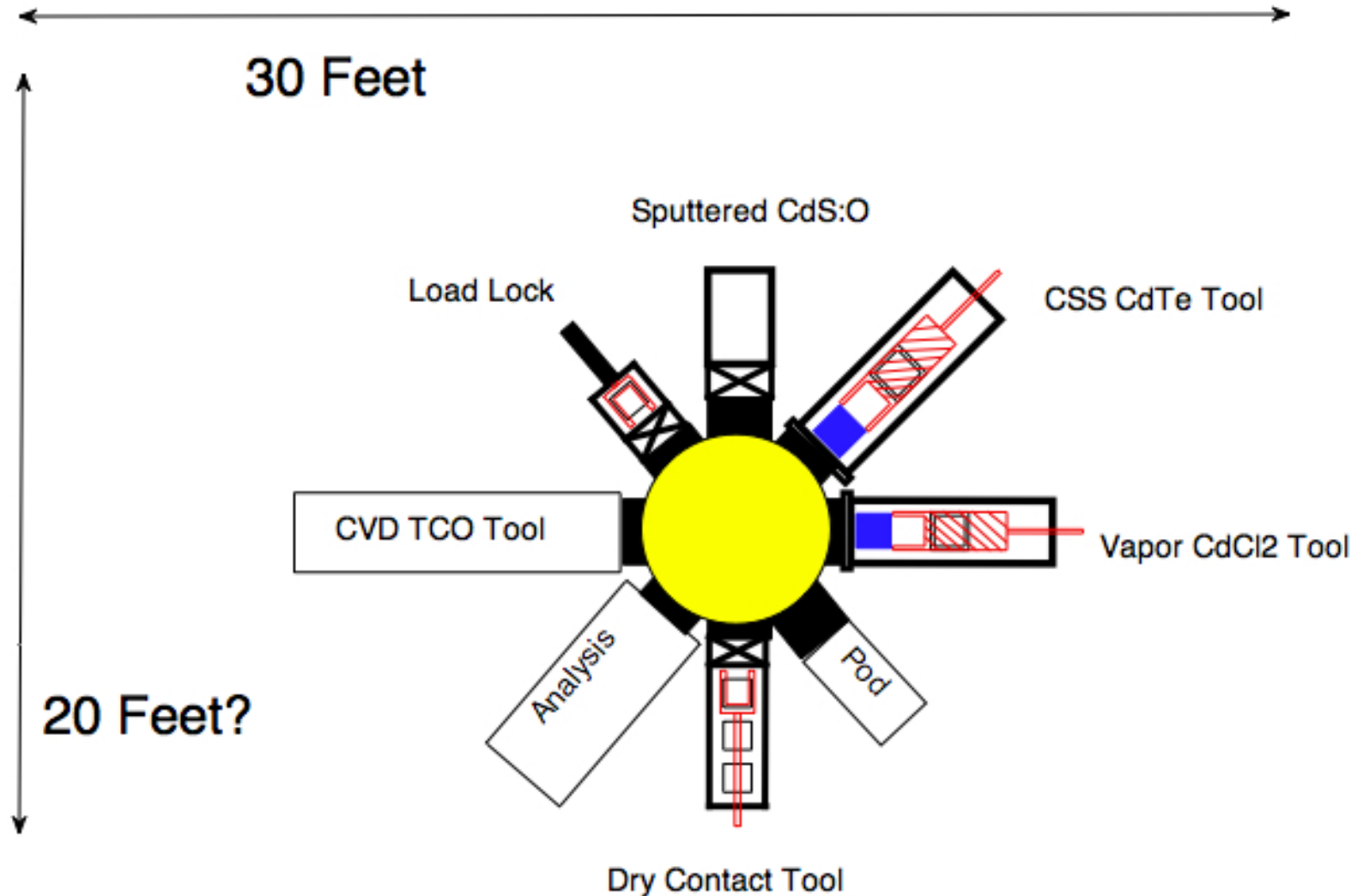
Design of Research vs. Large Production CdTe Systems

Criteria	Research Design	Production Design	Ratio
Deposit Area	6"x6"	24"x48"	1:32
Process Speed (minimum)	1 step/hr	~60 steps/hr	1:60
Samples to Service	100 samples	10,000 samples	1:100
SNAFU Tolerance	Low	High	-
Samples per Run	1-10 samples	10,000 samples	-
Start/Stop Time	~30 min	~8 hr	-
Dormancy	~90% of time	Only for Service	-
Process Sequence	Recipe Driven Can Skip Steps Can Change Order Can Change Time	In-Line All Steps - Every Time Same Order Same Time/Step	-
Shutter	Very Important	No Need	-
Scheduled Service	Variable	Weekly (Weekend)	-

CdTe PDIL Platform

Phase 1 Design

All Dry, Soda-Lime Glass, ~14%

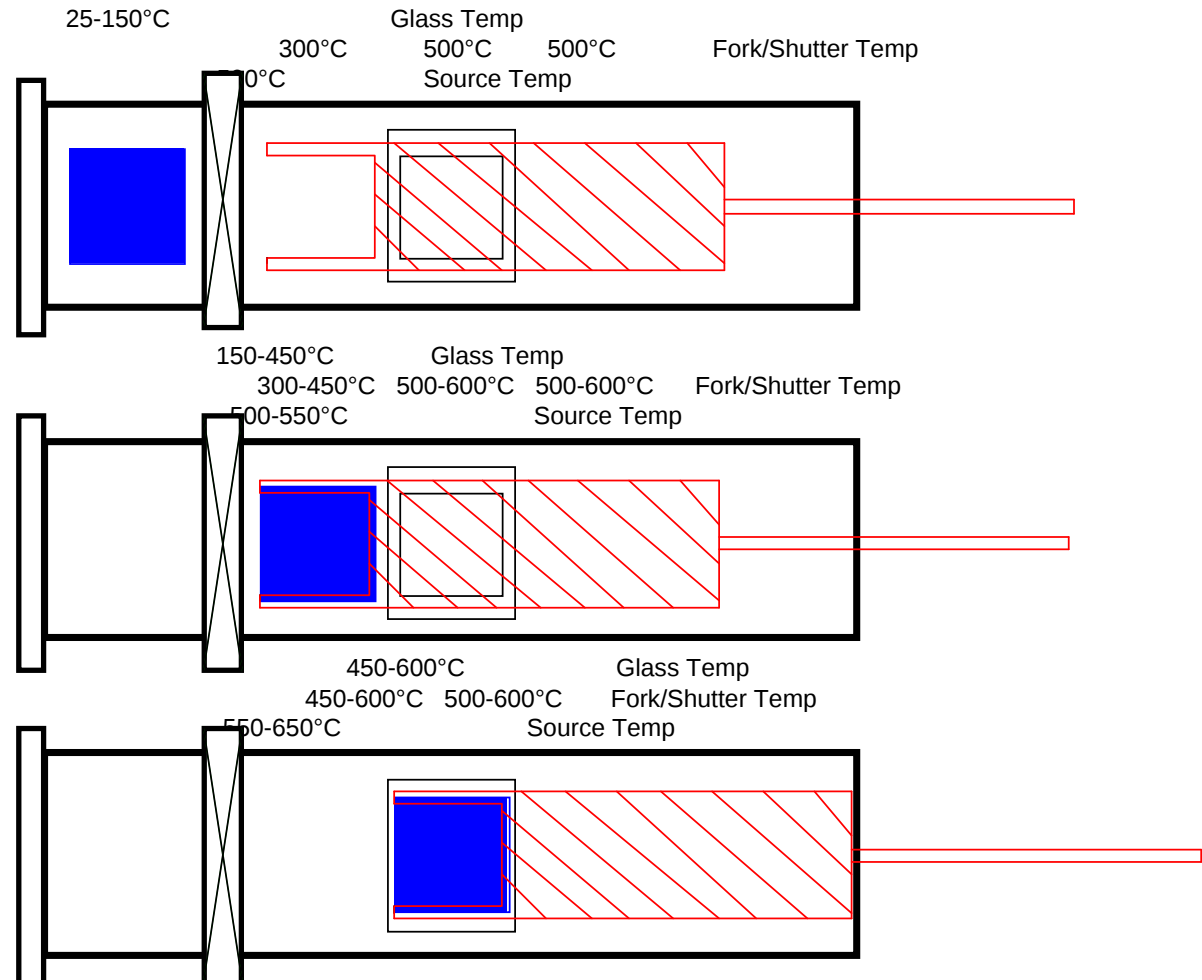


Critical Design Issues

All CdTe PDIL Platform Chambers Must Consider the low Thermal-Shock tolerance of Soda-Lime Glass ($\Delta T < 150^\circ\text{C}$)

Biggest Concern for CSS chamber where temperature difference potential is $\sim 600^\circ\text{C}$

Also must consider the design of an integral shutter

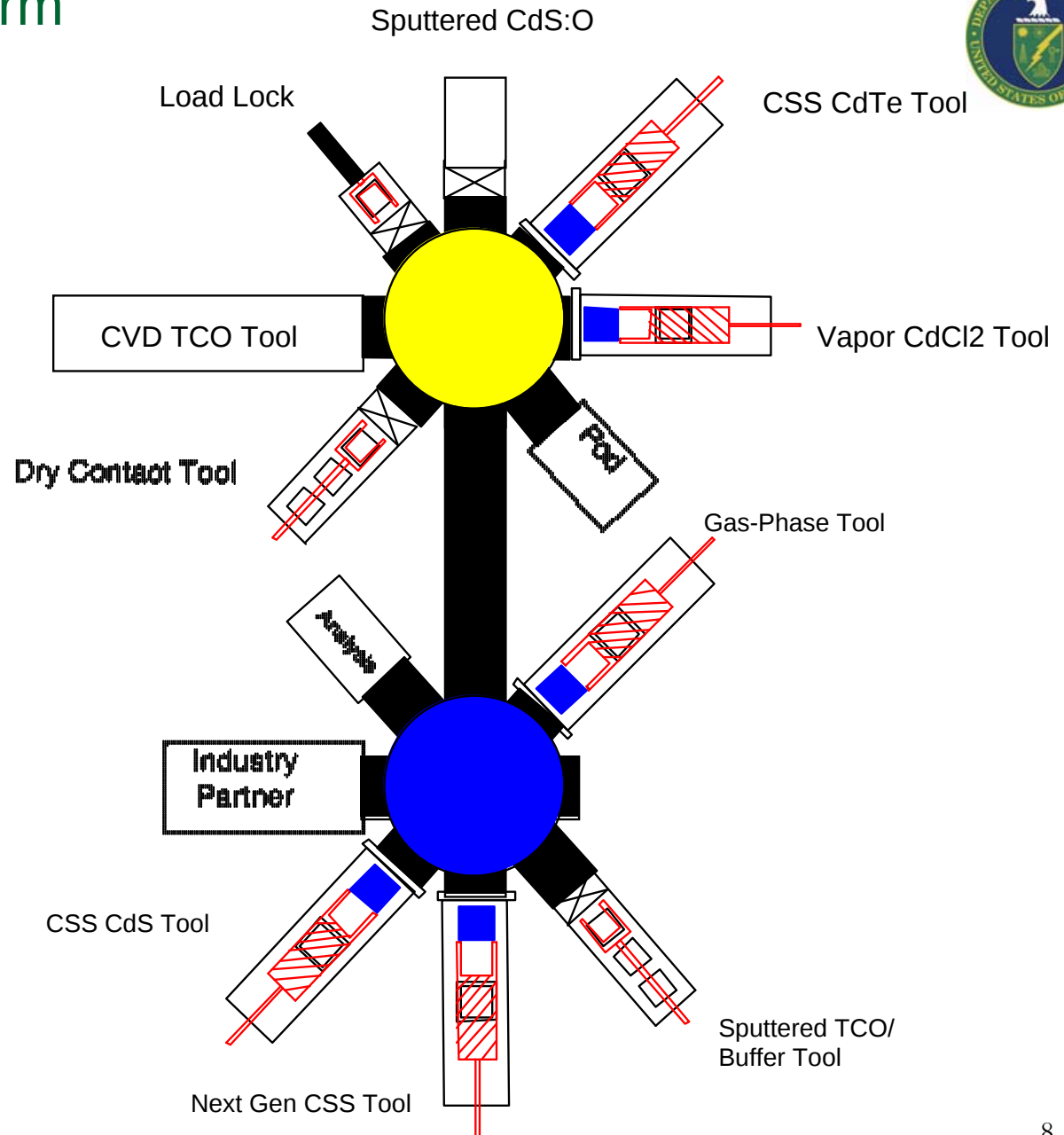


CdTe PDIL Platform



Phase 2 Design
All Dry, 15-17%+

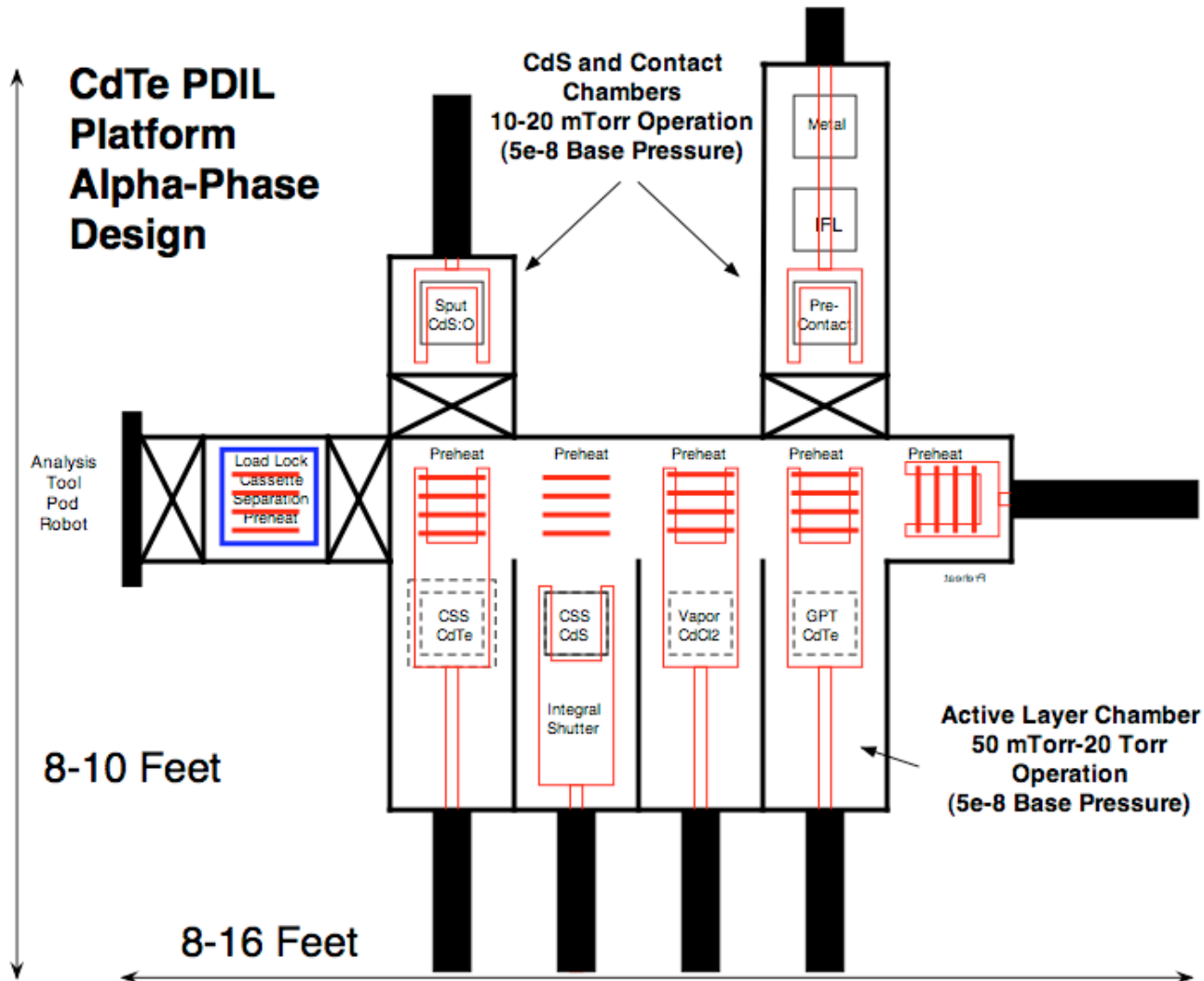
Allows for comparing
process options and
processes from
industrial partner(s)



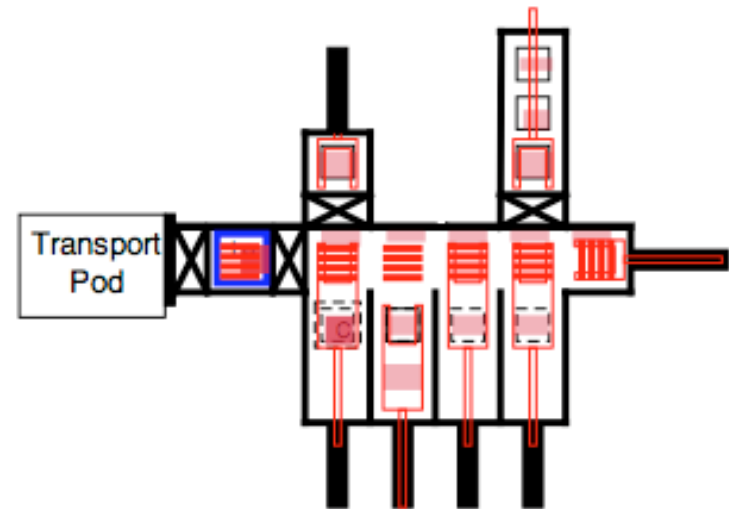
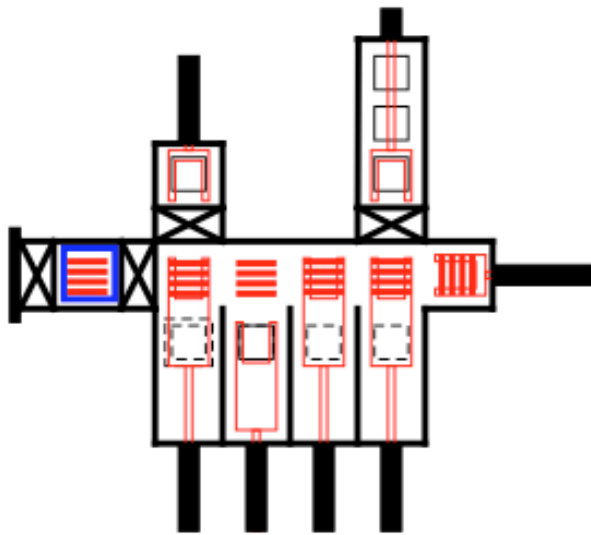
CdTe PDIL Platform



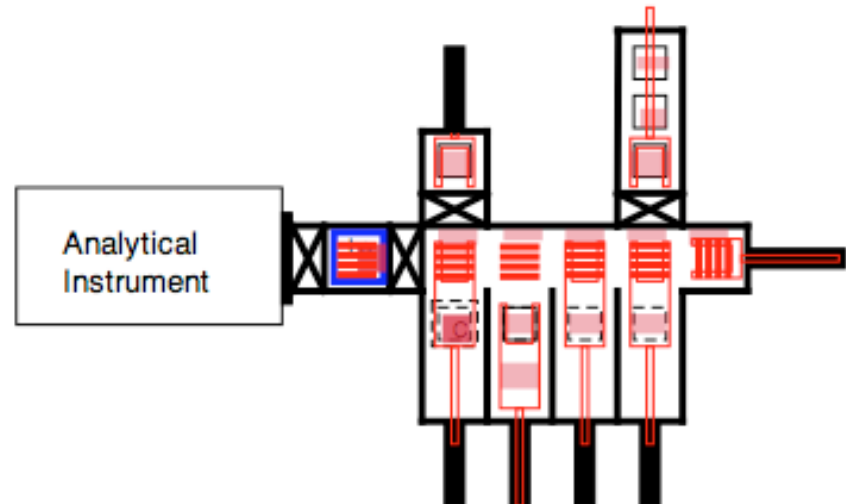
Design Concept Idea *All Dry, Soda Lime Glass, 10%+*



CdTe PDIL Platform



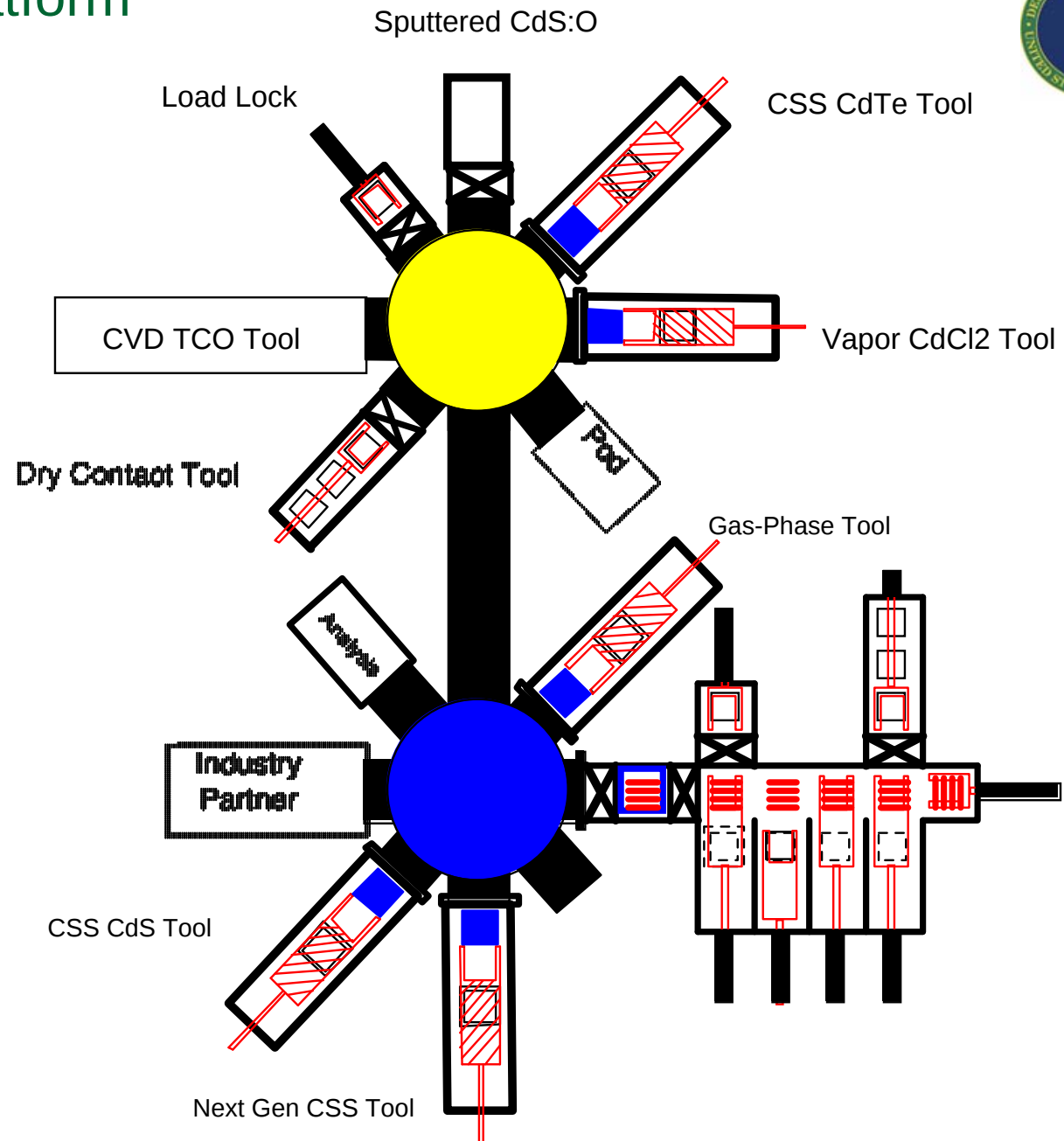
Concept Tool Design
Stand Alone
With Pod
Analytical Instrument



CdTe PDIL Platform



Concept Tool
With 2 Robots



Atmospheric Processing Platform

Maikel van Hest



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