APS Upgrade Status

Stuart Henderson

APS-Users / OPS Meeting

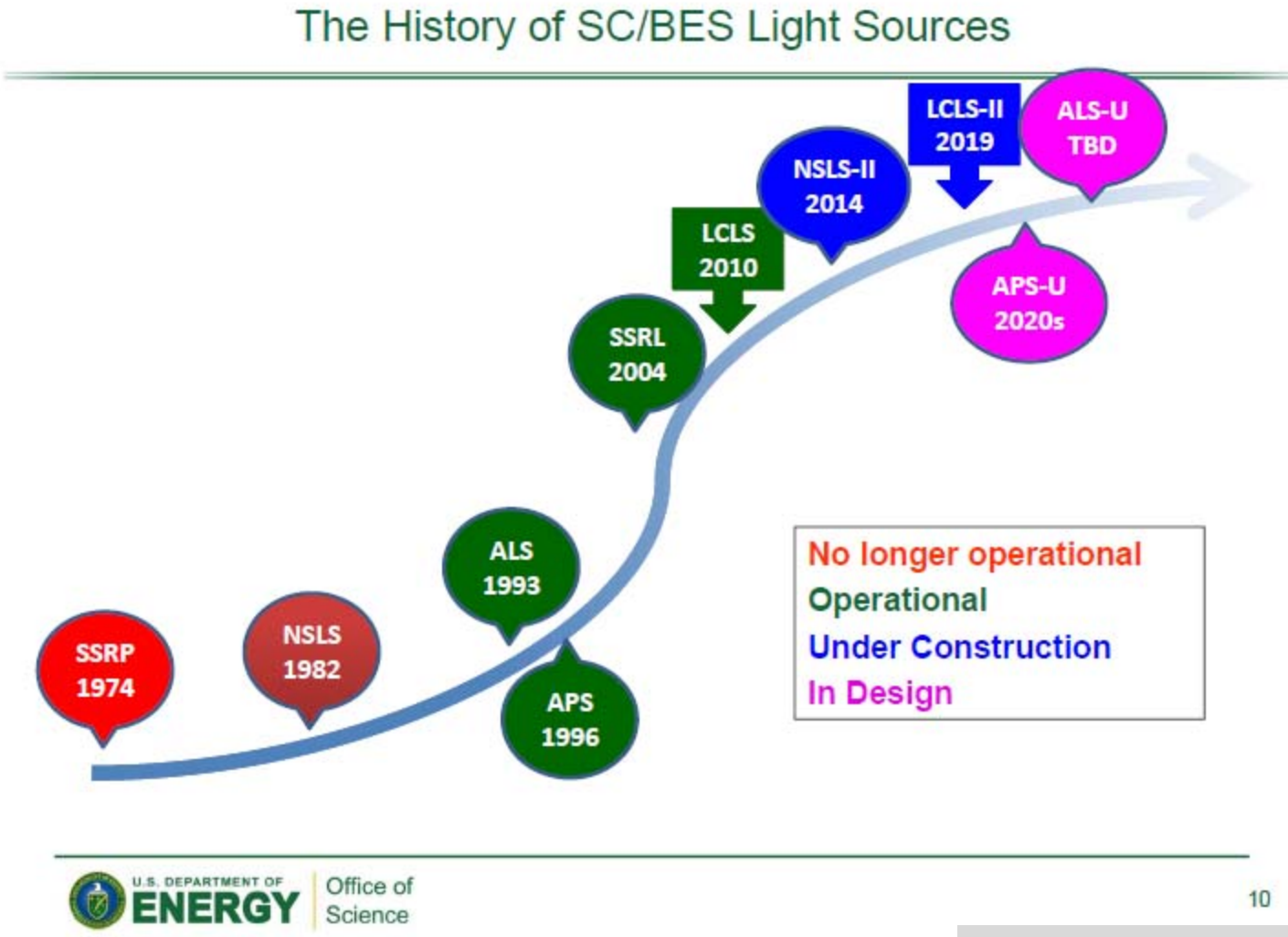
August 28, 2014

The APS Upgrade message is getting out there

- UChicago Board of Governors
- Secretary of Energy Advisory Board meeting at Argonne
- Annual Lab Plan Briefing
- BES Triennial Review
- Meeting with DOE Office of Science (yesterday!)

We are seeing a lot of enthusiasm surrounding our Upgrade plans

Secretary of Energy Advisory Board Meeting at ANL (June 2014)



P. Dehmer, SEAB Presentation, June 2014

Competitive Landscape

ESRF (France)

- Council approved second phase of upgrade, which incorporates an MBA lattice
- ESRF plans to resume operation in 2020, complete four state-of-the-art beamlines by 2022

SPRING-8 (Japan)

- Capable of upgrading in 2020 timeframe

MAX-IV (Sweden)

- Construction underway; inauguration June 2016

SIRIUS (Brazil)

- Completing final design; operational in 2018

The uncertain U.S. position within the competitive landscape was a central theme in the July 2013 BESAC Report:

*'…It is essential that the facilities this science community [of storage ring users] relies on remain **internationally competitive** in the face of the innovative developments**…** The Office of Basic Energy Sciences should ensure that U.S. storage ring x-ray sources **reclaim their world leadership position**…'*

Our plans for the APS Upgrade enable the U.S. to establish a world leadership position in storage-ring-based x-ray sources

Progress

- Refinement of the multi-bend achromat storage ring concept
- Execution of critical R&D and refinement of R&D plans
- Refinement of proposed Project Scope
- Development of Conceptual Design Report (first draft in-hand)
- Development of Cost Estimate and Resource Loaded Schedule
- Considerable preparation for the DOE Office of Science/BES Briefing

DOE Office of Science and BES Briefing

We prepared and presented the full complete “Business Case” for the Upgrade:

- Science Case
- Technical Case
- Project Management
- Project Status:
  - Project Assumptions, Scope, Cost and Schedule
  - Installation Planning
  - Argonne Investment
- Communications strategy with DOE

Comparison of APS-U to other light sources worldwide in early 2020s

Parameter		APS	APS Upgrade		ESRF-II	SPring8-II	Petra-III	NSLS-II	MAX-IV	Sirius
		Present	Hi-Bright	48 Bunch						
Energy [GeV]		7	6	6	6	6	6	3	3	3
Current [mA]		102	200	200	200	100	100	500	500	500
Emittance, Horizontal [pm]		3113	67	48	142	99	1000	800	302	275
Brightness (*)	8 keV	1	88	51	61	43	4.1	3.7	13.9	22.7
	20 keV	1	336	144	164	137	2.9	0.8	5.2	8.1
	80 keV	1	382	152	154	127	1.0	0.01	0.4	0.3
Flux Density (*) (#)	8 keV	1	4.6	4.1	3.9	1.8	1.8	0.4	2.0	1.7
	20 keV	1	10.4	9.1	7.7	4.1	1.4	0.1	0.6	0.5
	80 keV	1	10.4	9.0	7.5	3.9	0.1	0.0	0.0	0.0
Coherent Flux	8 keV	9.3	813	472	562	398	38	34	129	211
(10^{11} ph/s)	20 keV	0.6	198	85	97	81	2	0	3	5
Single Bunch Brightness @ 8 keV (*)		1	6.5	25.5	1.5	5.1	0.3	0.1	1.9	3.1
Flux for 10 nm focus @ 20 keV (*)		1	336	144	164	137	2.9	0.8	5.2	8.1

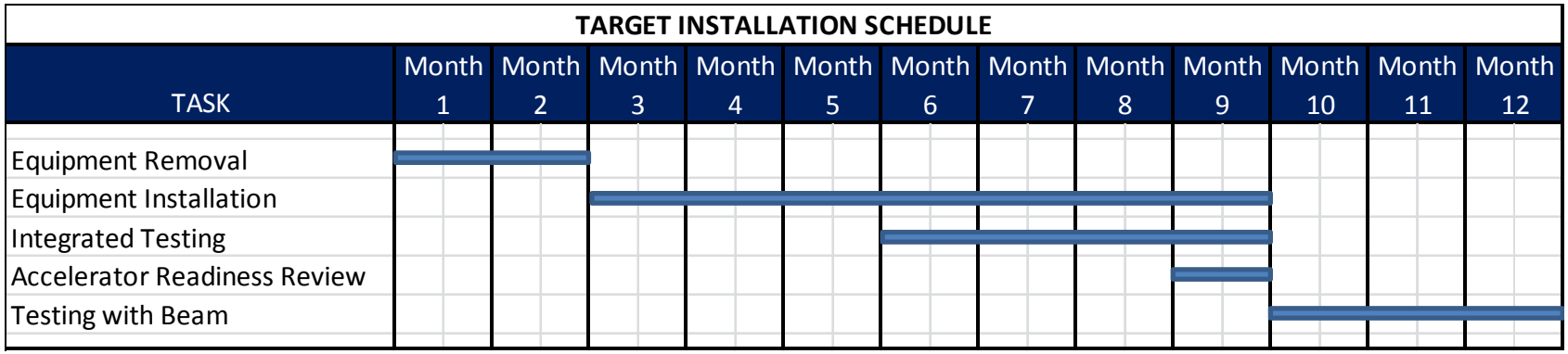
(*) Relative to present APS performance

(#) Flux Density is through a 0.5 x 0.5 mm aperture at 30 m

No light source now operating or under construction can match all of APS-U's technical capabilities

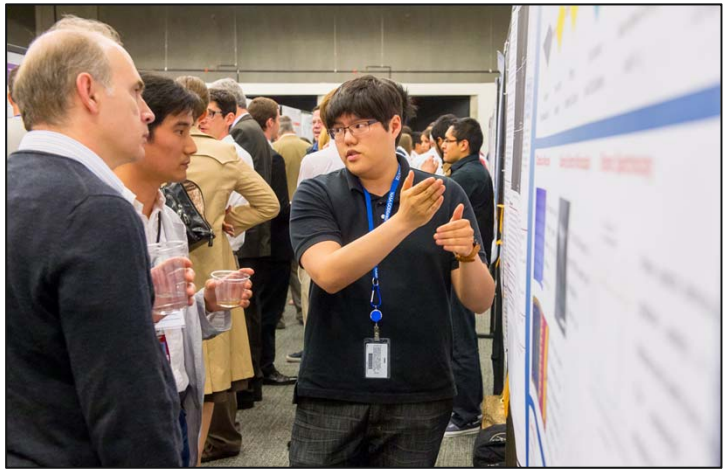
APS-U removal and installation plan

- Current planning calls for a 12-month shutdown and testing period, prior to resumption of operations
- Plan has substantial detail for this stage of the Project
  - Multi-shift, multi-crew operations
- Risk mitigation includes additional shifts, additional workdays
- Given central importance of minimizing APS unavailability, installation and testing requires a very different approach from typical installations, with all equipment in-hand, tested and ready to go, and adequate space
- SPEAR 3 is a proof of principle: same duration, 1/5th the size
- APS-U's preliminary removal/installation plan has been externally reviewed:
  - '…the committee members believe that the…plans are well developed and achievable'; 'The schedule of 9 months appears aggressive, but reasonable…'



Continuing community outreach and development of scientific opportunities is a high priority

- Scientific Community
  - We have established a Science Case Team to lead the scientific planning process
  - The team is organized along thematic areas, and works with community leaders to further develop the scientific opportunities



- Upcoming Workshops
  - *APS Upgrade Workshop on Coherent Imaging*, Sept. 6, 2014
  - *Synchrotron Environmental Science VI,* Sept. 11-12, 2014
  - *Workshop on high-pressure time-resolved synchrotron techniques,* Sept. 25- 27, 2014
  - *Diffraction Limited Storage Ring Workshop*, Nov. 19-21, 2014
  - *Full Field Imaging*, Jan. 19-20, 2015

These activities are part of a continuing process of user community engagement extending into APS-U operation

Finally,

What I would ask of the User Community

- Continue to make the case that the US needs an internationally competitive synchrotron x-ray source…and that you need it to carry out your science
- Let your voice be heard
- Take any opportunity you have to make the case for an Upgrade of APS
- Remember that there is a lot at stake
- If you need information, ask us
- We will be counting on your support as we continue to make the case that an upgraded APS is an essential 21st century tool for 21st century science

Preliminary consideration of project scope

- New, 4th-generation multi-bend achromat storage ring lattice in existing tunnel
- Doubling of the ring stored beam current
- New insertion devices for 35 sectors optimized for brightness and flux
- New and upgraded Front-Ends
- Suite of 3 new and 3 upgraded beamlines designed for best-in-class performance with MBA source properties
- Optics for remaining beamlines to make full use of MBA source properties
- Improved beam stability
- **Well-defined** installation and testing period is a **key deliverable**
  - **External review found the present ~12-month plan achievable**
  - Given the central importance of minimizing APS unavailability, the APS Upgrade will require a very different strategic approach from typical installations

APS Upgrade design builds upon existing $1.5 billion existing DOE and partner investments in infrastructure, APS injector, and beamlines

APS Upgrade: Using high brightness beams with high coherence at high energies to drive discovery

The APS-U will allow us to see and make sense of the complex, disorderly materials of the world – at the length, time and energy scales that matter most