



IR2 in the Context of the EIC Project

Jim Yeck, EIC Project Director

IR@@EIC Workshop

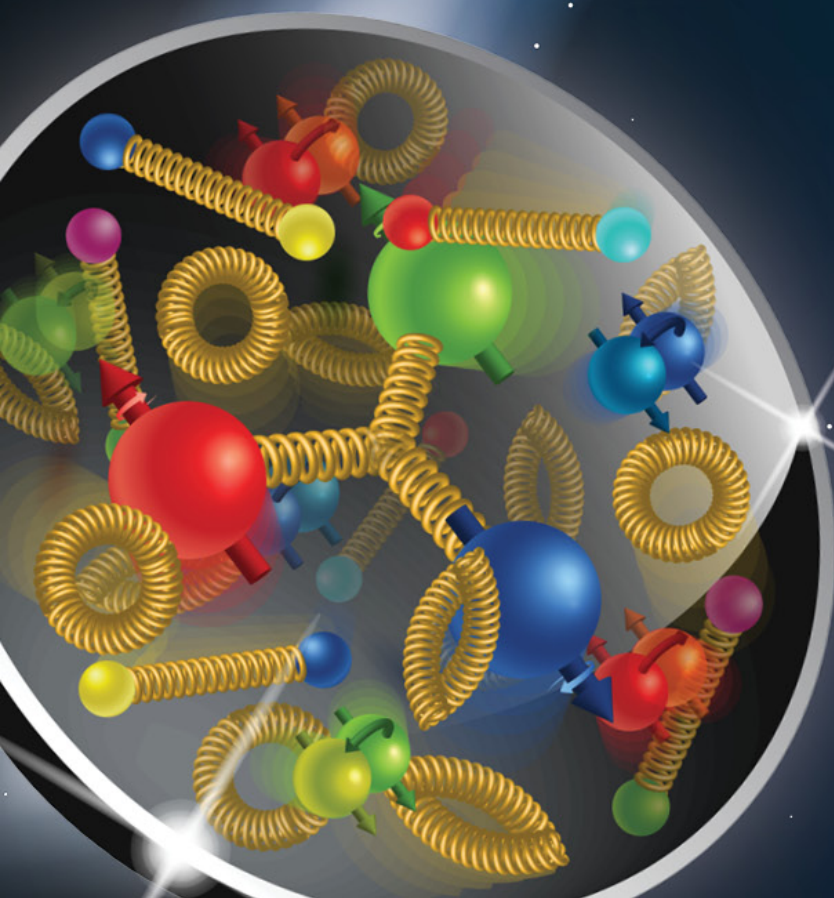
March 17, 2021

Electron-Ion Collider

BROOKHAVEN
NATIONAL LABORATORY

Jefferson Lab

U.S. DEPARTMENT OF
ENERGY | Office of
Science



Project Requirements

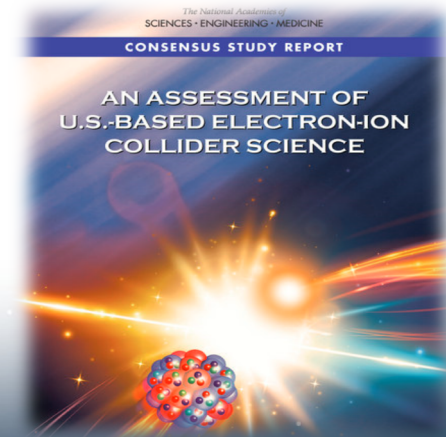
Project Design Goals

- High Luminosity: $L = 10^{33} - 10^{34} \text{cm}^{-2}\text{sec}^{-1}$, $10 - 100 \text{fb}^{-1}/\text{year}$
- Highly Polarized Beams: $\sim 70\%$
- Large Center of Mass Energy Range: $E_{\text{cm}} = 20 - 140 \text{ GeV}$
- Large Ion Species Range: protons – Uranium
- Large Detector Acceptance and Good Background Conditions
- Accommodate a Second Interaction Region (IR)

Conceptual design scope and expected performance meets or exceeds NSAC Long Range Plan (2015) and the EIC White Paper requirements endorsed by NAS (2018)

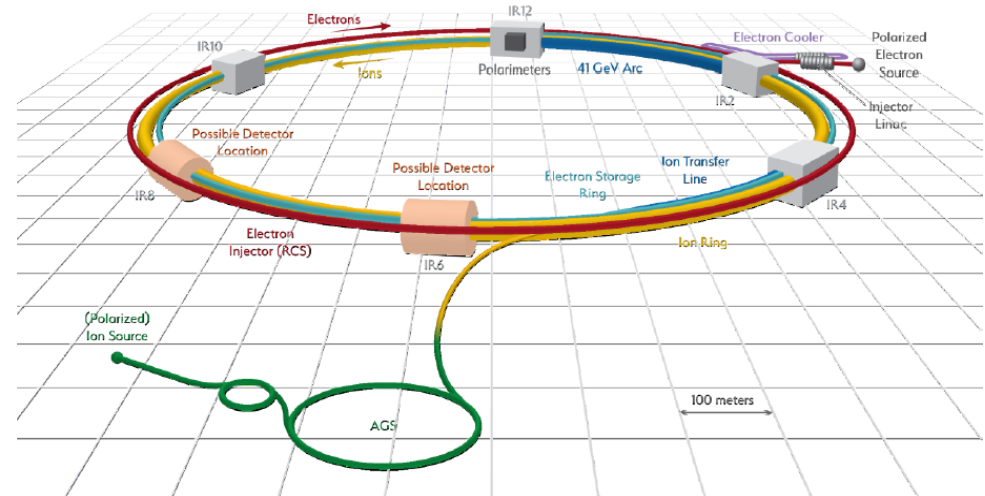
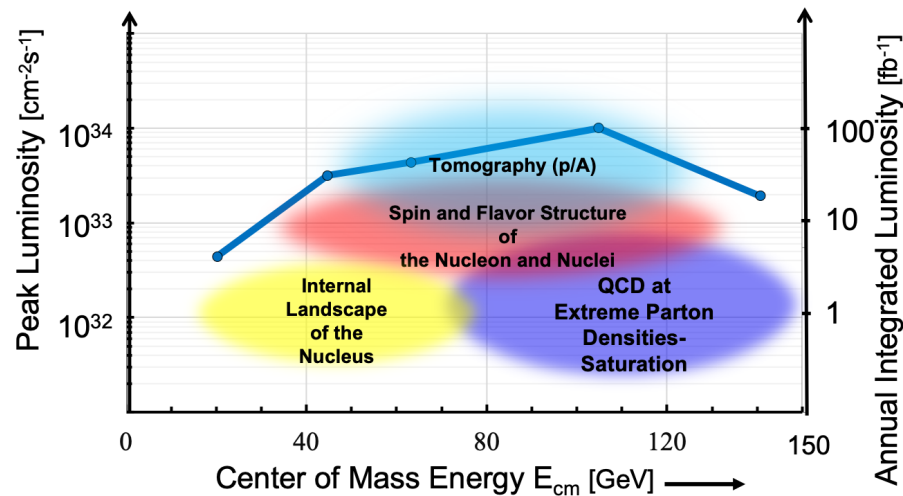


The 2015
LONG RANGE PLAN
for NUCLEAR SCIENCE



Electron-Ion Collider

EIC Machine Parameters



Double Ring Design Based on Existing RHIC Facilities

Hadron Storage Ring: 40 - 275 GeV

- RHIC Yellow Ring and Injector Complex
- Many Bunches, 1160 @ 1A Beam Current
- Bright Beam Emittance $\varepsilon_{xp} = 9$ nm
- Flat Beam, Requires Strong Cooling

High Luminosity Interaction Region(s)

- 25 mrad Crossing Angle with Crab Cavities

Electron Storage Ring: 2.5 - 18 GeV

- Many Bunches, Large Beam Current - 2.5 A
- 9 MW Synchrotron Radiation
- Superconducting RF Cavities , 10MW Power

Electron Rapid Cycling Synchrotron

- Spin Transparent Due to High Periodicity

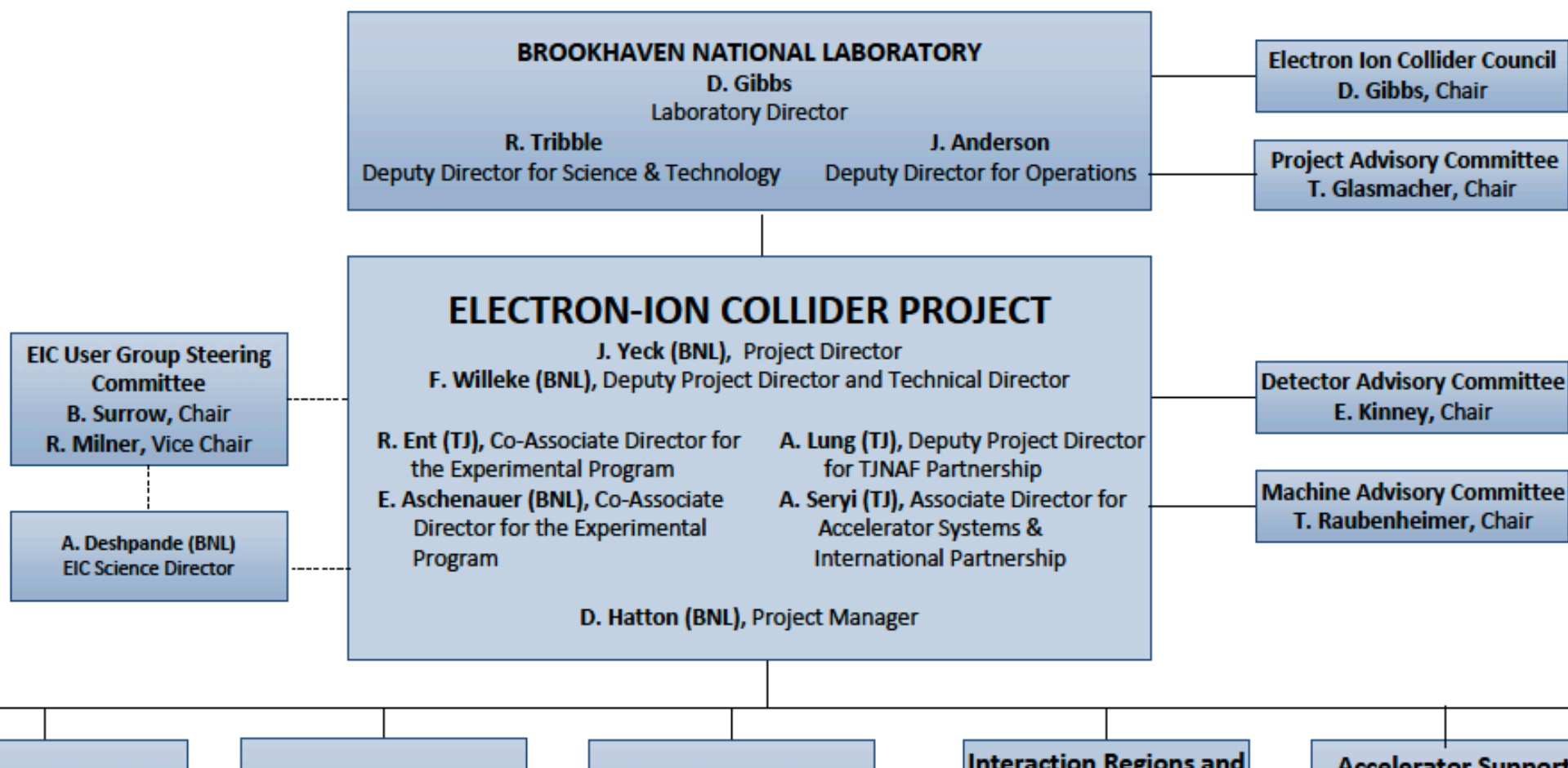
EIC Recent History

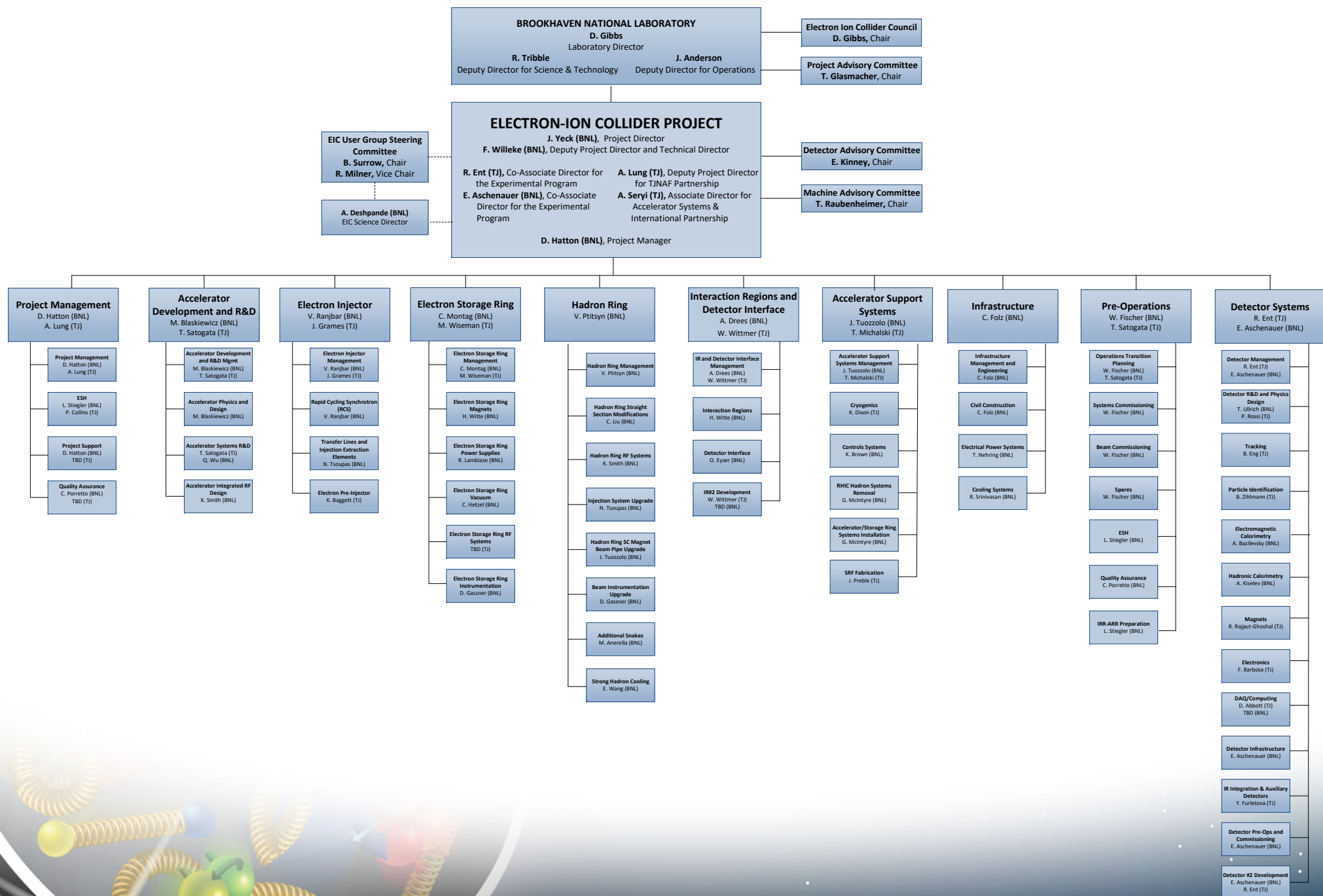
Event	Date
DOE Mission Need Statement Approved	January 22, 2019
DOE Independent Cost Review	July 2019
DOE Electron Ion Collider Site Assessment	October 2019
Critical Decision – 0 (CD-0) Approved	December 19, 2019
DOE Site Selection Announced	January 9, 2020
BNL TJNAF Partnership Agreement	May 7, 2020
DOE Office of Science Status Review	September 9-11, 2020
Independent EIC Conceptual Design Review	November 16-18, 2020
DOE Office of Science CD-1 Review	January 26-29, 2021
DOE Independent Cost Review	January - February 2021
<i>CD-1 Approval Target Date</i>	<i>April/May 2021</i>

Project Organization

- BNL/TJNAF Partnership
 - BNL and TJNAF partnering agreement signed in May 2020.
 - Executive Management Team established that integrates BNL and TJNAF into project leadership roles.
 - EIC Council, chaired by BNL Director, established in June 2020. TJNAF Director is a founding member. Major international partners will also join the Council.
- Established standing advisory committees with international membership
 - Machine Advisory Committee: 08/26/20, *TBD*
 - Project Advisory Committee: 08/27/20, 12/01/20, 04/29/21
 - Detector Advisory Committee: 09/28-29/20, 12/18/20, 03/24-26/21

Project Organization





EIC Partnership Plans

- Bi-lateral meetings with potential partners are underway to discuss opportunities in the accelerator and experimental areas.
- Accelerator Partnership Activities (~5-10% In-kind)
 - In-kind contributions to accelerator design and hardware expected
 - Workshop hosted by UK Cockcroft Institute in October 2020
Promoting Collaboration on the Electron-Ion Collider
- Detector Partnership Activities (Project Detector ~30% In-kind)
 - Expressions of Interest submitted in November 2020
 - Call for proposals for detectors issued in March 2021
- Regular meetings among the international funding agencies organized by DOE Office of Nuclear Physics.
- New York State is a partner in the EIC infrastructure (\$100M).

Experimental Program Preparation

[Yellow Report](#) and [EIC Conceptual Design Report](#) are both available and include the reference detector concept.

BNL and TJNAF Jointly Leading Process to Select Project Detector		
2020	Call for Expressions of Interest (EOI)	May 2020
	EOI Responses Submitted	November 2020
	Assessment of EOI Responses	On-going
2021	Call for Collaboration Proposals for Detectors	March 2021
	BNL/TJNAF Proposal Evaluation Committee	Spring 2021
	Collaboration Proposals for Detectors Submitted	December 2021
✓	Decision on Project Detector	March 2022

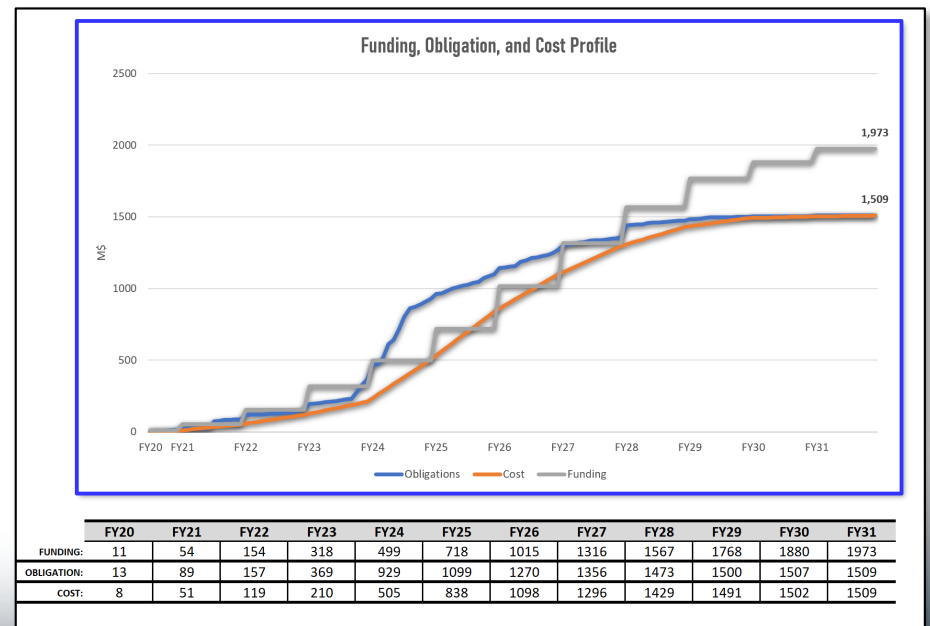
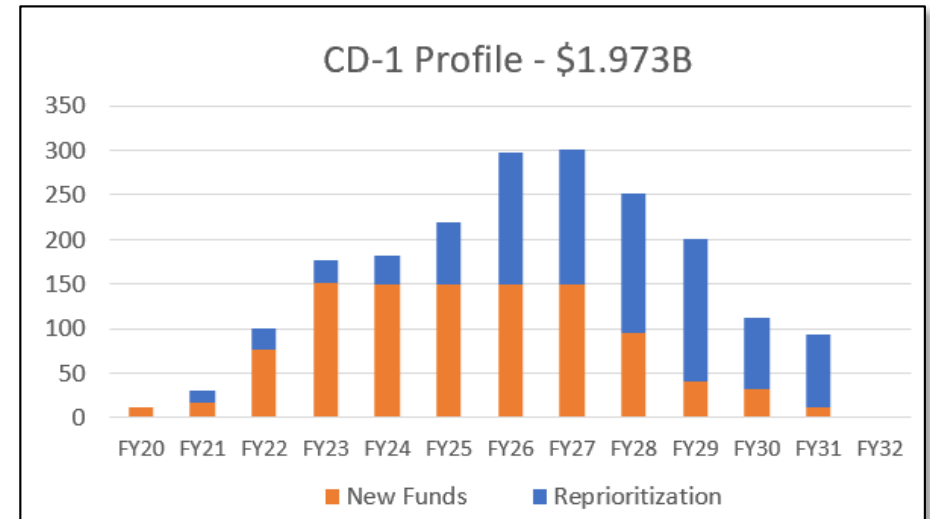
CD-1 Reviews

- CD-1 Preparation Reviews
 - Independent Design Review – November 2020 ✓
 - Director's Review – December 2020 ✓
- DOE CD-1 Reviews
 - DOE Office of Science, Office of Project Assessment
CD-1 Readiness Review – January 26-29, 2021 ✓
 - DOE Office of Project Management
Independent Cost Review – Jan/Feb 2021 ✓

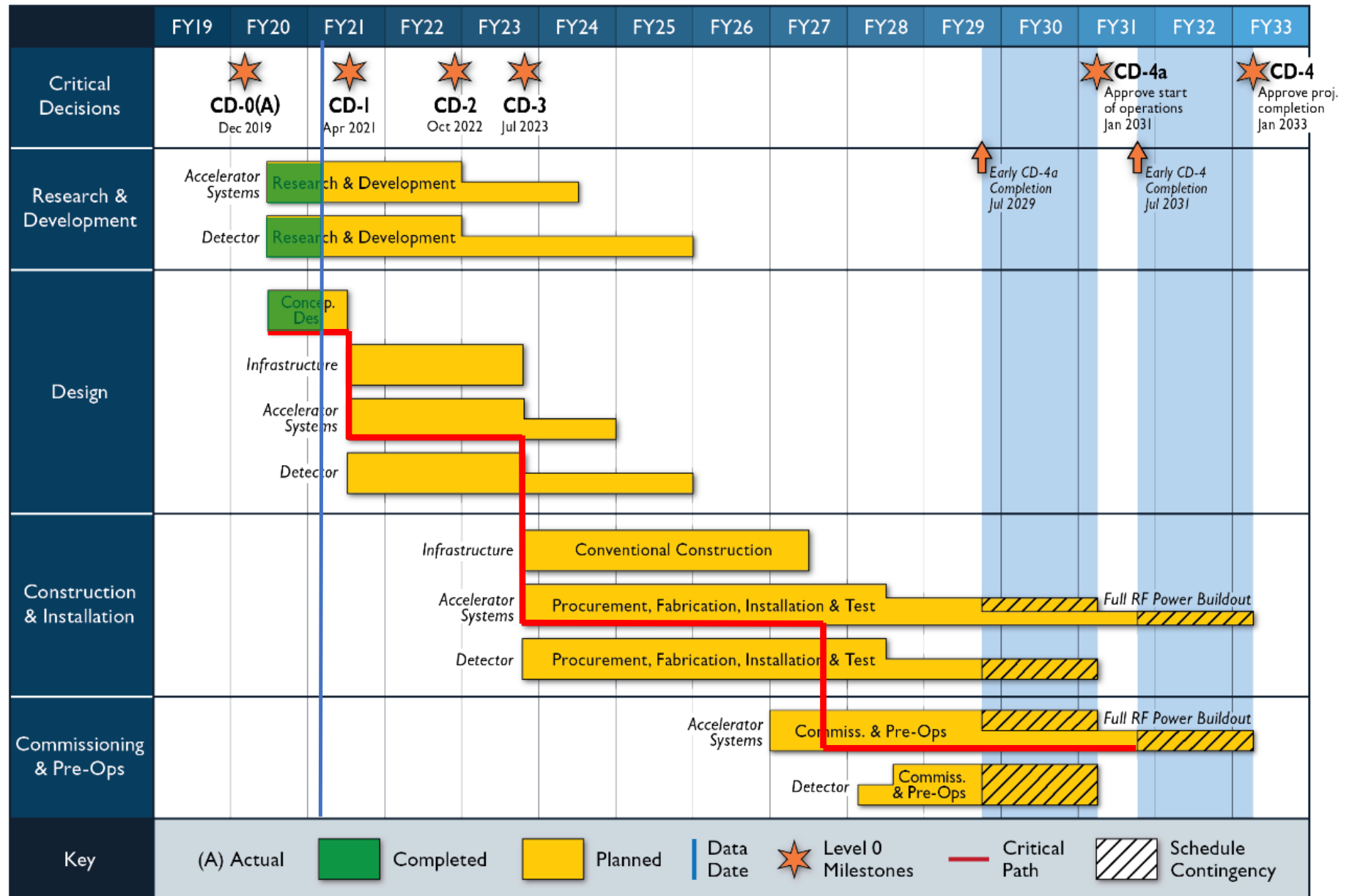
DOE reviews recommend proceeding with CD-1!

CD-1 Plan – Reference Profile v1

- TPC \$1,973M
- Proposed DOE PMB \$1,509M
- Contingency \$464M (30.1%)
- Milestones
 - CD-2 October 2022
 - CD-3 July 2023
 - CD-4a Jan 2031
 - CD-4 Jan 2033
- Issues to Address
 - Obligation profile exceeded funding profile in FY2024-2026
 - Contingency too low
 - Ambitious CD-3 date
 - Actual FY2021 funding of \$30M vs the \$43M planned

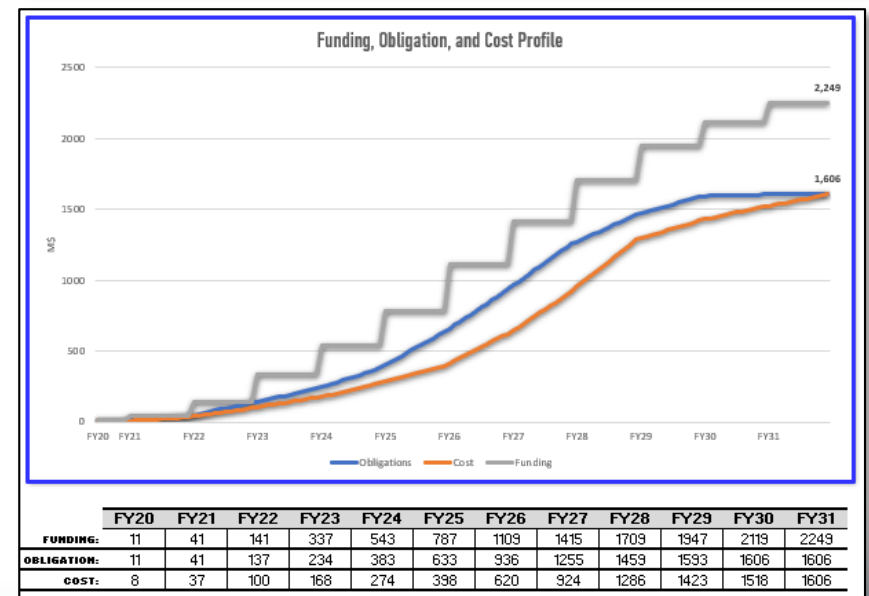
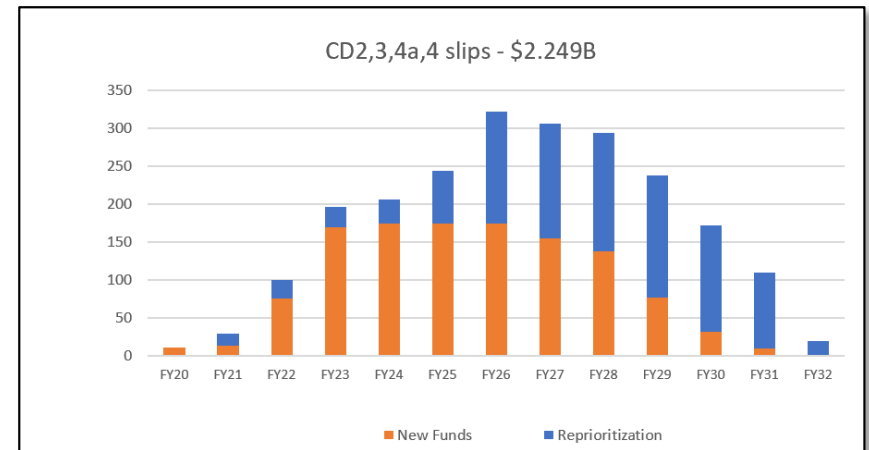


CD-1 Review Schedule



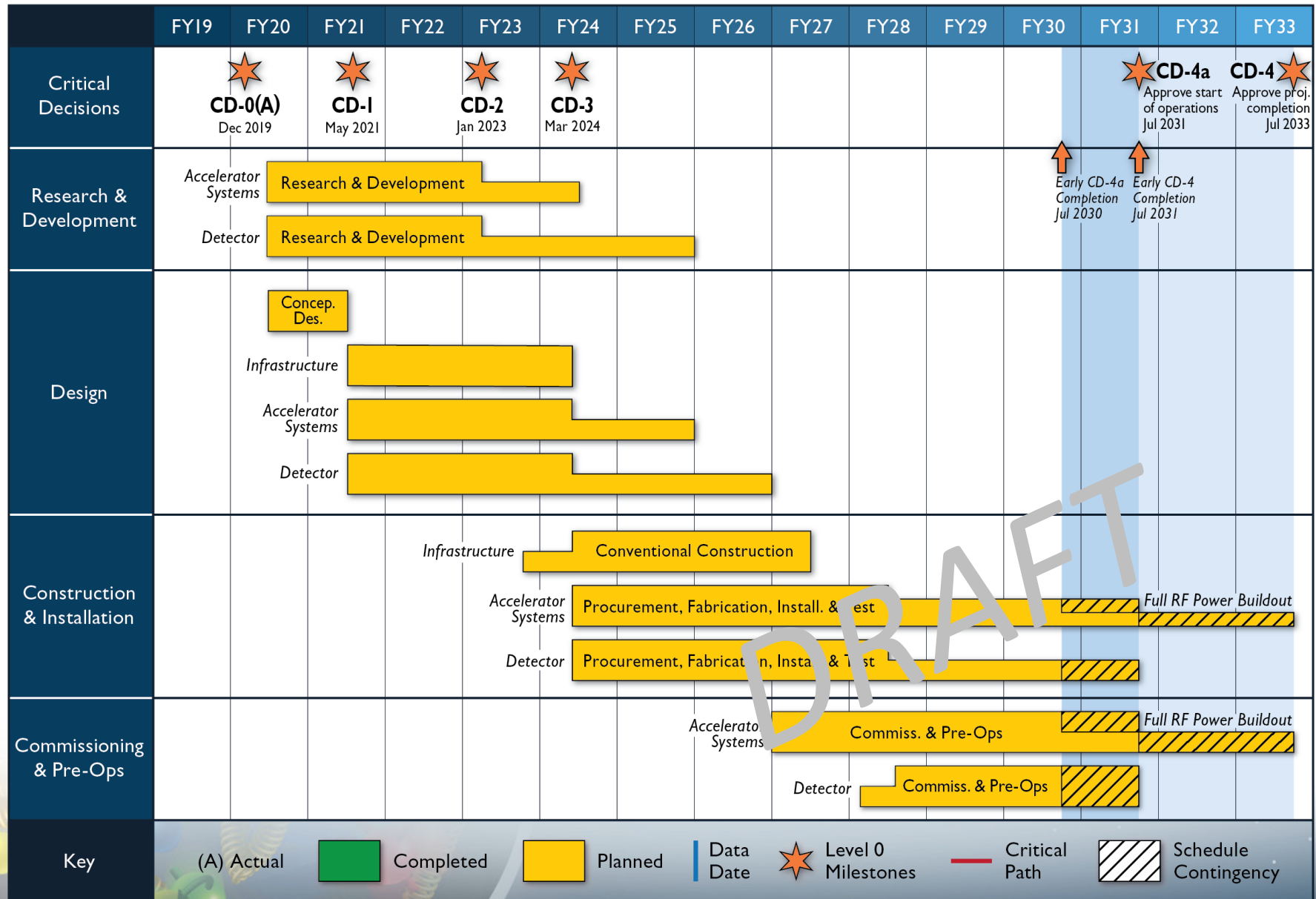
CD-1 Plan Revised – Ref. Profile v2

- TPC \$2,249M
- Proposed DOE PMB \$1,606M
- Contingency \$643M (40%)
- Revised Milestones
 - CD-2 January 2023
 - CD-3 March 2024
 - CD-4a Early Finish Jul 2030
 - CD-4a Jul 2031
 - CD-4 EF Jul 2031 (no change)
 - CD-4 Jul 2033 (24-month schedule contingency)
- Notes
 - Funding profile exceeds obligation plans
 - Realistic CD-3 and CD-4a timeline.
 - Sufficient schedule and cost contingencies



Note: CD date changes are relative to plan presented at the CD-1 reviews

Proposed Schedule – New!



Key Milestones

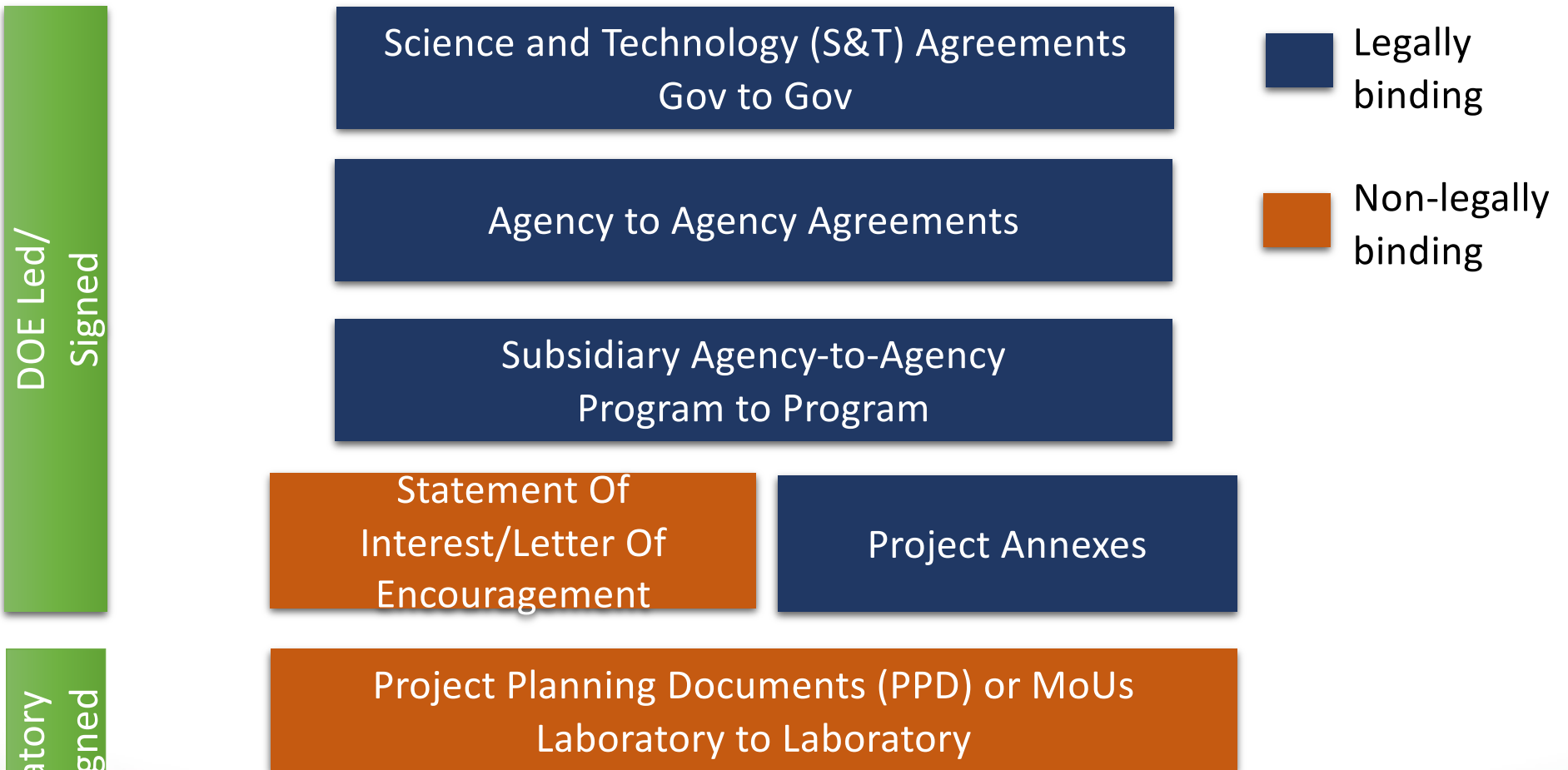
DOE Critical Decision (CD)	CD-1 Review (2020)	Change (Months)	Proposed (03/21)
CD-1, Alternative Analysis	April 2021	+1	May 2021
CD-2, Performance Baseline	October 2022	+3	January 2023
CD-3, Construction Start	July 2023	+6	March 2024
		Construction Start to Early Ops = 6 ¼ Years	
Early Start of Operations (CD-4a)	July 2029	+12	July 2030
Late Start of Operations (CD-4a)	January 2031	+6	July 2031
CD-4 Early Project Completion	July 2031	=	July 2031
		Schedule Contingency = 2 Years	
CD-4 Late Project Completion	January 2033	+6	July 2033

- Revised funding profile including actual FY2021 (\$30M vs \$43M)
- DOE Total Project Cost with 40% contingency
- Additional year of schedule contingency on project completion

Post CD-1 Timeline

Accelerator Technical Reviews	Spring/Summer 2021
Call for Detector Proposals	March 2021
Start Preliminary Design	April 2021
Detector Proposals Submitted	December 2021
Selection of Project Detector	March 2022
Start Earned Value Tracking	Summer 2022
Clarify In-kind Deliverables - Agreements	Summer/Fall 2022
Goal for CD-2 Approval	January 2023
Goal for CD-3 Approval	March 2024

Agreements



In-kind Contributions

- DOE requires legally binding agreements to accept hardware contributions from partners
 - Typically, a Project Annex (PA) to an existing Science & Technology (S&T) Agreement or an International Cooperative Research and Development Agreement (ICRADA).
 - If legally-binding agreement is not in place by CD-2, a non-binding Statement of Interest (SOI) may be developed expressing the interest to collaborate
- DOE requires non-binding documents at CD-2, Project Baseline
 - Project Planning Document (PDD) details the partner scope, list of deliverables (components and documents), milestones, management processes, organizational structures, and governance

IR2@EIC

- EIC with two interaction regions and detectors
 - Ensures a robust EIC physics program and enhances the science reach.
- IR2 and detector concepts needed now
 - Informs strategies for achieving IR2 and detector
 - Influences project decisions on IR1 and detector
 - EIC project schedule is an important planning constraint
- Major effort needed to secure resources (~\$500M)
 - Possibly a DOE Major Item of Equipment (MIE) project
 - Significant international engagement is expected

EIC Challenges and Opportunities

- Affordability – EIC is very large project for DOE Office of Nuclear Physics (NP) and Office of Science (SC)
 - Requires reprioritization of RHIC operations funding to EIC and new funding
 - Significant ramp up of project funding is required to maintain timeline for DOE Critical Decisions
 - Most cost-effective project follows closely to a technically driven schedule
- Partner Engagement – Expectations and Implementation
 - International engagement is highly desirable and widely expected
 - In-kind contributions to the accelerator and detector are being pursued
 - Partners must engage now given the EIC technically driven schedule

Summary

- Excellent progress in 2020 - congratulations on the Yellow Report and Conceptual Design Report!
- Ready for CD-1, DOE approval expected in May 2021.
- CD-2 preparations underway and approval milestone in less than two years, January 2023.
- DOE and the EIC project promoting international collaboration and partnership in the EIC and exploring possibilities for in-kind contributions.
- Response to the [Call for Collaboration Proposals for Detectors at the EIC](#) is critical to CD-2 and project success.