NSF Physics Division: Particle Physics Report

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NSF/PHY

USLUA 2016 Meeting

LBNL, 4 November, 2016

NSF Particle Physics Funding

The NSF is a science-driven rather than mission-driven funding agency.

Support can come from Particle Physics specific funding opportunities, Physics Division opportunities or cross-cutting opportunities within NSF.

In this presentation, comments on:

1. Physics Division Solicitation
2. Major Research Instrumentation Program (MRI)
3. MREFC
4. Midscale
5. Computing
6. Early Career Development (CAREER)
7. PIRE
8. Big Ideas

1. Physics Division Solicitation & Programs

At the NSF, particle physics is supported by four programs within the Division of Physics:

See the full solicitation *nsf16-566*
https://www.nsf.gov/pubs/2016/nsf16566/nsf16566.htm

(1) **Elementary Particle Physics (EPP) program**, which supports particle physics at accelerators and advances in detector development

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5624

(2) **Particle Astrophysics (PA) Program**, which supports non-accelerator experiments

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5633

(3) **Theory program**, which includes fundamental research on the forces of nature and the early history of the universe as well as support for the experimental program by providing guidance and analysis for high energy experiments

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503535

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503538

(4) **Accelerator Science program,** which supports research at universities into the educational and discovery potential of basic accelerator physics.

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504937

Experimental EPP and PA Programs:

- **Accelerator Based Particle Physics (EPP):**

  Energy Frontier (hadron and lepton collider) Experiments

  Intensity Frontier (including accelerator-based neutrino) Experiments

- **Cosmic Phenomena (PA):**

This area supports university research that uses astrophysical sources and particle physics techniques to study fundamental physics.

  Cosmic-rays, gamma-rays, and neutrinos

  Cosmic Microwave Background (CMB)

  Dark Energy

- **Underground Physics (PA)**:

This area supports university research that generally locates experiments in low background environments.

  IceCube science program

  Solar, underground and reactor neutrinos

  Neutrino mass measurements;

  Searches for the direct detection of Dark Matter.

Theory

The NSF Physics Division has two theoretical programs relevant to particle physics:

1. Theoretical High-Energy Physics
2. Theoretical Particle Astrophysics and Cosmology

- Both programs are directed by
  - Keith Dienes, kdienes@nsf.gov.

- FY15 Statistics: 2 CAREER awards, 28 regular awards (including both university groups and individual researchers), total budget approximately $13.7M. Number of proposals received was nearly twice the number from just three years ago. FY16 similar.

- Any questions about program emphases, budgets, and proposal submission should be directed to Keith by email.

Accelerator Science

- Program description and link to solicitation
  - Link to awards made so far is at the bottom of the page in this link
- Next Deadline: **1 Feb., 2017**
  - **N.B.: New Grant Proposal Guide (now called PAPPG) (NSF 17-1) will be in effect**
  - **If you don't read it all, read the Significant Changes.**
- Budget has been ~ $9M/year
- Expenditures:

2014	2015
$9,565,000	$9,287,000

Physics Division Proposal Preparation

- **All NSF proposals** must conform to the NSF Proposal & Award Policies & Procedures Guide:
  - Submissions before January 30, 2017 PAPPG (*nsf16-001*):
    https://www.nsf.gov/pubs/policydocs/pappguide/nsf16001/
  - Submissions on or after January 30, 2017 PAPPG (*nsf17-001*):
    https://www.nsf.gov/pubs/policydocs/pappg17_1/
- **All Physics proposals**, both science and R&D, must now go through a solicitation (*nsf16-566*).
    https://www.nsf.gov/pubs/2016/nsf16566/nsf16566.htm
  - For reference: physics division program specific deadlines (not target dates)
    - EPP and PA – October 26, 2016 (now passed)
    - Nuclear Physics Experiment and Theory - November 11, 2016
    - EPP and Astrophysics and Cosmology Theory – December 1, 2016
    - Accelerator Science – February 1, 2017

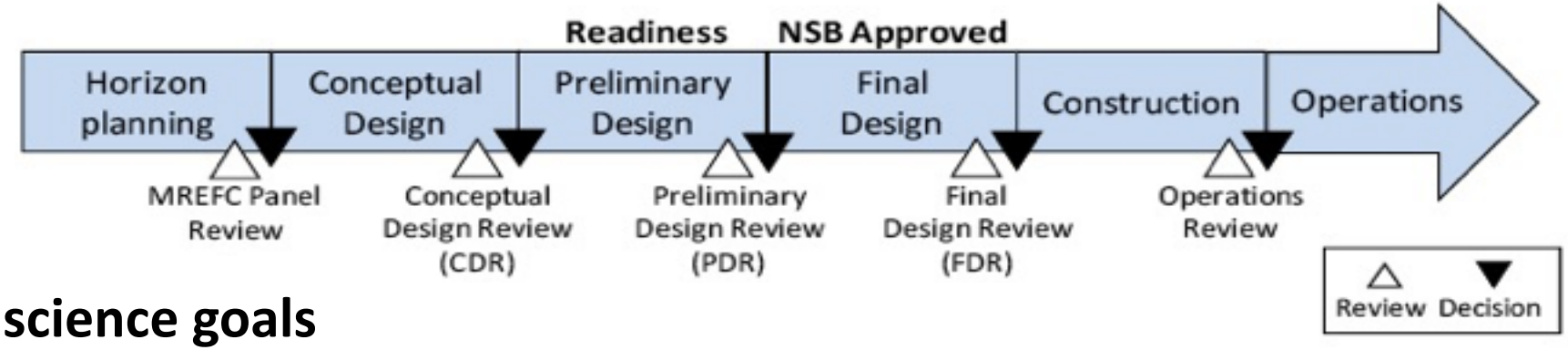
2. Major Research Instrumentation (MRI)

- Increase access to shared scientific and engineering instruments for research and research training
  - In institutions of higher education, and not-for-profit museums, science centers and scientific/engineering research organizations.
- Improve the quality and expand the scope of research and research training in science and engineering
  - By supporting proposals for shared instrumentation that fosters the integration of research and education in research-intensive learning environments.
- Two types. There is a limit to the number of submissions from a given institution (3)
  - Track (1) acquisition of a research instrument
  - Track (2) development of a research instrument.
  - Proposals for $100,000 - $4 million may be accepted from any MRI-eligible organization.
  - Proposals for less than $100,000 may be accepted from non-PhD granting institutions of higher education.
- Present Solicitation *nsf15-504*

  http://www.nsf.gov/od/oia/programs/mri
  - Proposers need to read this solicitation carefully.
  - Deadline: January 11, 2017
  - Program Contact: Kathleen McCloud or EPP/PA program directors

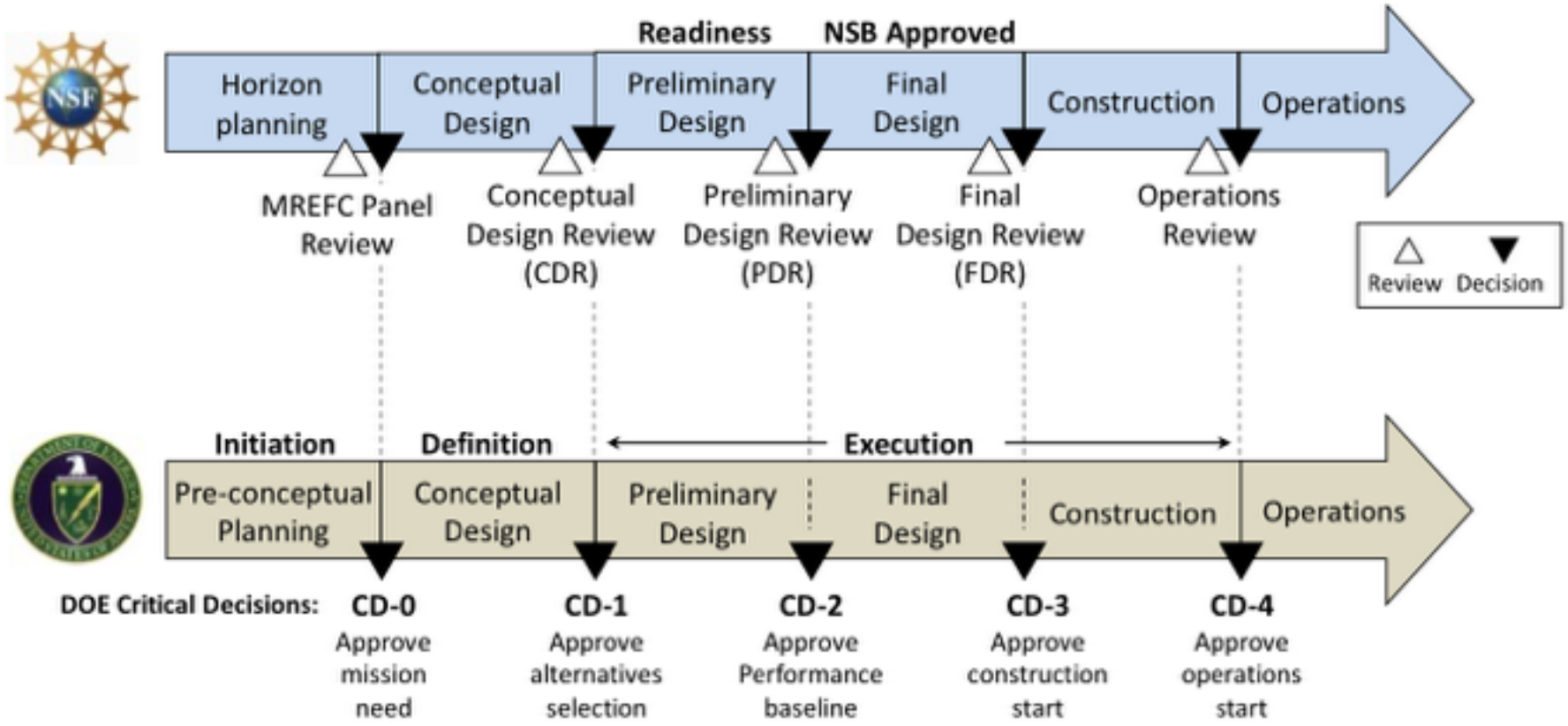
3. MREFC Process for HL-LHC

Phase 2 Upgrades of ATLAS and CMS



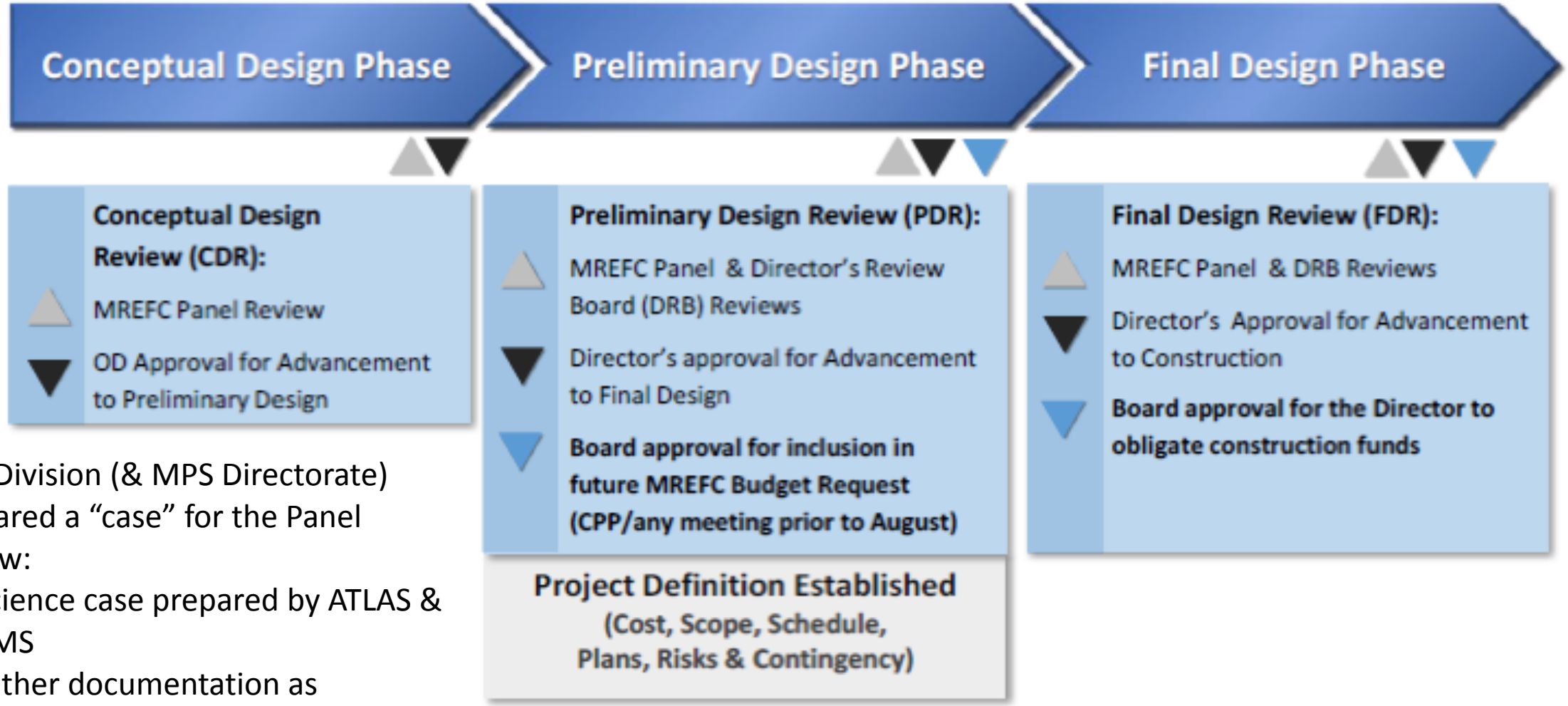
- **Review science goals**
- **Conceptual Design Stage**
  - Requirements, initial estimates of cost (including operations), risk and schedule
- **Preliminary Design ("Readiness") Stage**
  - Definition and design of major elements, detailed estimates of cost, risk and schedule, partnerships, siting
- **Final Design Stage ("Board Approved") Stage**
  - Interconnections and fit-ups of functional elements, refined cost estimates based substantially on vendor quotes, construction team substantially in place

Comparison of agency planning processes



Links to the NSF Large Facility Manual (2015 and 2016/Draft)

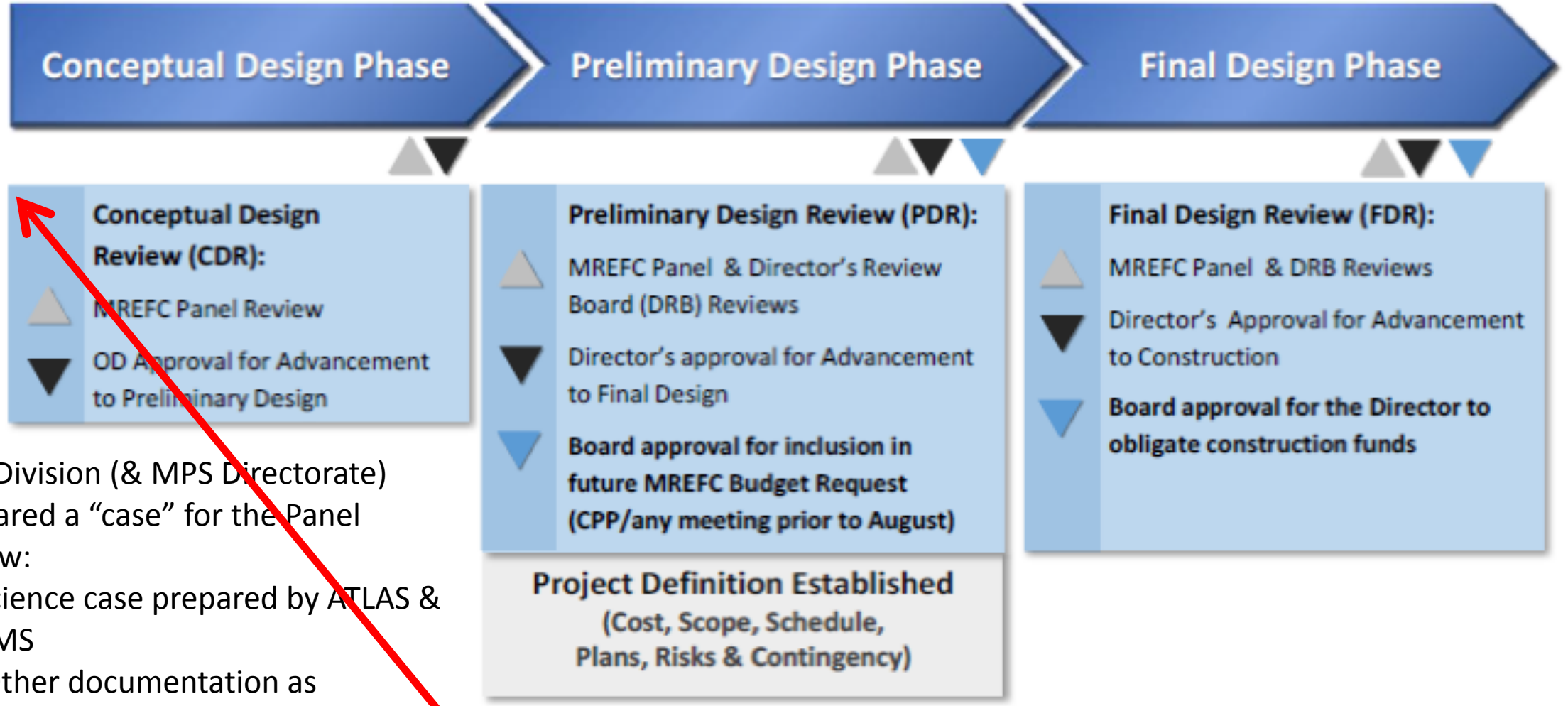
https://www.nsf.gov/publications/pub_summ.jsp?ods_key=lfm
https://www.nsf.gov/bfa/lfo/docs/LargeFacilitiesManual2016Draft_5.4.2016.pdf



PHY Division (& MPS Directorate) prepared a "case" for the Panel review:

- Science case prepared by ATLAS & CMS
- Other documentation as mentioned in the NSF Large Facility Manual

Panel members are the AD's of all of NSF. Panel Review took place 6 Oct.



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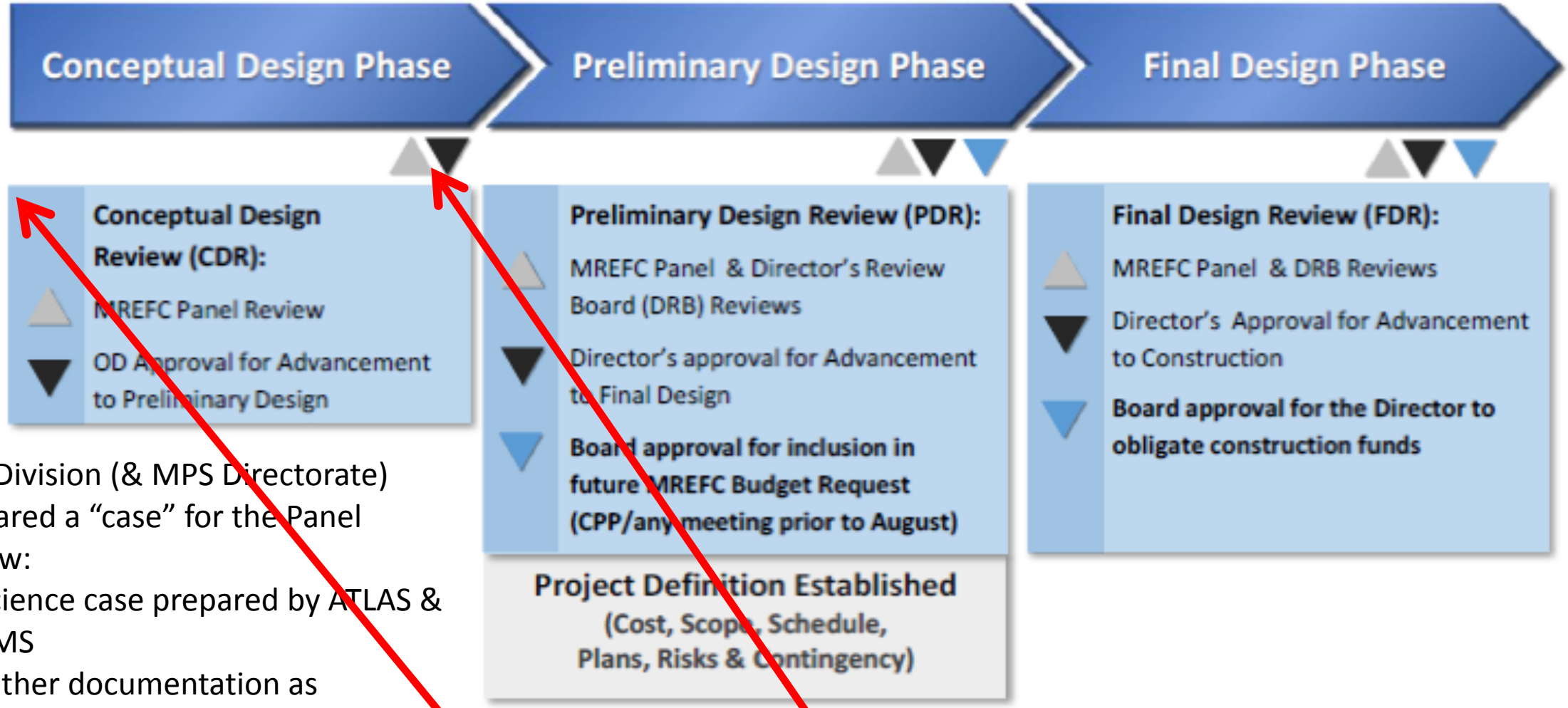

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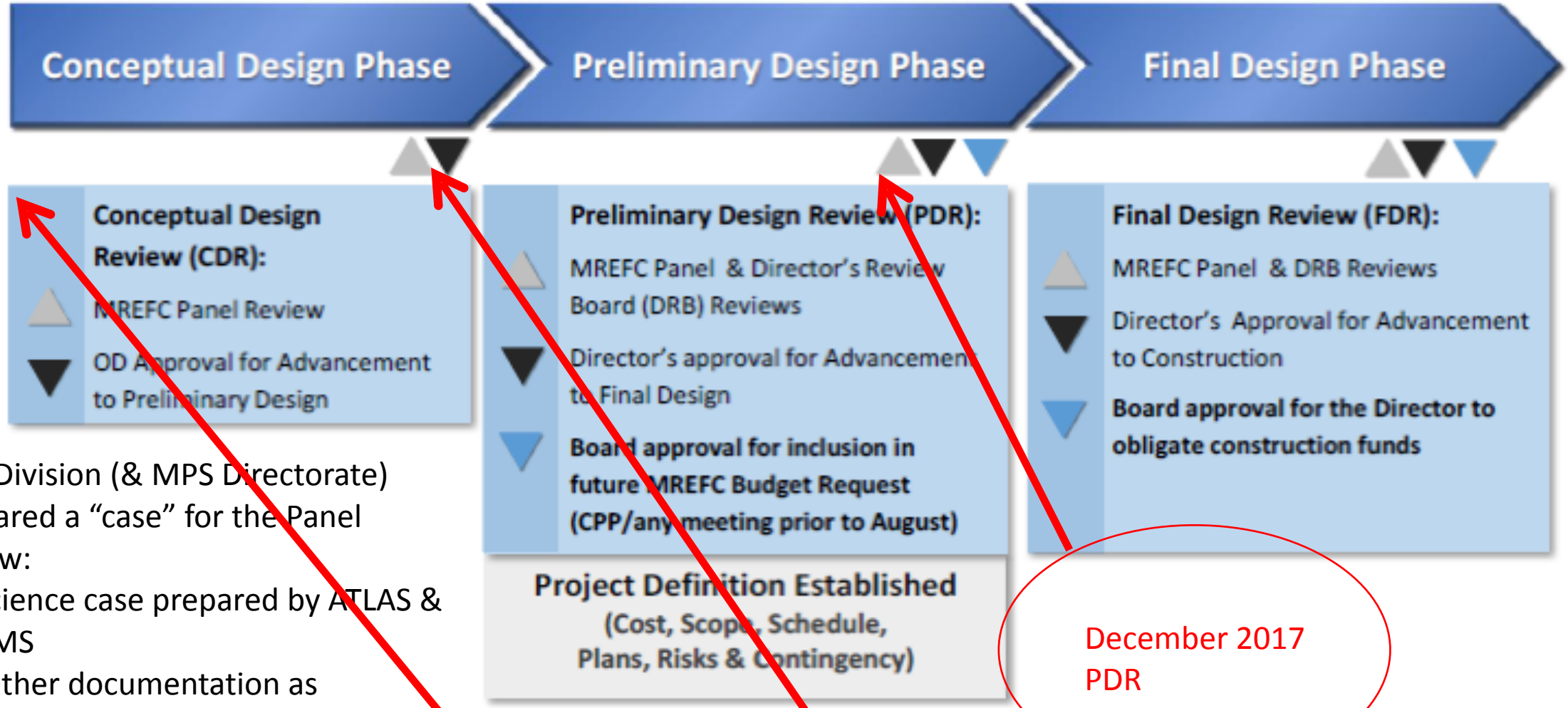

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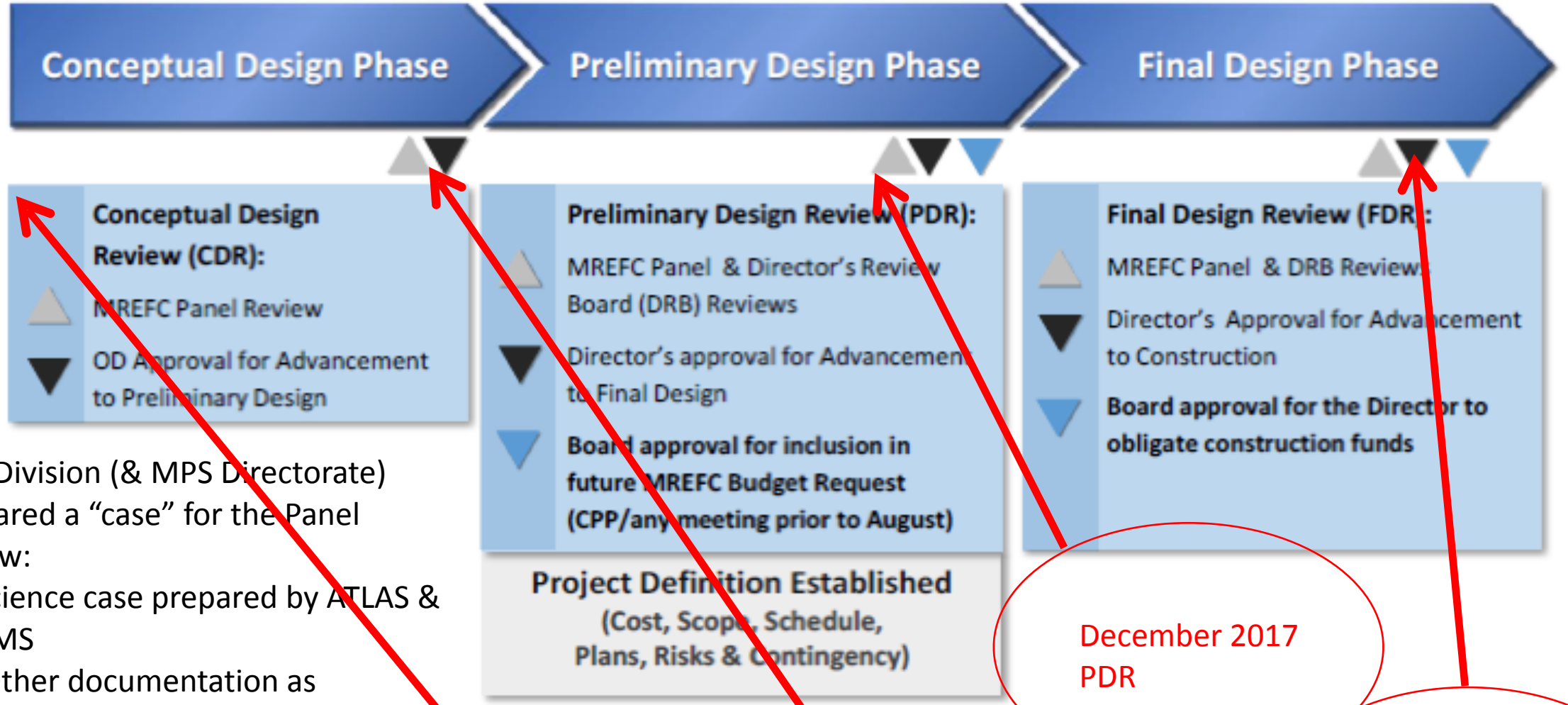

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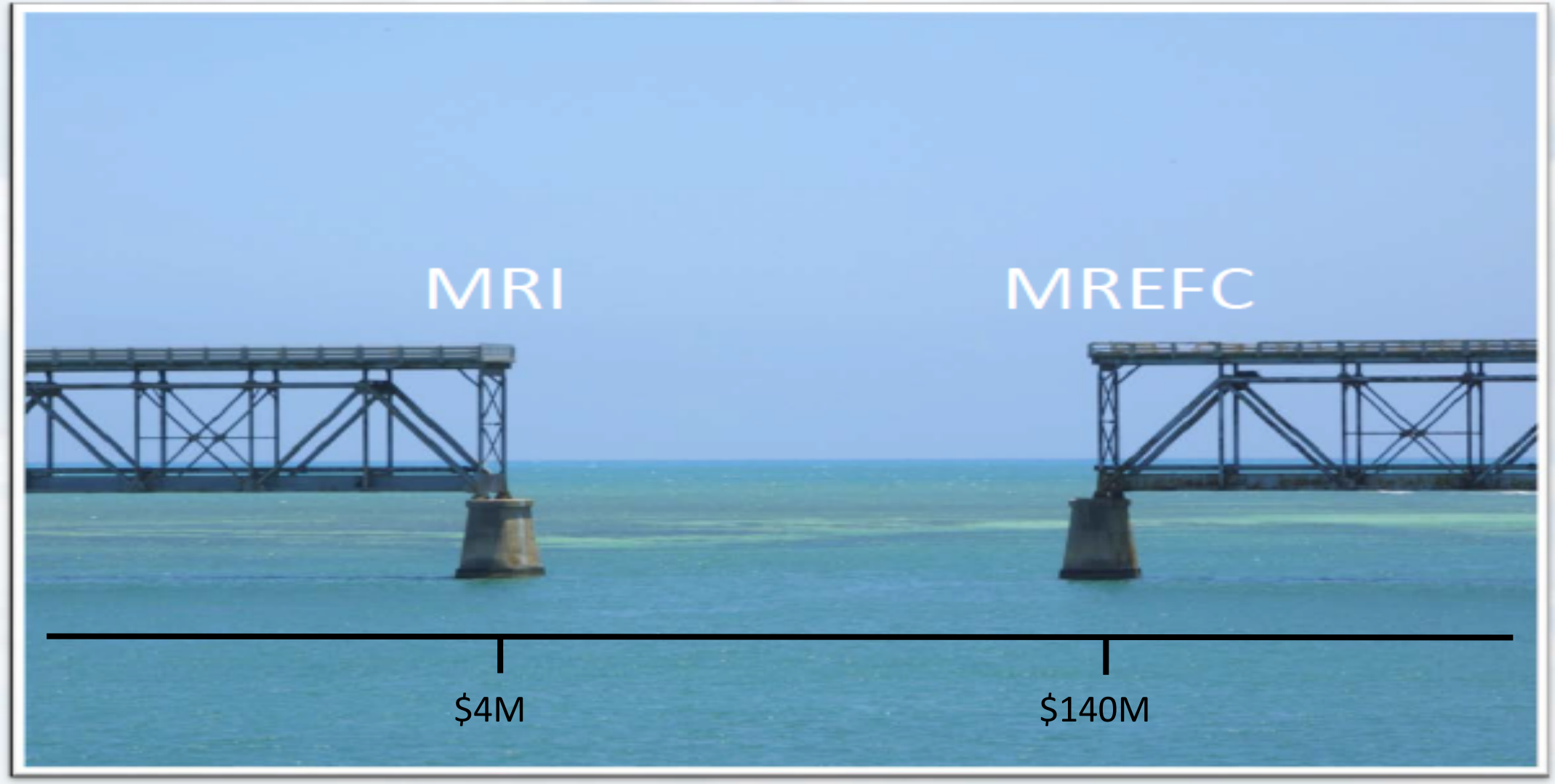
December 2017 PDR

Target is 2020 contingent on NSB approval at each phase

4. Midscale



Midscale Programmatic Support…

- Mid-Scale Program
  - See relevant sections of *nsf16-566*
  - https://www.nsf.gov/pubs/2016/nsf16566/nsf16566.htm

  - Targeted toward instrumentation acquisition or development at the level of $4M or above.
  - Directed R&D

  - Applications go through the base programs
  - Important to discuss any potential submission with EPP/PA program directors first.
  - Several potential programmatic steps/stages may be necessary…
    - A planning grant may be needed
    - Conceptual Design, Preliminary Design, Final Design

Mid-Scale Status

- Current funding enables projects on the order of $10M/4-5 years
- Demand is much higher than we can accommodate

- Examples:
  - LHC Upgrades: LHCb, CMS, ATLAS
  - nEDM
  - Super Nemo, Xenon1T
  - SPT, Super CDMS

5. Computing

- In MPS/PHY
  - Computational Physics
    - All Physics Division computing related proposals go through this solicitation
    - CP is the program through which the Physics Division participates in the CDS&E program.
    - There is no Computational Physics Solicitation for FY17.

- CDS&E, Computational and Data-Enabled Science and Engineering

  - **Physics**: ideas at the interface between scientific frameworks and computing capability that enable advances well beyond the expected natural progress of either activity, including development of science-driven algorithms to address pivotal problems in physics and efficient methods to access and mine large data sets.

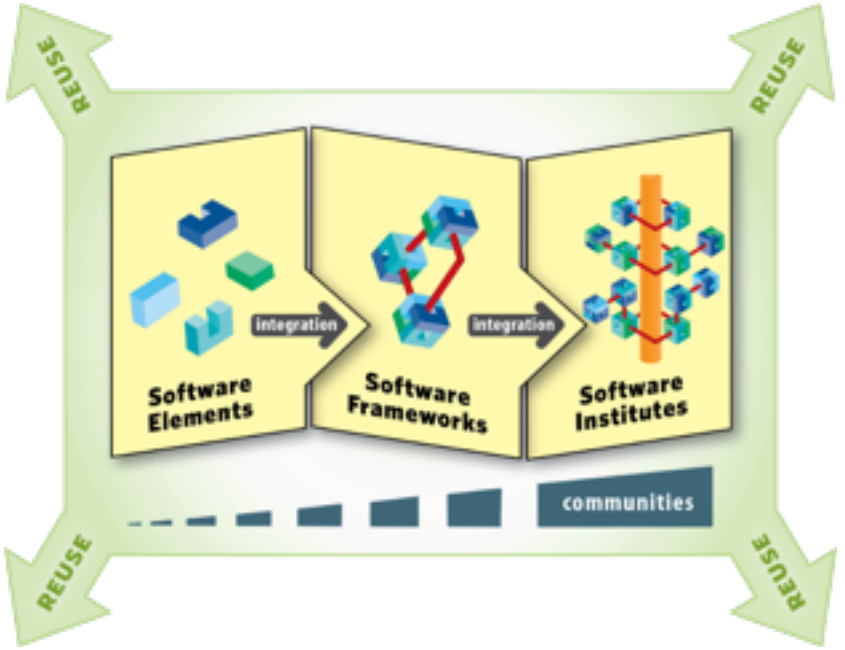
Software Infrastructure for Sustained Innovation (SI2: SSE & SSI)

- The program includes three classes of awards:
  - **Scientific Software Elements (SSE):** SSE awards target small groups that will create and deploy robust software elements for which there is a demonstrated need; these software elements will in turn advance one or more significant areas of science and engineering.
  - **Scientific Software Integration (SSI):** SSI awards target larger, interdisciplinary teams organized around the development and application of common software infrastructure aimed at solving common research problems faced by NSF researchers in one or more areas of science and engineering. SSI awards will result in a sustainable community software framework serving a diverse community or communities.
  - **Scientific Software Innovation Institutes (S^2I^2):** S^2I^2 awards will focus on the establishment of long-term hubs of excellence in software infrastructure and technologies, which will serve a research community of substantial size and disciplinary breadth.

CISE/ACI, Advanced Cyberinfrastructure

- CIF21, Cyberinfrastructure Framework for the 21st Century
  - A Vision and Strategy for Software for Science, Engineering, and Education (NSF 12-113)
  - Implementation of NSF Software Vision

- In CISE/ACI (Advanced Cyber Infrastructure)
  - Co-funded with MPS (PHY, OMA)
  - SI2, Software Infrastructure for Sustained Innovation
    - SSE, Scientific Software Elements – Due 21 Feb. 2017
    - SSI, Scientific Software Integration – Due 19 Sept. 2017
    - S2I2: Scientific Software Innovation Institutes
      - Conceptualization Proposals (accepted anytime)
        --See LHC example next slide
    - Reuse
  - DIBBs, Data Infrastructure Building Blocks
    - DIBBS Solicitation
      - Deadline January 3, 2017



S2I2: Scientific Software Innovation Institutes

- [NSF] Issued a Software Institute Conceptualization award:

"Conceptualization of an S2I2 Software Institute for High Energy Physics"

Award 1558216 (Elmer, Princeton) / 1558233 (Sokoloff, Cincinnati) / 1558233 (Neubauer, UIUC)

that sponsors community workshops and conceptual work to take advantage of the significant data and computing requirements of the Large Hadron Collider as a science driver for next generation high-performance software and sustainability developments.

Next workshop: S2I2 HEP/CS Workshop - December 7-9, 2016 at *University of Illinois at Urbana-Champaign.*

6. NSF Early Career Development Program (CAREER)

- Current FY17 Deadline is Past…
  - July 22, 2016 for MPS Directorate and these are currently in Merit Review.
  - Next solicitation will have dates for FY18 that are similar to this year (expected to be mid-July 2017).

- Solicitation: *nsf15-555*
- http://www.nsf.gov/career/
- https://www.nsf.gov/pubs/2015/nsf15555/nsf15555.pdf

7. PIRE Program

See Solicitation: *nsf16-571*

- https://www.nsf.gov/pubs/2016/nsf16571/nsf16571.htm
  - A new program call appears typically every two years.
  - The emphasis of the program varies and may or may not map onto particle physics related research areas or activity.
- Preliminary Proposal Deadline:
  - September 14, 2016 (now passed)
  - A pre-proposal submission is required.
- Full Proposal (by invitation only)
  - Invitations for proposal submission: Week of January 24, 2017
  - Deadline for Full Proposal submission: April 24, 2017

8. NSF Big Ideas

NSF Ideas for Future Investment (Big Ideas)

- Research Ideas:
  - Harnessing Data for 21st Century Science and Engineering
  - Shaping the New Human – Technology Frontier
  - Understanding the Rules of Life: Predicting Phenotype
  - The Quantum Leap: Leading the Next Quantum Revolution
  - Navigating the New Arctic
  - Windows on the Universe: The Era of Multi-Messenger Astrophysics
- Process Ideas:
  - Growing Convergent Research at NSF
  - NSF-Includes: Enhancing Science and Engineering through Diversity
  - Mid-scale Research Infrastructure
  - NSF 2050

  - https://www.nsf.gov/about/congress/reports/nsf_big_ideas.pdf

Final Comments

- The NSF Physics Division and Directorate for Mathematical and Physical Sciences have a firm interest in advancing Elementary Particle Physics across the frontiers.
- The MREFC Process for HL-LHC is in progress.
- Take a thoughtful look at the NSF Big Ideas
- We wish you a very successful USLUA meeting!

Additional Information

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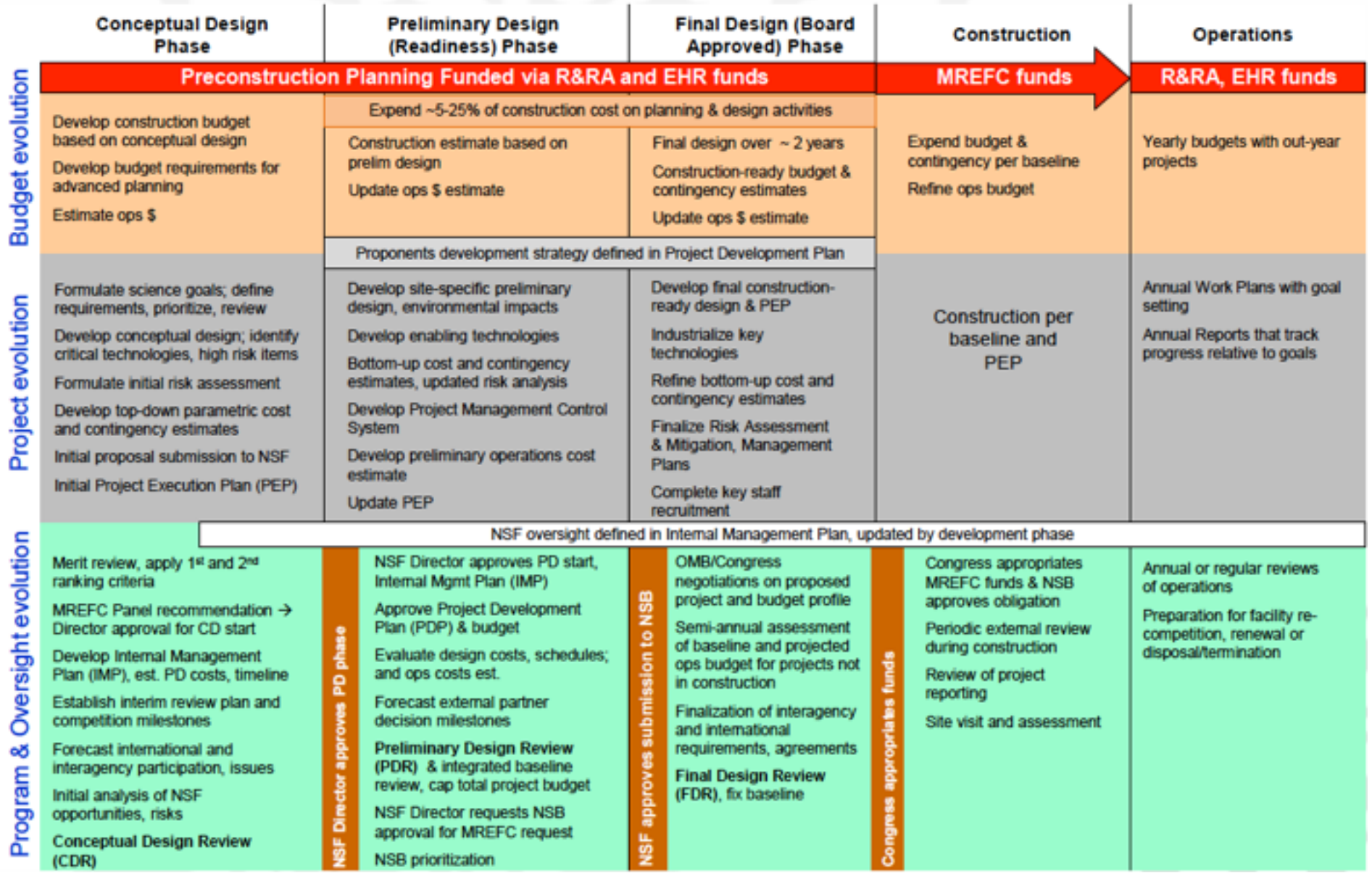
Relevant to the MREFC Process

Detail based on the NSF the Large Facilities Manual