(pre)TDR and ePIC engagement, detector aspects

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ePIC Collaboration Meeting
Lehigh, July 24-27, 2024

(pre)TDR and ePIC engagement, general aspects

From Elke (July 2023)

What Is Coming Up – TDR

We will start the process of writing a draft TDR later this year, and then this will continue towards a first version of a TDR in 2024.

Working model will be similar as we used to create the CDR, Elke/Rolf with engagement of ePIC leadership, and a mix of the project CAMs and EPIC WG representatives. At the late phases the editing rights will become more restricted. We plan to use where we can input from the CDR, YR, proposals, technical notes, etc.

Where ePIC would like to play a major role ?

Chapter 2: Physics Goals and Requirements *(should be short, < 50 pages)*
- 2.1 EIC Context and History (like CDR 2.2 or YR section 1)
- 2.2 The Science Goals of the EIC and the Machine Parameters (like CDR 2.3)
- 2.3 The EIC Science (follow YR structure)
- 2.4 Scientific Requirements

Chapter 3: Interaction Region 6 Overview (Elke/Rolf contributing)

Chapter 8: Experimental Systems *(can be long such that we can use as standalone detector TDR)*
- 8.1 Experimental Equipment Requirements Summary (like CDR 8.2)
- 8.2 General Detector Considerations and Operations Challenges (YR 10, CDR 8.3)
- 8.3 EIC Detector
- 8.4 Detector R&D Summary
- 8.5 Detector Integration
- 8.6 Detector Commissioning and Pre-Operations

Chapter 11: Commissioning (Elke/Rolf contributing)

Appendix-B: Integration of a Second Experiment (mainly emphasizing feasibility, luminosity sharing, polarization with two experiments, and first-order checks of magnets/acceptance)

Physics

Detector

Main focus in this report

Main steps of the ePIC internal discussion

- *Coordinator meeting Oct. 27, 2023*
- *EB meeting, November 11, 2023*
- *The main message anticipated to the Collaboration at the General meeting on Dec. 1, 2023*
- *A dedicated discussion session at the ePIC meeting at ANL on*
- *Once more at EB meeting, March 11, 2024*

In parallel, several discussions at the weekly ***EIC PM – ePIC SP office meetings***

ePIC (pre)TDR engagement – sharing responsibilities with the Project

CHAPTER 2

2 Physics Goals and Requirements

- 2.1 EIC Context and History
- 2.2 The Science Goals of the EIC and the Machine Parameters.
- 2.3 Scientific Requirements
  - 2.3.1 Systematic Uncertainties
  - 2.3.2 Radiative Corrections
- 2.4 The EIC Science (ePIC performance for key observables)
  - 2.4.1 Origin of Nucleon Mass
  - 2.4.2 Origin of Nucleon Spin
  - 2.4.3 Multi-Dimensional Imaging of the Nucleon
    - 2.4.3.1 Imaging in Momentum Space
    - 2.4.3.2 Imaging in Transverse Position Space
  - 2.4.4 Properties of Nuclear Matter
    - 2.4.4.1 Gluon Saturation
    - 2.4.4.2 Nuclear Modifications of Parton Distribution Functior
    - 2.4.4.3 Passage of Color Charge Through Cold QCD Matter .

ePIC responsibility

Joint responsibility

Project responsibility

CHAPTER 8

8 Experimental Systems

- 8.1 Experimental Equipment Requirements Summary
- 8.2 General Detector Considerations and Operations Challenges
  - 8.2.1 General Design Considerations
  - 8.2.2 Backgrounds and Rates
  - 8.2.3 Radiation Level
- 8.3 The ePIC Detector
  - 8.3.1 Introduction
  - 8.3.2 Magnet
  - 8.3.3 Tracking
  - 8.3.4 Particle Identification
  - 8.3.5 Electromagnetic Calorimetry
  - 8.3.6 Hadron Calorimetry
  - 8.3.7 Particle Identification
  - 8.3.8 Far-Forward Detectors
  - 8.3.9 Far-Backwards Detectors
  - 8.3.10 Polarimetry
  - 8.3.11 Readout Electronics and Data Acquisition
  - 8.3.12 Software and Computing
- 8.4 Detector Integration
  - 8.4.1 Installation and Maintenance
- 8.5 Detector Commissioning and Pre-Operations

Goals of the ePIC (pre)TDR effort

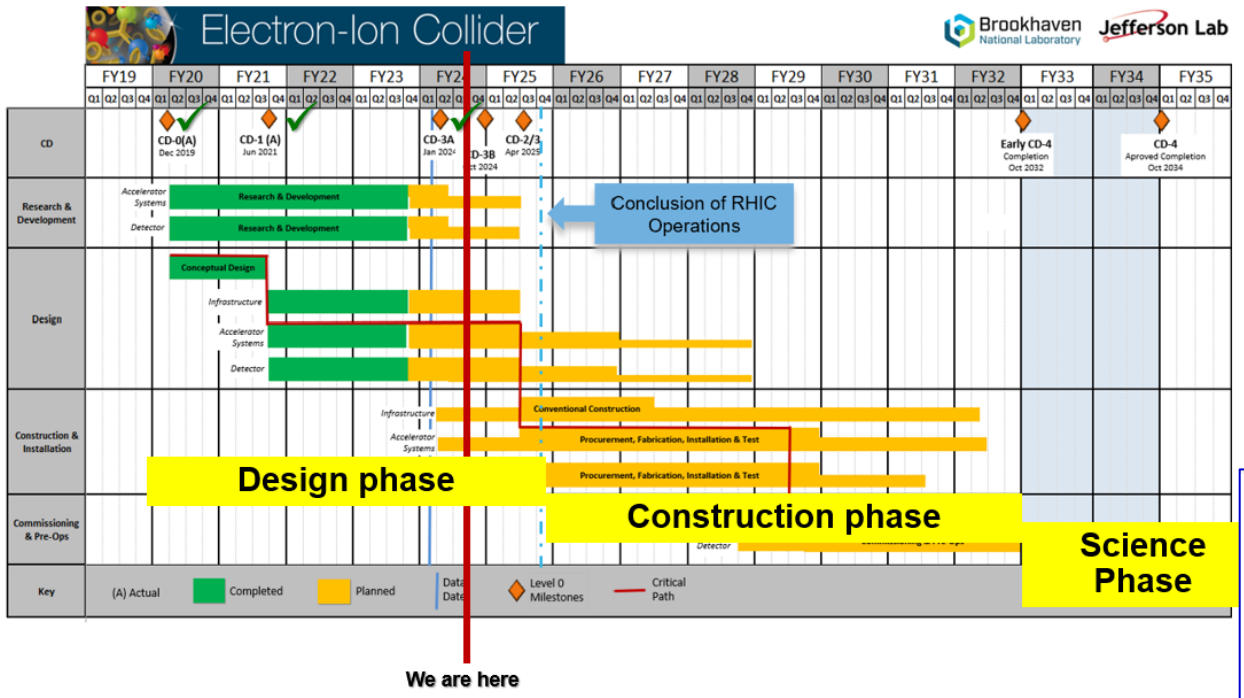
- The ePIC contributions to the EIC TDR (Chapters 2,8)
  - The EIC (pre)TDR is the top priority
  - Precise timescale driven by EIC project requirements → our effort schedule is evolving

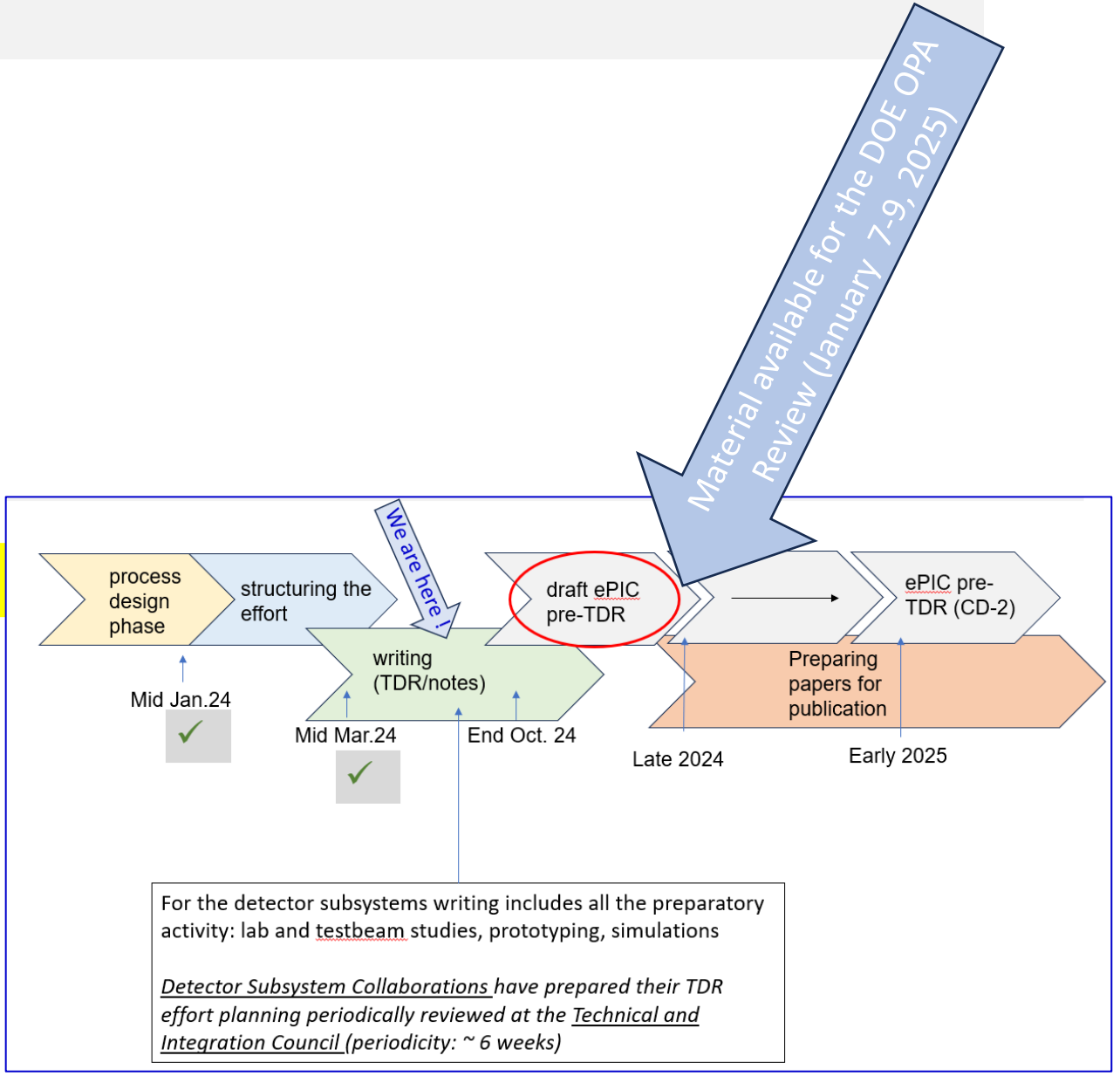
- An extended version of the ePIC detector section from the EIC TDR with appropriate front matter, published in a scientific journal (such as NIMA, JINST, PRC)
  - Derived from TDR Chapter 8

- An ePIC Physics Performance long paper published in a scientific journal (such as NIMA, JINST, PRC)
  - Derived and expanded from TDR Chapter 2 (Section 2.3)

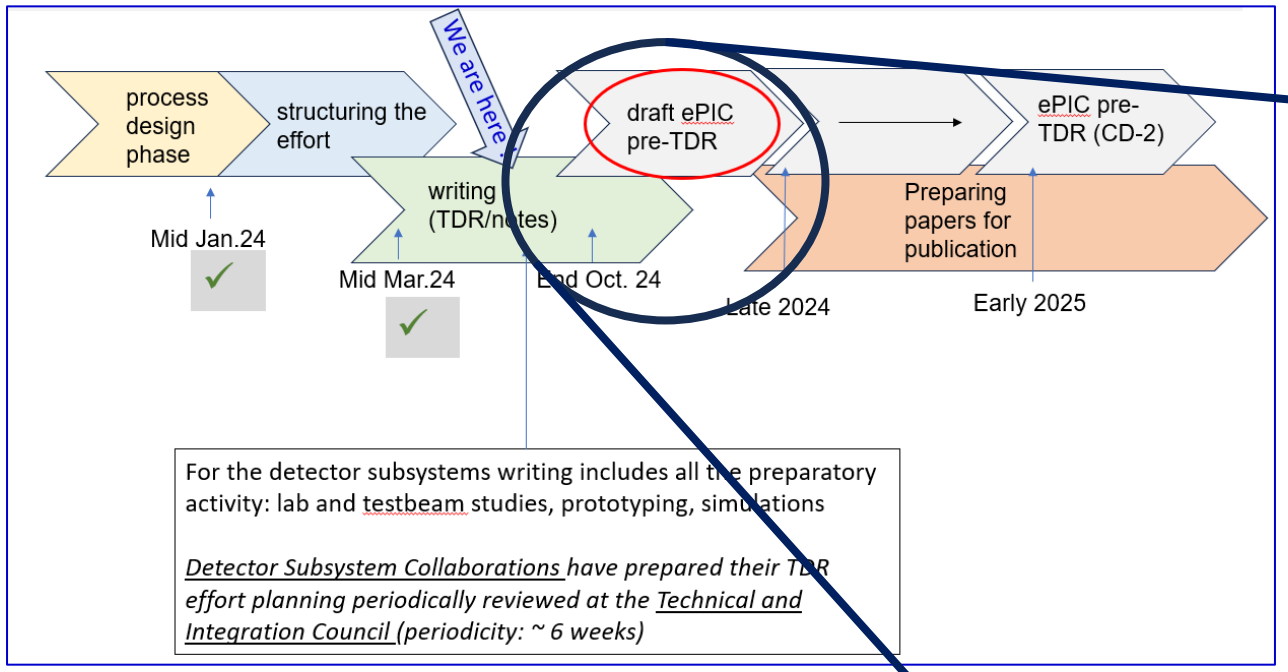
- A paper published in a scientific journal about the ePIC software and computing model
  - Derived and expanded from TDR Chapter 8.3.12 “Software and Computing”
  - This paper, anticipated already last year, has to regarded, as well as the two other ones, as a product related to the TDR effort

Schedule


Electron-Ion Collider
Brookhaven National Laboratory
Jefferson Lab
FY19 FY20 FY21 FY22 FY23 FY24 FY25 FY26 FY27 FY28 FY29 FY30 FY31 FY32 FY33 FY34 FY35
CD
CD-0(A) Dec 2019
CD-1 (A) Jun 2021
CD-3A Jan 2024
CD-3B Oct 2024
CD-2/3 Apr 2025
Early CD-4 Completion Oct 2032
CD-4 Aproved Completion Oct 2034
Research & Development
Accelerator Systems
Detector
Research & Development
Research & Development
Conclusion of RHIC Operations
Design
Conceptual Design
Infrastructure
Accelerator Systems
Detector
Construction & Installation
Infrastructure
Accelerator Systems
Conventional Construction
Procurement, Fabrication, Installation & Test
Procurement, Fabrication, Installation & Test
Commissioning & Pre-Ops
Detector
Key
(A) Actual
Completed
Planned
Level 0 Milestones
Critical Path
Design phase
Construction phase
Science Phase
We are here


Material available for the DOE OPA Review (January 7-9, 2025)
process design phase
structuring the effort
We are here !
writing (TDR/notes)
draft ePIC pre-TDR
ePIC pre-TDR (CD-2)
Preparing papers for publication
Mid Jan.24
Mid Mar.24
End Oct. 24
Late 2024
Early 2025
For the detector subsystems writing includes all the preparatory activity: lab and testbeam studies, prototyping, simulations
Detector Subsystem Collaborations have prepared their TDR effort planning periodically reviewed at the Technical and Integration Council (periodicity: ~ 6 weeks)

Schedule



ZOOMING

2 preTDR draft versions in 2024

- **Version0** by **September 29** available in overleaf (*)
- During October 2024, internal review process!
  - Recommendations to be integrated in Version1
- **Version1 by December 1** available in overleaf (*)

(*) about overleaf more in the coming slides

preTDR – Version0 & Version1

Only 2 preTDR draft versions in 2024 to minimize the load in view of the end-of-year “milestone”

- **Version0** by **September 29**
  - All preTDR text is there, even if it can be in a rough version
  - Additional material: planning required, part already in
  - Plots for Version0 can make use of a scattered set of simulation campaigns

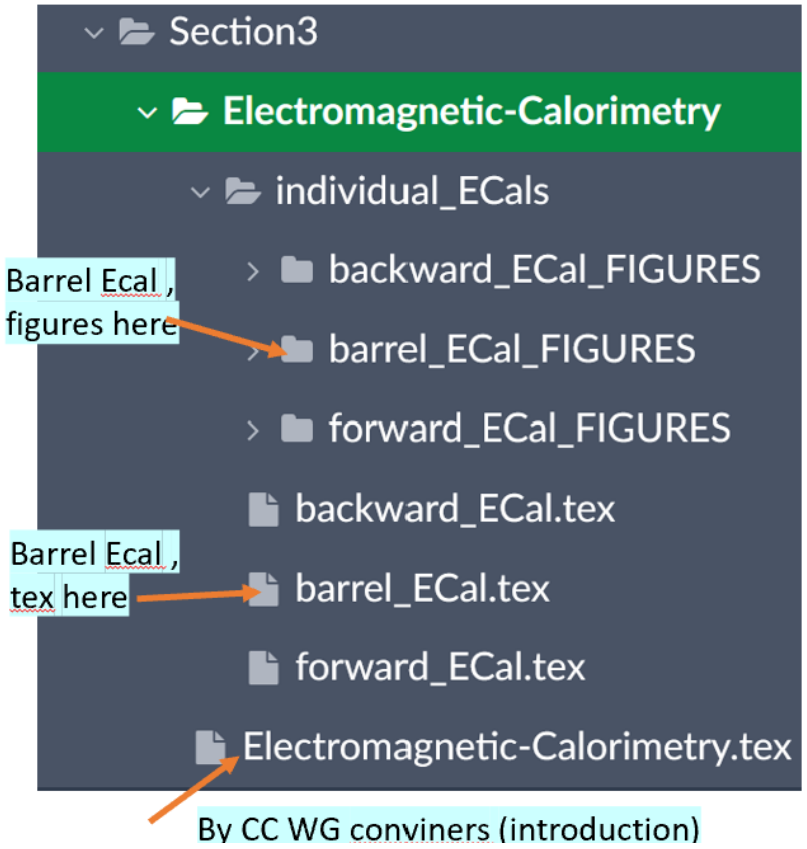
- During October 2024, internal review process!
  - Recommendations to be integrated in Version1

- **Version1** **by December 1**
  - More refined text
  - Recommendations form the internal review have to be integrated
  - The additional material expected, it can still be in a rough text version
  - Plots for Version1 make use of the **October simulation campaign**
  - Version1 is the material that will be used for the Jan. 2025 DOE OPA review

(pre)TDR and ePIC engagement, specific detector aspects

Selected (pre)TDR frame: overleaf

- **Acknowledging the overleaf project creation by Douglas Higinbotham**
  - Also supported by his collaborator Anil Panta
- **DSC contributions are included in the chapter/section 8.3**
- **Preparing the frame in overleaf for the DSC material**
  - Authorized for text editing
    - DSLs, DSCTs
    - CC WG conveners
  - Technical aspects
    - the project is structured so that, while progressing in your editing, you do not need to recompile the whole of it at each step: recompiling a subsection is enough;
    - Directories organize to facilitate the parallel work of the various CC WGs/ DSC



preTDR – overleaf frame for detectors, cont.

- **The structure discussed at 2 TIC meetings and finally approved is in: please, preserve it!**

8.3.5.2 The barrel electromagnetic calorimeter

Requirements

Requirements from physics: Add text here.

Requirements from Radiation Hardness: Add text here.

Requirements from Data Rates: Add text here.

Justification

Device concept and technological choice: Add text here.

Subsystem description:

General device description: Add text here.
Sensors: Add text here.
FEE: Add text here.
Other components: Add text here.

Requirements from Data Rates: Add text here.

Implementation

Services: Add text here.

Subsystem mechanics and integration: Add text here.

Calibration, alignment and monitoring: Add text here.

Status and remaining design effort:

R&D effort: Add text here.
E&D status and outlook: Add text here.
Other activity needed for the design completion: Add text here.
Status of maturity of the subsystem: Add text here.

Environmental, Safety and Health (ES&H) aspects and Quality Assessment ning: Add text here.

Construction and assembly planning: Add text here.

Collaborators and their role, resources and workforce: Add text here.

Risks and mitigation strategy: Add text here.

Additional Material Add text here.

- The length each DSC subsection is expected to be within **10-15 page** → **Executive summary format**

BUT

- **Additional Material, as wide as needed;** all the extra material exceeding the compact format of the pre-TDR document. At a later time, this extra material, which can be abundant, will be moved in appropriate **Appendices**.

A missing ingredient: rules for the **plots**

What do text editors (all of them, not detector only) need ?

- Graphical format
- A recipe to preserve plot documentation

We would like that these two requirement are already used for Version0
→
They will be distributed by August 15

TC-office and preTDR - Monitoring the DSC effort

- **Monitoring the DSC progresses with periodic reports (~ every 6/7 weeks) at the TIC meetings**
  - Most recently
    - 6/3: Tracking
    - 6/10: PID
    - 6/24: FF
    - 7/1: FB
    - 7/15: Calorimetry; electronics/r-o/DAQ

TC-office and preTDR - hardware studies

- **Following the lab / testbeam / rad-hard studies**

Part of the (pre)TDR effort, already mentioned within the TC-office report on Wednesday

  - At recent TIC meetings

    - 5/13: **photosensors for PID Cherenkov subsystems**, updates of hardware studies
      - Constant progress in establishing SiPms for these applications
      - Initial characterization of the first HRPPD units
    - 5/20: progress of **ASTROPIX** development
    - 6/3: a report concerning the delivery of the **BaBar quartz bars** at Jlab
    - 6/17: news from the **first ITS3 testbeam**
    - 6/24: news from the **dRICH test beam; TimePix4** news
    - 7/8: forward **HCal insert/ZDC prototype** testbeam at STAR; **rad-hard studies** for the calorimetry SiPM, an update

TC-office and preTDR - suggested priorities for simulation studies

- Studies for <u>subsystems where there are technical aspects still open</u>:
  - simulations dedicated to soft gamma and to vector meson production in order to optimize the **ZDC configuration**
    - UCR and Regina U. robustly at work;
  - motivation and requirements for the **backward HCal**
    - the activity needs to move towards a better focus and more robust organization;
  - needs in term of space resolution for the **outer MPGD**
    - In progress (typically discussed at the MPGD-DSC-Simulation meetings);
  - impact on physics of **dRICH with single vessel vs dRICH with split vessel**
    - In an extremely preliminary status.

Part of the (pre)TDR effort, already mentioned within the TC-office report on Wednesday

TC-office and preTDR - next coming new duties

- **Propose a list of internal reviewers for the October review**
  - Prepare a list in advance, in September
  - Obtain their availability in advance

- Contribute to the **internal reviewing process**
  - in October

- On the basis of Version0/1, **start structuring the detector paper**
  - When the internal review is over, from November on