Commissioning, Maintenance and Operation of the ePIC Experiment at the EIC

prepared by:

Abhay Deshpande, Rolf Ent, John Lajoie and Rosario Nania

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The present draft relates to the ePIC experiment but can also serve as model for a potential future second EIC detector.

Maintenance and Operation (M&O) costs of the experiment are incurred not only when the detector is running but also during construction and commissioning. Institutes and agencies committed to supplying 'deliverables' as defined in separate agreements have implicit responsibility for M&O costs associated with construction and commissioning of those items. In addition, M&O for general infrastructures and items shared among the different detector systems should be considered as **common costs** and should be divided among the funding agencies

The document contains a draft list of items that incur M&O costs to operate the ePIC experiment. Ultimately this list will define what is included and is not included in the M&O agreement(s). It will cover material costs, any personnel costs related to detector operation that are either 'billed' (e.g., outsourced manpower) or external (e.g., the use of personnel for tasks directly and exclusively to do with ePIC detector M&O), and computing-related costs. In a future iteration we plan to include preliminary estimates of the total cost of operating the ePIC experiment.

Timetable

This document is prepared to guide first discussions at the RRB in May 2024. It is expected that those discussions, followed up by the written exchange of comments, will allow a further iteration of the document for the RRB in late 2024, and provide the seeds that can be used in further agreements between the EIC host labs and the agencies.

Period of validity

This document is aimed at preparing agreement to cover the M&O costs during ePIC detector construction, commissioning, and operations. It is assumed to start from 2028 onwards to allow time for the funding agencies to prepare. Costs for the period 2025-2027 can be handled 'informally' as has been the case hitherto. An assumption has been made for how costs and funds will evolve in time from construction to running. It is anticipated that the actual M&O costs will be updated annually for approval by the EIC-RRB.

Governance Model

The EIC is a US-based collider. DOE and the host labs promote the EIC as a facility that is fully international in character with the EIC-RRB to provide oversight of resources utilized for detector construction, operations, and planning. To set the stage towards costs, we give here a short description of the key governance principles:

- US DOE finances EIC accelerator operations, determines number of operations weeks and schedule.
- US DOE supports the host labs' administrative and technical staff and the infrastructure costs for the experiments.
- DOE and non-DOE participate in and finance the governance of the experimental program including construction and upgrades, maintenance and operations (M&O), and distributed software and computing.
- BNL and TJNAF, as the co-hosts for the EIC Experimental Program, convene nominally twice a year the EIC-RRB as international oversight body.

In the following we will use the acronyms :

FA	Funding agencies
CI	Collaborating institute
HL	Host Laboratories

Cost categories

- *Category A* concerns equipment built and maintained using Common Funds e.g. magnets, or services and operations common to the whole experiment e.g. software licenses. *(FA+CI +HL common cost)*
- *Category B* concerns maintenance of equipment built by a sub-set of the collaboration, mainly sub-detectors. *(FA+CI+HL)*
- Category C concerns collaboration support using Common Funds, e.g., support for travel and as-needed time for key Collaboration functions, local co-support of travel for visiting scientists, and general support for a global strategy to allow for underprivileged scientists to participate in EIC science. *(FA+CI+HL common cost)*
- *Category D* concerns items for which the DOE and US host laboratories would naturally assume responsibility for, e.g. costs to run the accelerator which sets the weeks of operations and schedule, infrastructure for the experimental areas and experiments and infrastructure operations costs, survey and alignment, and the overall Environmental, Health, and Safety aspects for detector operations *(DOE +HL)*

Detector related costs	
Gas consumption	A
M&O of gas systems	A
M&O of cooling systems (incl. consumption)	A
M&O of moving/hydraulic systems	A
Shutdown maintenance and operation	A
Magnet power supply maintenance	A
UPS maintenance for common systems	A
Sub-detector electronics maintenance	B
Beam pipe	A
Counting & control rooms	A
Test and Diagnostic Equipment	A
Computing	
Recording media	A
Computing services*	A
Detector controls	A
Computer/LAN maintenance/replacement	A
System management	A
Software license fees	A/B
Common desktop infrastructure	A
Data management	A
Collaboration Secretariats	
Photocopying machines, fax, printers	A
Printing and publication costs	A
Secretarial assistance	A
Support for Visiting Scientists	C
Support for Collab. Positions (Technical and Resource Coordinators, etc.)	C

Test beams and calibration facilities	
General operation	A
Upgrades	A/B
Common electronics and DAQ	A
Test and Diagnostic Equipment	A/B
Counting & control rooms	A
Special Services*	
Laboratory instruments	A/B
Test and Diag. Equipment	A/B
Assembly and active storage areas	A/B
Workshops	A/B
Cooling, ventilation, and pumps	A/B
Heavy transport	A
Cranes	A
Transportation	A
Passive storage space	A/B
Engineering	A
Detector safety systems	A
Communications	
Cellular phones	A/B
Videoconferencing	A/B
Outreach	
Outreach events and activities	C

* These items are intended to cover specific exceptional needs that go beyond what would ordinarily be expected to be covered by the host laboratories.

Notes on computing

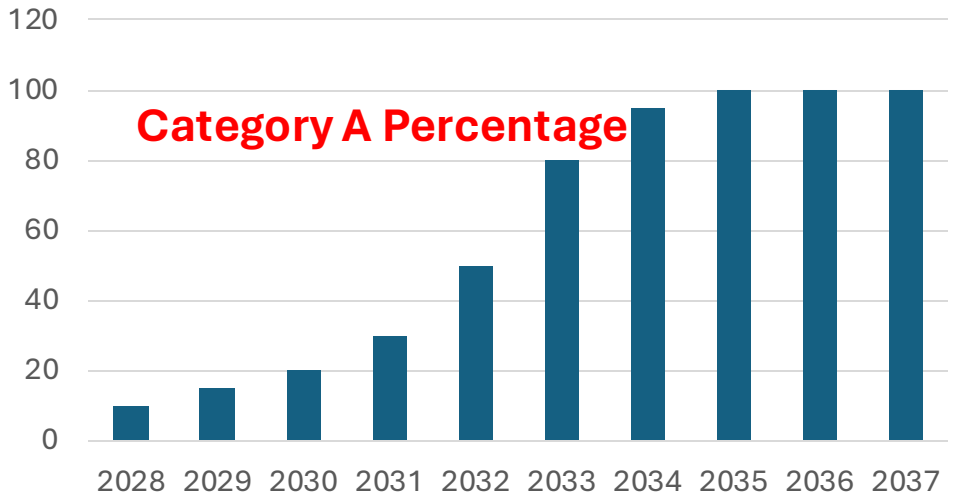
It is currently envisioned that in-kind contributions to computing would be managed by agreements with the ECSJI. The common fund document notes that:

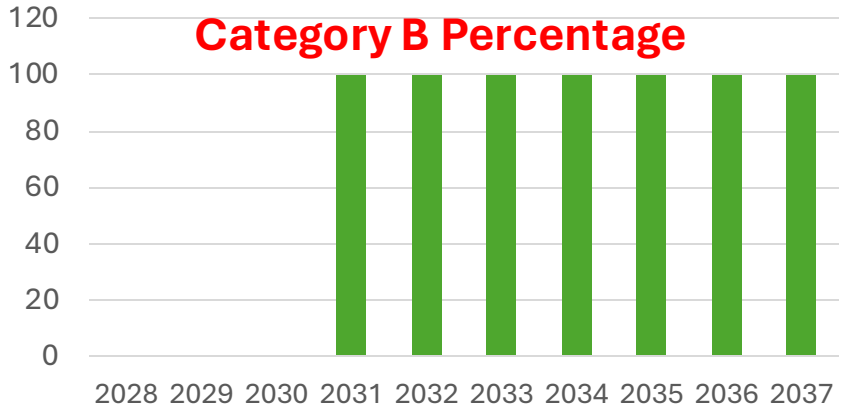
“It seems likely that in some cases the EIC-RRB will have to endorse in-kind rather than cash contributions to M&O costs.”

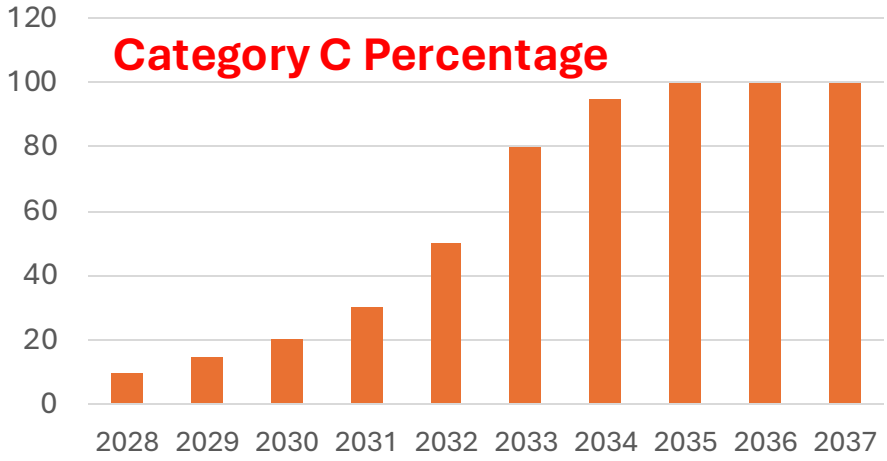
Open Question: How should in-kind contributions to computing be treated in this context?

(Draft)Timelines

assumed installations completed around 2030, the exact date assumptions may change in future iterations







Cost sharing

Category A items

Sharing by scientists is linked directly to the exploitation of a detector and is perceived to be a fair measure of benefit. To fold in the educational and more transient character of students, 'scientists' are taken to be fully-qualified PhDs, or the equivalent, appearing as named authors on publications of the collaboration. This implies that a reference publication is defined annually.

Category B items

For Category B items a sharing with a different cost-sharing algorithm may be more appropriate. FAs and CIs can retain responsibility for their own category B costs and sharing can vary with sub-system. Because many ePIC sub-systems have multiple participants, the institutes participating to a given detector sub-system will propose a sharing of the M&O costs as agreed among themselves, and the EIC-RRB will make sure this proposal can be accepted..

Category C items

Category C items can be handled in the same way as category A items, as a sharing with scientists with a PhD-equivalent level. The cost-sharing mechanism may be chosen to differ from that used for category A items to take into account the special role of the DOE host laboratories to host the ePIC collaboration and visiting scientists, and to encourage participation in ePIC detector operations of underprivileged scientists.

Fair Sharing

There are several groups of participants in ePIC and contributions may differ:

- Participants that have contributed to building the EIC machine and those that have not so contributed.
- Participants that have contributed to ePIC by in-kind sub-system contributions or by intellectual contributions.
- Participants that have provided labor or have provided direct equipment scope.
- Participants that provide contributions to the ePIC distributed computing.
- Participants that belong or not to RRB member FAs or as observer status.

All participants should be treated in a transparent way and that due recognition is given for their contributions. Specific situations will be evaluated by the EIC-RRB.

Rebates

A possible way of recognizing contributions to the machine and/or to the distributed computing is via 'rebates', whereby DOE pays part of the category A bill of contributors.

Flexibilities

It is understood that the financial situation in each member and non-member (observer) country that participates in the EIC-RRB may be different. There should be some means for the EIC-RRB to apply flexibility in contributions to the M&O Common Funds. The EIC-RRB can fold this into their determinations of equitable sharing of M&O costs at their bi-annual meetings

Thank you for comments and inputs.