PETRA IV.
NEW DIMENSIONS

Status PETRA IV Project

PETRA IV Progress Review Meeting, 27 November 2023

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Project Leader PETRA IV

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

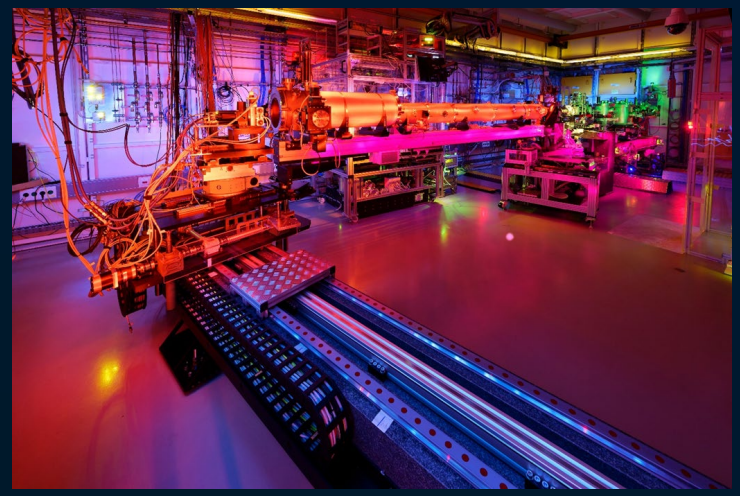
DESY.

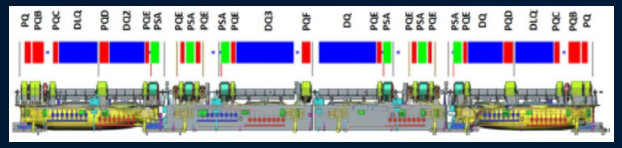
PETRA IV Project

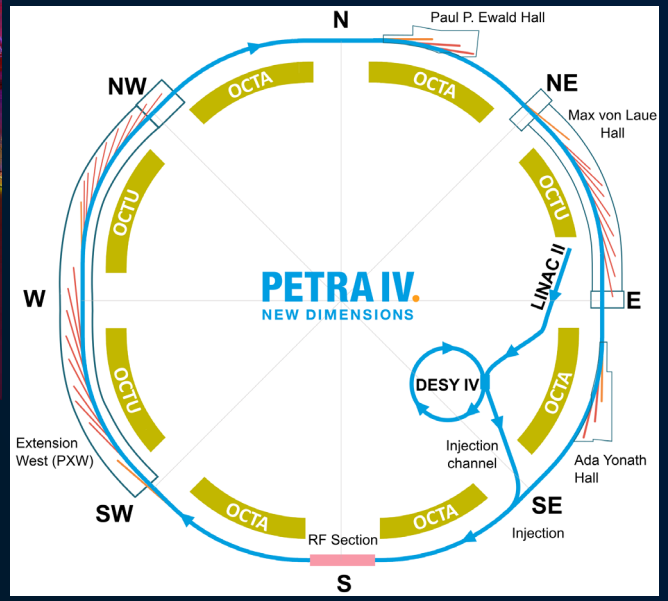
Extension/Refurbishment of the existing infrastructure, accelerator complex, and experimental facilities

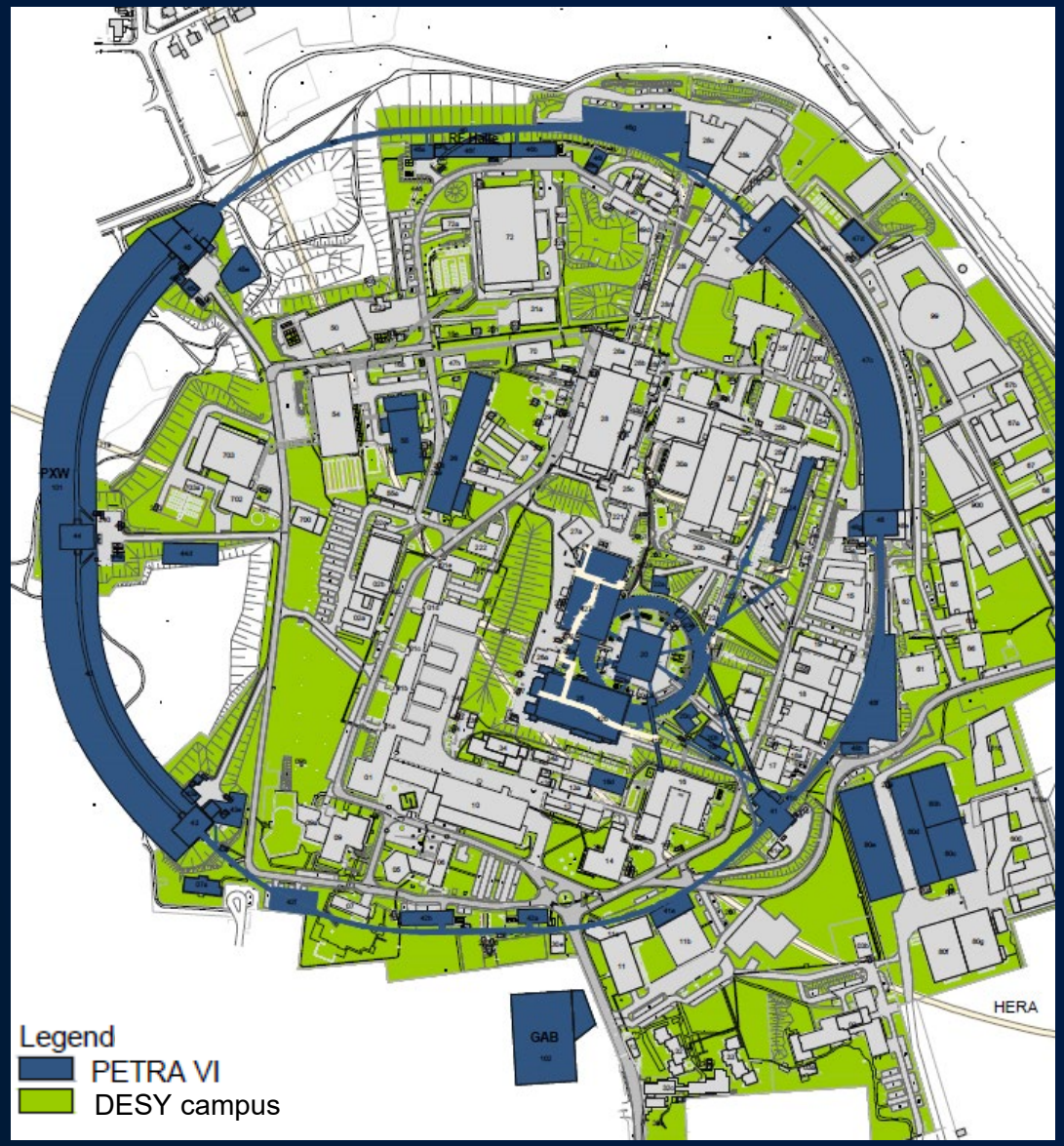
Baseline design is fixed and costs have been assessed and reviewed on that basis

Increase in performance by a factor of 500







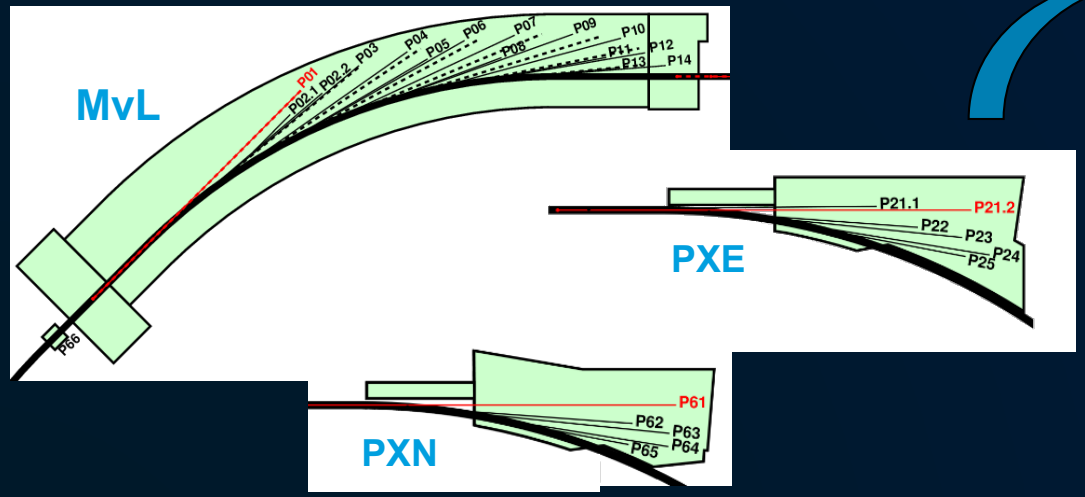


PETRA IV – Experiments

Number and Distribution of Beamlines

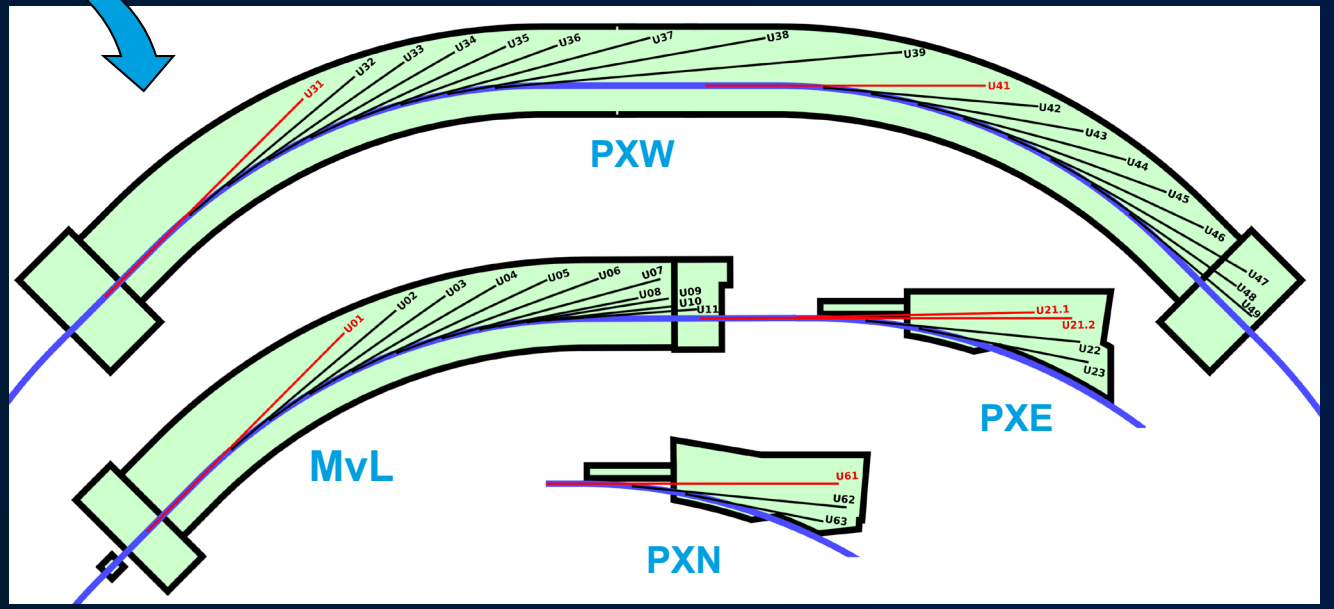
PETRA III Beamlines (max): 26 + 1 VUV

- 25 beamlines in operation (3 experimental halls)
- Many canted sectors (2 m and 5 m IDs)
- Partners: 3 EMBL, 2.5 Hereon, 1.3 India (virtual), Sweden, MPG



PETRA IV Beamlines (max): 35 + 1 VUV

- 31 ID project beamlines (4 experimental halls)
- Preservation of BL infrastructure in existing halls possible
- Canting very limited (1 – 5 mrad only, 4.3 m IDs)
- 5 high-brightness beamlines (10 m IDs)
- Partners: EMBL, Hereon, India, Sweden, MPG, …



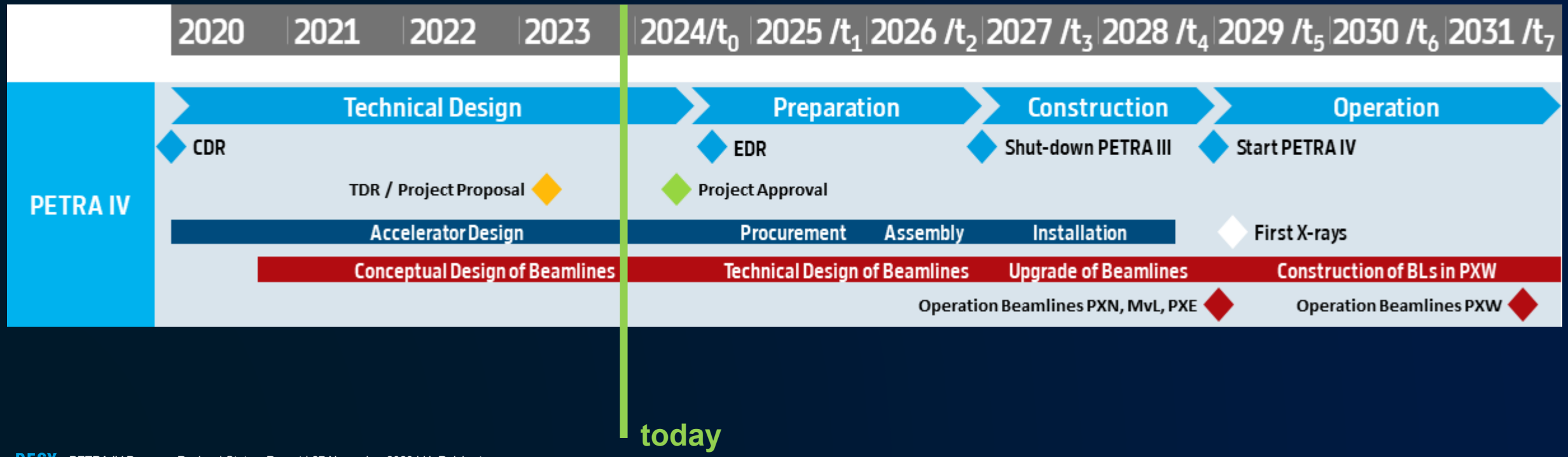
PETRA IV – Schedule

Project fixed by (external) boundary conditions

- Start of operation 1/2029 with 19 beamlines
- Shutdown of max. 2 years (2027/2028)
- Overall project duration to full project delivery: 8 years (2024-2031)

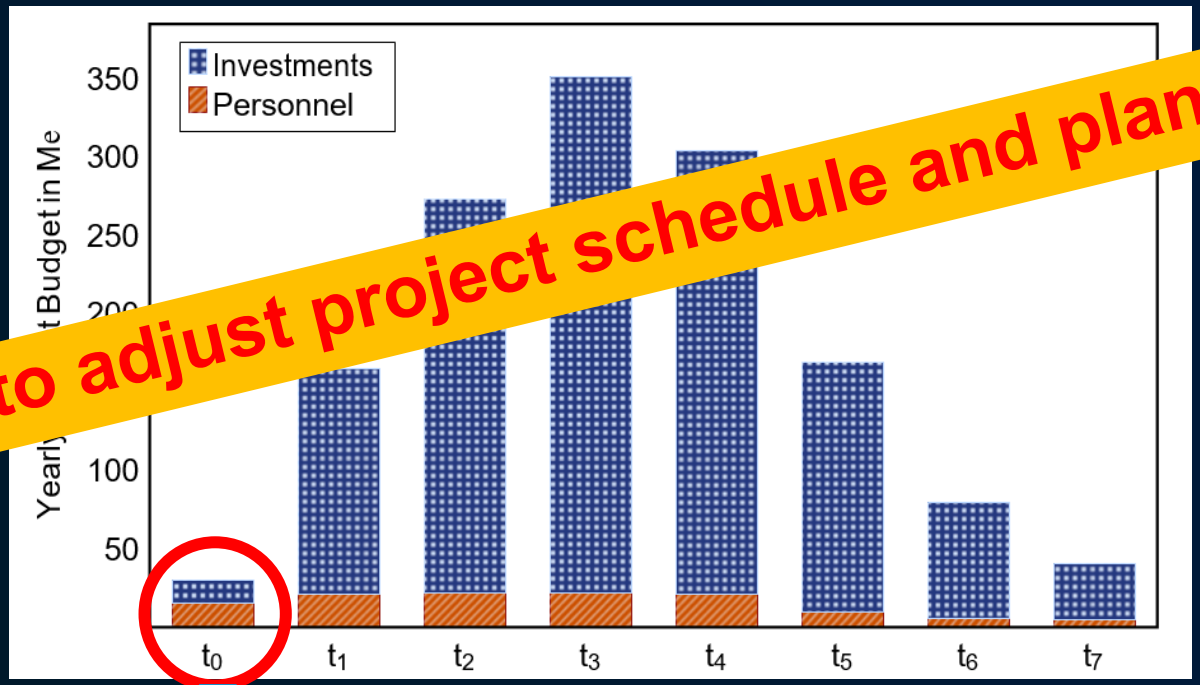
→ No longer possible, shift by at least 1 year

t_0 = 2025 or later



PETRA IV – Spending Profile

Values in Me	Spending Profile of the Project								
Categories	t_0	t_1	t_2	t_3	t_4	t_5	t_6	t_7	**Sum**
Investments	14.6	144.6	251.4	329.8	282.8	159.1	74.4	36.3	**1,293.0**
Personnel Budget	15.3	20.6	22.0	21.7	21.0	9.8	5.3	4.3	**120.0**
PETRA IV Project	29.9	165.2	273.4	351.5	303.8	168.9	79.7	40.6	**1,413.0**



Need to adjust project schedule and planning

Financing (most likely):
- 90% Federal
- 10% State

Issue: probably not available in 2024

2024: recruitment of ~100 FTE
contracts with general planners

PETRA IV Project – Milestones since last Review

2-stage process

22 July 2023 – Internal cost review (requested by DESY DIR)

4/5 September 2023 – External cost review (requested by SR)

27 September 2023 – FHH secures its share of PETRA IV project costs

13 November 2023 – Signature MoU DESY, EMBL, Hereon, FhG

16 November 2023 – Budget Committee: Funding for preparatory measures for PETRA IV

2024 – 2026

- 10 M€ Transformation project
- 15 M€ LPA
- 20 M€ Preparation PETRA IV Project
  - 3.5 M€ prototyping
  - 16.5 M€ civil construction & TGA (planning)

PETRA IV – Project Budget after Review

Overview (price index end of 2022)

PETRA IV	DESY's Own Contribution			Third Party Funding			Sum
	Personnel		Investments	Personnel		Investments	
	PY	Mio.€	Mio.€	PY	Mio.€	Mio.€	Mio.€
Accelerators	580	52.8	**40.4**	344	31.4	331.4	**455.6**
Experiments	634	57.7		365	33.3	225.7	**316.7**
Logistics	22	2.0		180	16.2	13.3	**31.5**
Infrastructure	109	9.9		185	16.9	607.2	**634.0**
Safety	19	1.7		24	2.4	20.2	**24.3**
Management	52	4.7		219	19.8	2.4	**26.9**
Sum in Mio.€		**128.8**	**40.4**		**120.0**	1,200.2	**1,489.4**

Reduction by 54 M€ in total project cost
(only investments – correction for VAT)

PETRA IV – Project Change Implemented

Project evolution

Baseline design & budget frozen in March 2023
Boundary condition: budget envelope is fixed (reference year: 2022) – no contingency / spares
build-to-budget for WPG3 (fixed invest amount for BLs & computing)

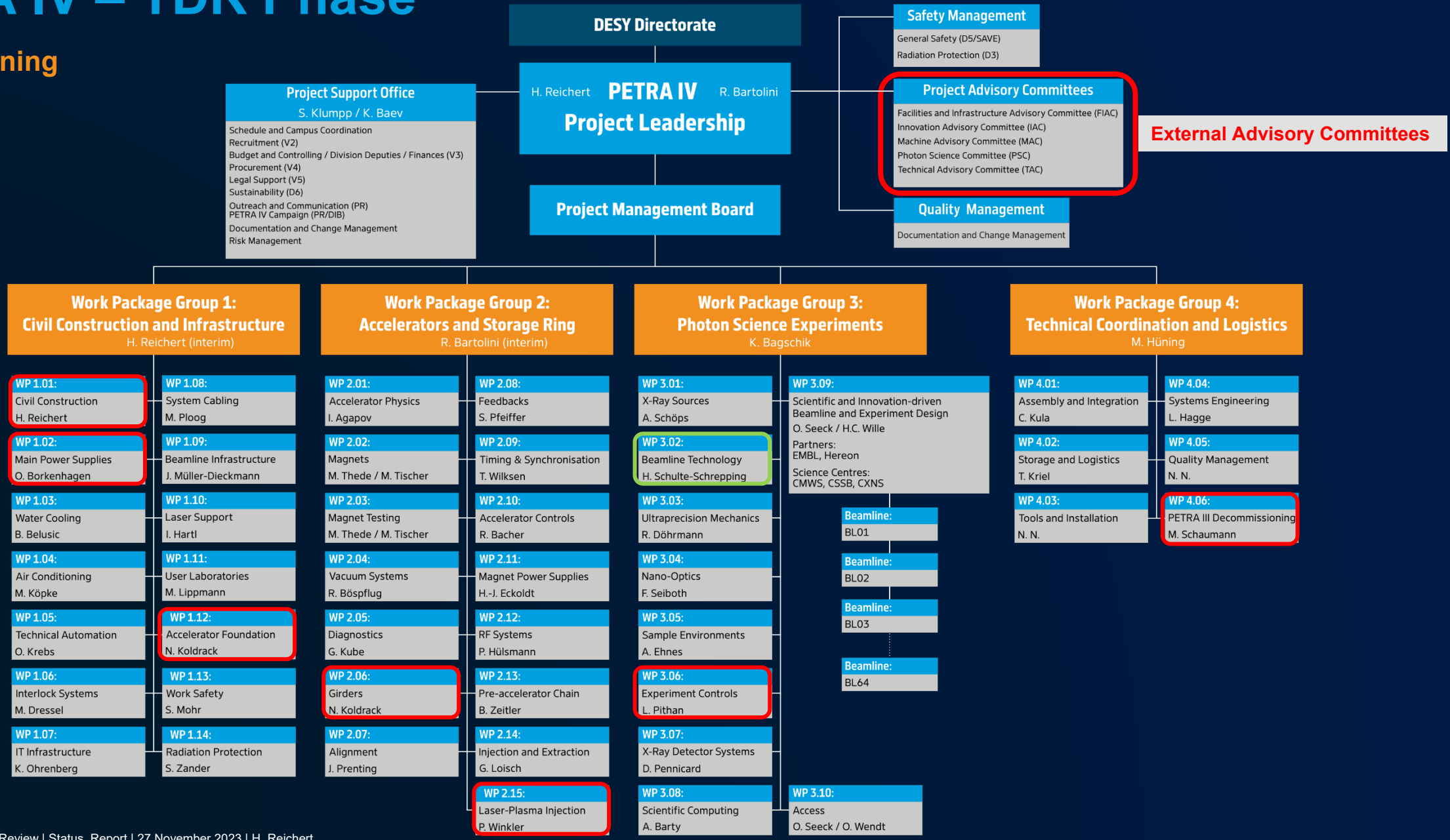
Strategy:

- **Collect change requests quarterly (first deadline 30 Nov. 2023)**
- **Decision and update of baseline budget (end of December 2023)**

„War chest“: decommissiong costs (disposal cost of PETRA III)
sale of raw material to scrapers (recycling)
continued design optimisation (reduction of electricity consumption)
replace 1-to-1 hot-swap system by 1-to-N
invest from operation budget t_5 – t_7 → procurement of spares

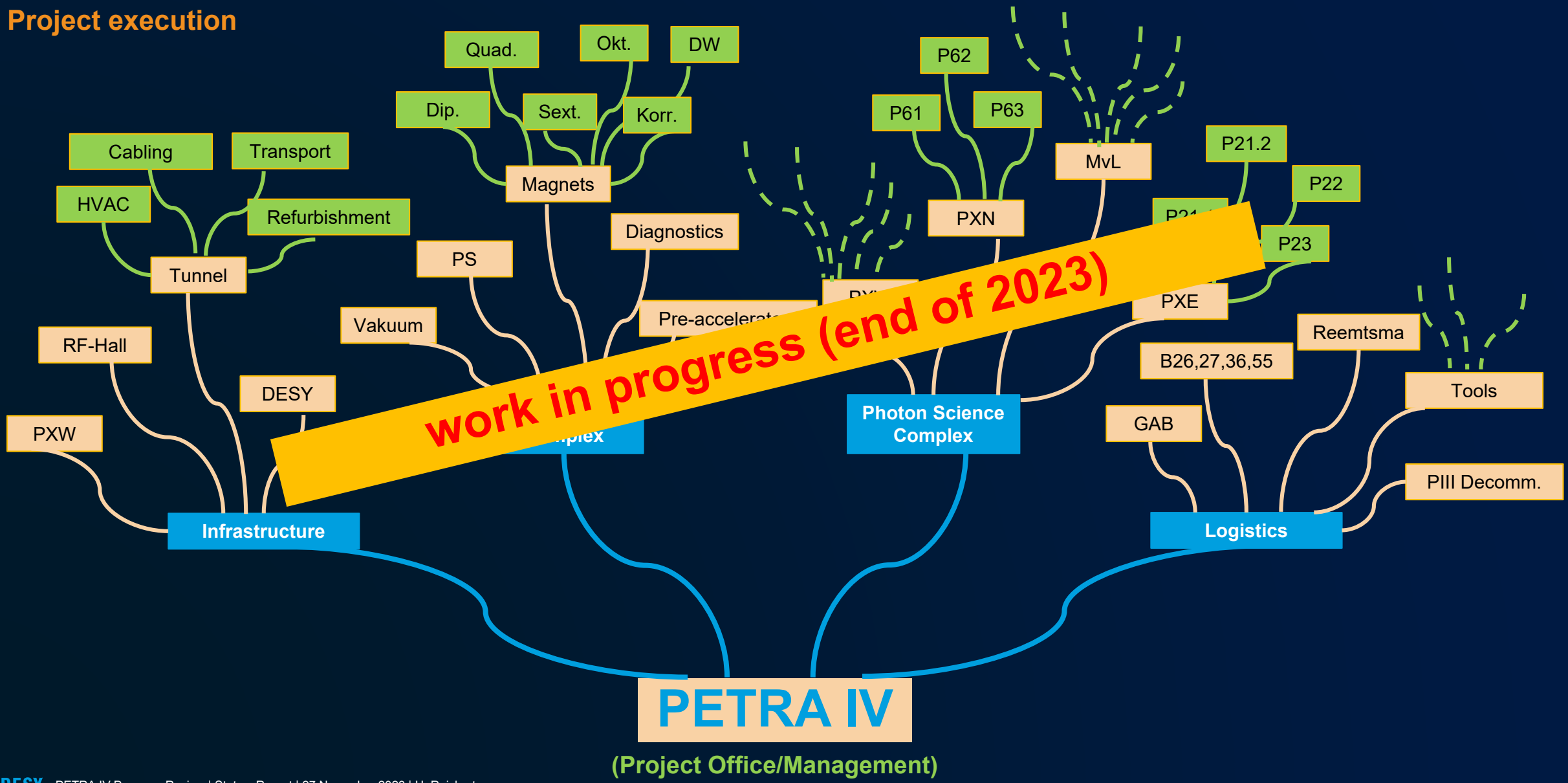
PETRA IV – TDR Phase

Project planning



PETRA IV – Project Phase

Project execution



PETRA IV – Project Organisation

Preparation for execution phase

→ Karolin Baev

PETRA IV – Civil Construction and Infrastructure (WPG 1)

Outlook

Adjust strategy for the entire WGP to cope with delay in project approval and financing

- **Depleted project team: urgently need recruitment of WPG 1 lead & WP 1.01 lead**

  Currently only two persons working on the civil construction work package

- **LP 1-3 planning on the “big ticket items” has started (including TGA): GAB, PXW, RF hall**

  Try to reach LP 3 (compensates partially for delay and saves budget)

- **Step-by-step refinement of requirements for the next buildings**

  Staggered approach for the definition of needs and (pre-)planning

PETRA IV – Accelerators and Storage Ring (WPG 2)

Outlook

Adjust strategy to advance and expand prototyping → presentation by Riccardo

- **Switch to 1-to-N hotswap**

  Reduces investment costs (buidings, power supplies, IT, etc.)

- **Reinforce efforts to develop options for injection scheme (long-term)**

  Options for injection (decision in approx. 2 years)
  - **DESY IV (medium-term)+ LPA (top-up, medium-term) + LPA only (long-term)**
  - **DESY IV (long-term) + LPA (top-up, long-term)**
  - **DESY II refurbished (short-term op.) + LPA (medium-to-long-term)**

  (DESY IV: approx. 80 M€ / DESY II refurbishment: not assessed yet)

PETRA IV – Photon Science Experiments (WPG 3)

Outlook

Adjust strategy to advance and expand prototyping → presentation by Kai

- **Implement tech-task group (additional resources & PETRA III reorganisation**

  Advance prototyping, in particular for X-ray optics

- **Advance beamline design**

  CDRs for all beamlines by summer 2024

- **Prepare for decision on beamline control system**

  Test BLISS and Bluesky on BLs under construction (P25 & P63)

PETRA IV – Technical Coordination & Logistics (WPG 4)

Outlook

WPG is well underway – needs no adjustment → presentation by Markus

- Delay in project start relieves pressure on logistics

  → Schedule for the construction of the GAB is unaffected

- Continue detailed installation planning

PETRA IV – Operation Budget

Operation budget PETRA IV (without contribution from partners – EMBL, Hereon, KIT, MPG, ….)

Operation Budget in M€	PETRA III		PETRA IV	
Personnel		**37.6**		**51.3**
Accelerator operation	108 FTE		139 FTE	
Experiments	145 FTE		206 FTE	
Recurrent		**14.8**		**20.3**
Electricity (2022 price)	10 M€		13.3 M€	
consumption	74.3 GW h		98.4 GW h	
other recurrent costs	4.8 M€		7.0 M€	
Invest		**8.4**		**21.3**
Total		**60.8**		**92.9**

Personnel in the Divisions M & FS (LK-II funding)

M – Division in FTE			FS – Division in FTE		
Group Name	PETRA III 2022	PETRA IV 2029	Group Name	PETRA III 2022	PETRA IV 2029
M & MR (mngt.)	1.3	3.0	PETRA-D	46.4	60.0
D3	2.0	3.0	PETRA-S	34.1	41.7
MBB	1.8	2.0	PETRA-USG	2.9	24.0
MCS	11.2	17.0	FS-BT	16.3	19.0
MDI	11.3	12.0	FS-EC	10.0	17.0
MEA	6.9	7.0	FS-TI	13.8	17.0
MHF	10.1	10.0	FS-US	10.4	12.0
MIN	12.3	14.0	FS-SC	11.2	16.0
MKK	10.2	20.0			
MPC	12.8	15.0			
MPE & MPY	5.8	7.0			
MPS	4.2	5.0			
MSK	6.8	9.0			
MSL	0.6	0			
MVS	10.4	13.0			
MLS	0	2.0			
Total	**107.7**	**139.0**		**145.1**	**206.7**
	+ 31.3	**+ 18.7**		**+ 61.6**	**+ 37**

+ 60% overhead

P IV : 207.4 FTE

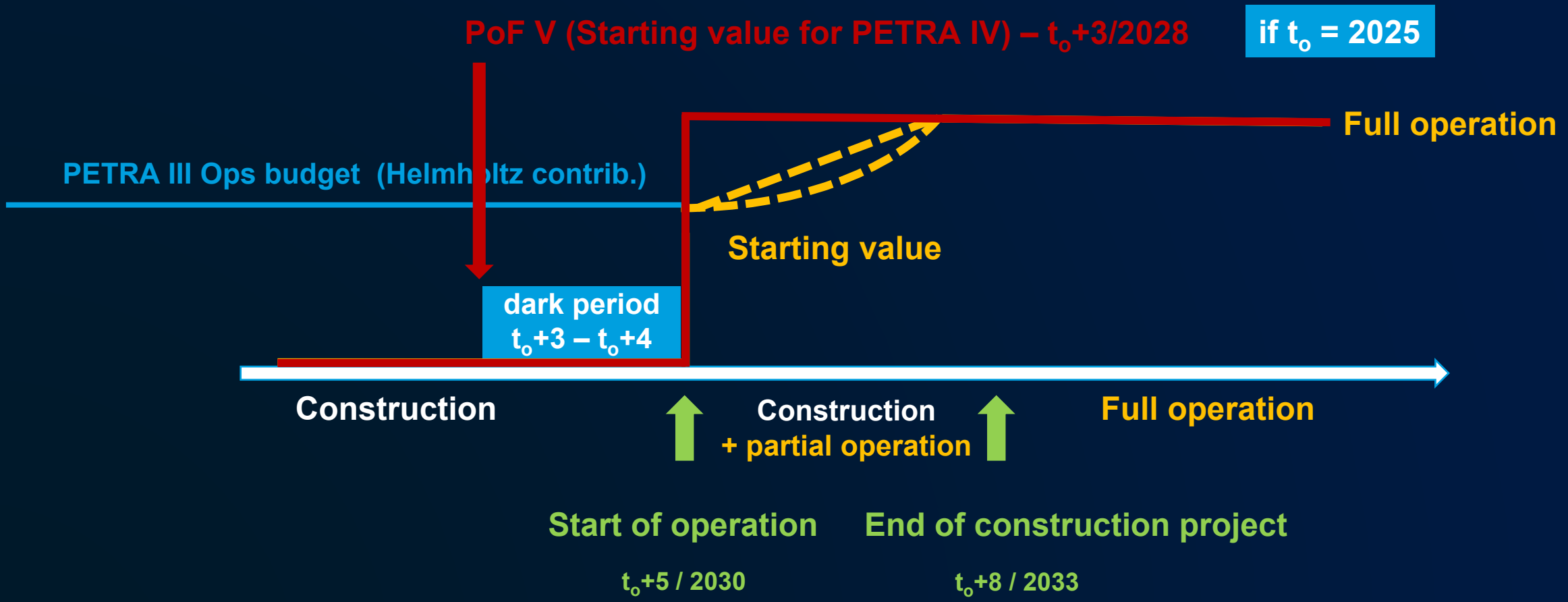
P III : 151.7 FTE

Δ = 55.7 FTE

Δ = 92.9 + 55.7 FTE

PETRA IV – Operation Budget

Operation budget ramp-up



PETRA IV – Priority Recruitments

Ongoing discussions with Directorate & hosting divisions

Rank	Work Package		Position	DESY Group	ID
0	pso03	Budget Controlling	Accountant	MPY	P.pso03.1
1	WPG1	Civil Construction and Infrastructure	Work Package Group Leader	MPY	P.101.5
2	WP 1.01	Civil Construction	Civil Construction Engineer / WP Leader	MPY	P.101.1
3	pso01	Schedule and Campus Coordination	Schedule Manager	MPY	P.pso01.1
4	pso04	Procurement	Procurement (Construction)	V4	P.pso04.2
5	WP 1.02	Main Power Supplies / MKK	Engineer	MKK1	P.102.3
6	WP 1.03	Water Cooling / MKK	Engineer	MKK2	P.103.3
7	WP 1.04	Air Conditioning / MKK	Engineer	MKK3	P.104.3
8	WP 3.02	Beamline Technology / ZM1	Design Engineer Preparation and Models	ZM1	P.302.5
9	pso08	Documentation and Change Management	Junior Scientfic Manager	MPY	P.pso08.1
10	pso04	Procurement	Procurement (EKM)	V4	P.pso04.4
11	WP 2.05	Diagnostics	Scientist	MDI	P.205.8
12	WP 2.05	Diagnostics	Engineer (Racks)	MDI	P.205.25
13	WP 4.01	Assembly, Integration, Test	CAD engineer	MPY	P.401.5
14	WP 3.09	Beamline and Experiment Design			P.309.12
15	WP 3.02	Beamline Technology	Preparation and Models (located in ZM1)	ZM1	P.302.18
16	WP 4.05	Quality Management		MPY	P.405.2
17	WP 2.08	Feedbacks	SW programmer 2	MSK	P.208.10
18	WP 4.01	Assembly, Integration, Test	Requirements Engineer	MPY	P.401.8
19	WP 3.09	Beamline	Mechatronic Engineer		P.309.7
20	WP 3.02	Beamline Technology	Mechanical Engineer Optics	FS-BT	P.302.5
21	WP 2.01	Accelerator Physics	Physicist (replacement)	MPY	P.201.2
22	WP 3.01	X-Ray Sources	Engin./Tech. Magn. Tuning	FS-US	P.301.9
23	WP 2.02	Magnets	Engineer DLQ	FS-US	P.202.7
24	WP 3.06	Experimental Control System	General purpose GUIs	FS-EC	P.306.13
batch01	WP 2.06	Girders	Engineer	MEA	P.206.3
batch01	WP 2.02	Magnets	Engineer	MEA	P.202.5
batch01	WP 2.03	Magnet Testing	Measurement engineer	MEA	P.203.5
batch01	WP 1.01	Civil Construction	Civil Construction Engineer	MPY	P.101.7
batch01	WP 1.01	Civil Construction	Civil Construction Engineer	MPY	P.101.8

+ Renewal of time-limited contracts