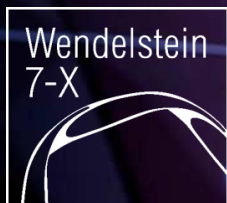




TKT MP2.4 Work packages



EUROfusion

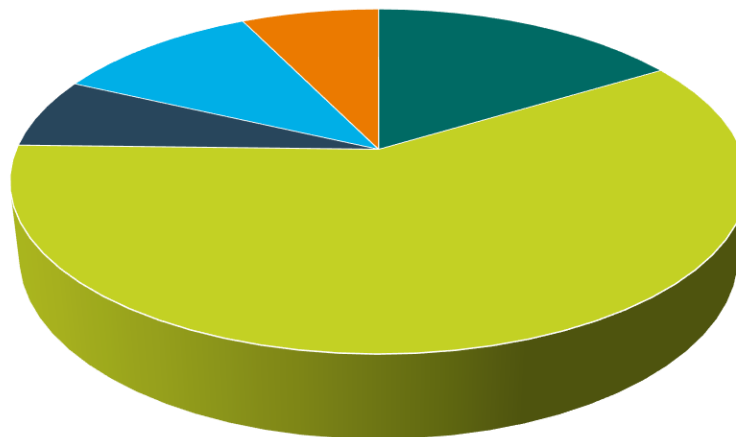
A. Lorenz, H. Lentz, D. Behrendt & E5-ENG



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MP2.2 analysis

- Duration: 7.8 months
- Total hours: planned: 10350 h performed 22.500 h → 11.000 hours in 5 categories
- TH hours: planned: 9301 h performed: 14.000h



- unforeseen repair
- work package not registered
- RO works not considered in planning
- planning precision insufficient
- work scheduled without available design

MP2.4 update since July TKT

- Duration shortened: → from 9,7 to **8,7 months** **now: 21.07.2025 – 13.04.2026**
- Total of all AP reduced: → from 55.000h to **44.000 h**
- TH-team workload reduced: → from 33.000h to **21.000 h**
- resource estimates: contingency introduced for holiday, illness and unforeseen work
- Resource overload in November and December 2025 of up 24 ppm has been smoothed out
- But slight workload increase on E3 and E5 groups**

Ressourcenname	Neu vom 21.11.24												
	Jul 25	Aug 25	Sep 25	Okt 25	Nov 25	Dez 25	Jan 26	Feb 26	Mrz 26	Apr 26	Mai 26		
E5-ENG/TH	1.374	1.703	1.895,02	2.527,60	1.389	165	1.366	1.577	1.840	731	608	9,2 Ø AK	
E5-ENG/TH Schw	244	372	759	536,5	438,50	39,00	430	697	398	27		2,4 Ø AK	
E5-ENG/TH Elek	159,7	180,3	0	48	350	100	82	119	119	390	128	1,0 Ø AK	
	1777,7	2255,3	2654,0	3112,1	2177,5	304,0	1878,0	2393,0	2357,0	1148,0	736,0	20792,6 Stunden Gesamt	
benötigte AK	12	15	18	21	15	3	13	16	16	8	5	12,6 Ø AK	
Ressourcenname	Alt vom 28.06.24												
	Jul 25	Aug 25	Sep 25	Okt 25	Nov 25	Dez 25	Jan 26	Feb 26	Mrz 26	Apr 26	Mai 26		
E5-ENG/TH	702	1.351	1.712,00	2.209,60	4.552	2.549	3.049	1.769	2.002	1.062	247	12,9 Ø AK	
E5-ENG/TH Schw	389	344	399	679	997,5	971,5	404	244	331	304	92	3,1 Ø AK	
E5-ENG/TH Elek	0	269	467	418	467	309	514	560	678	400	128	2,6 Ø AK	
	1091,0	1964,0	2578,0	3306,6	6016,5	3829,5	3967,0	2573,0	3011,0	1766,0	467,0	30569,6 Stunden Gesamt	
benötigte AK	7	13	17	22	40	26	26	17	20	12	3	18,5 Ø AK	

Logbook of changes / important planning steps

- **Work packages for all (but one) projects and plants analysed and:**
 - introduced scenarios of manageable workloads → selected optimum with 25000h TH team
 - introduced contingency
 - fixed TH team of 7 internal staff resources + 5 IPP + 4 ANÜ
 - Outsourced SUP and scaffolding support to additional ANÜ / suppliers
- **Decisions taken**
 - A043 divertor gas inlet repair postponed indefinitely
 - A034 Neutron counter calibration postponed to MP2.6 at earliest
 - A079 XMCTS: repair of leaking adapter box postponed to MP2.6
 - A105 MATEO installation postponed to MP2.6
 - Plasma vessel metrology survey postponed to MP2.6 (to be decided; TKT 18.Nov 2024)
 - A201 S-FILD discarded after retreat, **however, now in new RSR application**
- **Stop of registration now**
 - **New RSR proposals not yet considered**
 - **New or changed work packages to be analysed and if exceeding critical path to be decided via W7-X board.**

Workload on other groups in E3 and E5

Distribution of MP2.4 maintenance activities on groups, projects and plants [hours]

E3

Anlagen	RO	Arbeit
P031	E3 QRH	517 Std.
P081	E3 QMI	1.072 Std.
P210	E3 DCI	104 Std.
A002	E3 ECRH	162 Std.
A055	E3 CHE	216 Std.
A062	E3 QME	168 Std.
A122	E3 QSK	220 Std.
A087	E3 QSS	144 Std.
A092	E3 QSS70	192 Std.
		2795

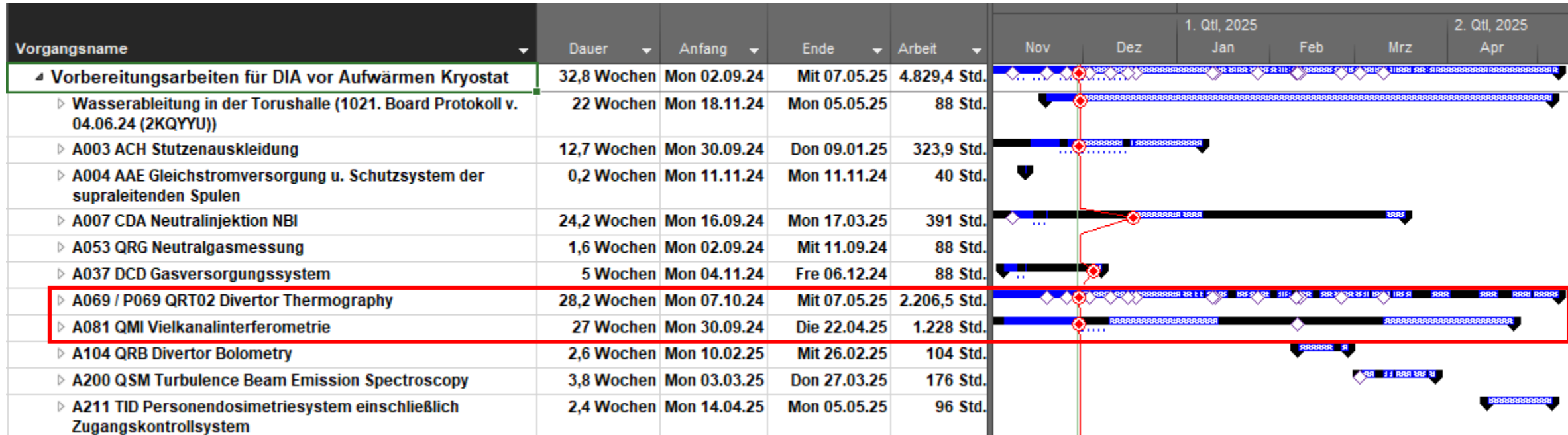
E5-DEV

Anlagen	RO	Arbeit
nn	E5-DEV/MC	616 Std.
A004	E5 AAE	192 Std.
A064	E5 AAM	1.120 Std.
A021	E5 BCF	160 Std.
A021	E5 BCV	160 Std.
A127	E5 GDI	256 Std.
A069	E5 QRT02	204 Std.
A036	Fa. Pfeiffer	144 Std.
		2852

E5-DYN

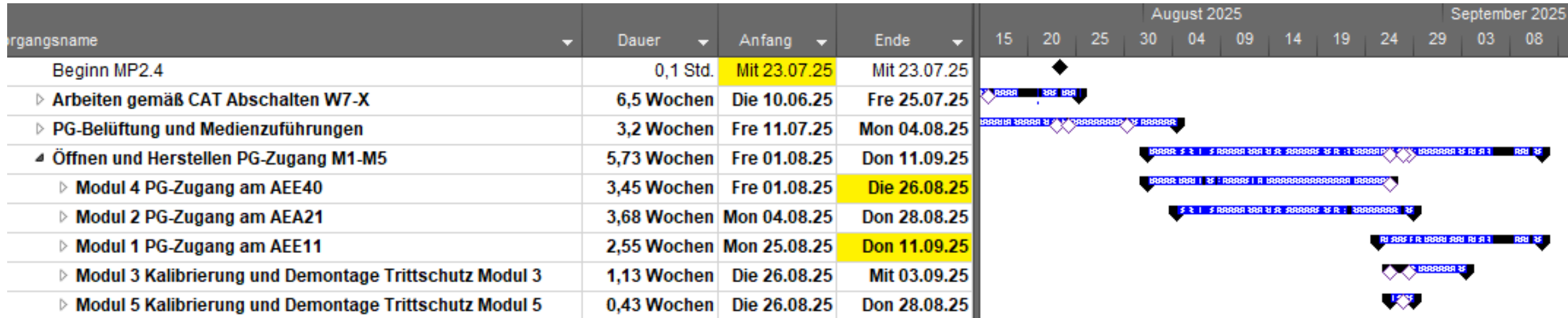
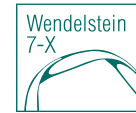
Anlagen	RO	Arbeit
P030	E5 QHI	480 Std.
A068	E5 QMR	317 Std.
P215	E5 QRK	280 Std.
A107	E5 QRN	120 Std.
A114	E5 QSH	116 Std.
A057	E5 QSL	192 Std.
		1505

Preparation = production/pre-assembly from Sep 2024



- MP2.4 preparation intensified (+1000h) and running to plan
- Welding resources fully loaded
- **Keeping the announced handover deadlines is essential to avoid delays later**

1st phase: Start MP2.4, opening plasma vessel confirmed



- Use of 3 plasma vessel entrances: module 2, module 1 and module 4
- Duration to start PV works further shortened to **5W (first module)** and **7W (all modules)**, respectively
- Calibration slots optimized in M3 and M5



Status of 6 new projects → new systems

organgsname	Dauer	Anfang	Ende	Arbeit	Hälfte 2, 2025					Hälfte 1, 2026				
					J	A	S	O	N	D	J	F	M	A
▲ Montage Diagnostik MP2.4	52,2 Wochen	Die 10.06.25	Mit 01.07.26	#####	[Gantt chart bars for Montage Diagnostik MP2.4]									
▲ Montagetarbeiten in MP2.4 mit Einfluss auf Schliessen PG	39,35 Wochen	Die 10.06.25	Mit 25.03.26		[Gantt chart bars for Montagetarbeiten in MP2.4 mit Einfluss auf Schliessen PG]									
▷ A081 QMI Vielkanalinterferometrie	14,3 Wochen	Don 07.08.25	Die 18.11.25	608 Std.	[Gantt chart bar for A081 QMI Vielkanalinterferometrie]									
▷ A105 QRJ Divertor Manipulator (MATEO)	1 Woche	Mon 19.01.26	Mon 26.01.26	80 Std.	[Gantt chart bar for A105 QRJ Divertor Manipulator (MATEO)]									
▷ A200 QSM Turbulence Beam Emission Spectroscopy	17,93 Wochen	Mit 10.09.25	Mit 28.01.26	442 Std.	[Gantt chart bar for A200 QSM Turbulence Beam Emission Spectroscopy]									
▷ A210 DCI Impurity Powder Dropper	5,05 Wochen	Don 25.09.25	Mon 03.11.25	48 Std.	[Gantt chart bar for A210 DCI Impurity Powder Dropper]									
▷ A215 QRK MANTIS	22,63 Wochen	Mon 06.10.25	Mit 25.03.26	408 Std.	[Gantt chart bar for A215 QRK MANTIS]									
▲ Montagetarbeiten MP2.4 ohne Einfluss auf Schliessen PG	52,05 Wochen	Die 10.06.25	Mit 01.07.26		[Gantt chart bars for Montagetarbeiten MP2.4 ohne Einfluss auf Schliessen PG]									
▷ A030 QHI Heavy Ion Beam Probe (HIPB)	17,8 Wochen	Mon 05.01.26	Die 12.05.26	1.912 Std.	[Gantt chart bar for A030 QHI Heavy Ion Beam Probe (HIPB)]									
▷ A081 QMI Vielkanalinterferometrie	16,88 Wochen	Mit 08.10.25	Mon 16.02.26	1.248 Std.	[Gantt chart bar for A081 QMI Vielkanalinterferometrie]									
▷ A105 QRJ Divertor Manipulator (MATEO)	31,6 Wochen	Fre 01.08.25	Mit 25.03.26	204 Std.	[Gantt chart bar for A105 QRJ Divertor Manipulator (MATEO)]									
▷ A200 QSM Turbulence Beam Emission Spectroscopy	6,7 Wochen	Mon 11.05.26	Mon 29.06.26	92 Std.	[Gantt chart bar for A200 QSM Turbulence Beam Emission Spectroscopy]									
▷ A210 DCI Impurity Powder Dropper	8,98 Wochen	Die 10.02.26	Don 16.04.26	768 Std.	[Gantt chart bar for A210 DCI Impurity Powder Dropper]									
▷ A215 QRK MANTIS	34,95 Wochen	Mit 13.08.25	Mon 04.05.26	2.024 Std.	[Gantt chart bar for A215 QRK MANTIS]									

- Work reduced by 6000h hours by:
 - postponing portions of projects and
 - technical progress enabling better ressource estimates
- Project boundary conditions for MATEO and HIPB stabilized
- DR Progress required: **no DDR held as yet, in case of MANTIS no CDR as yet.**

Work intense projects (according to ENG resources > 1400h)



Vorgangsname	Dauer	Anfang	Ende	Arbeit	Hälfte 2, 2025					Hälfte 1, 2026				
					J	A	S	O	N	D	J	F	M	A
9-EGD-Montageplanung_MP2_4	91,2 Wochen	Mit 28.08.24	Fre 10.07.26											
Vorbereitungsarbeiten für DIA vor Aufwärmen Kryostat	32,8 Wochen	Mon 02.09.24	Mit 07.05.25	Std.										
A069 / P069 QRT02 Divertor Thermography	28,2 Wochen	Mon 07.10.24	Mit 07.05.25	2.206,5 Std.										
Montagearbeiten in MP2.4 mit Einfluss auf Schliessen PG	39,35 Wochen	Die 10.06.25	Mit 25.03.26											
A003 ACH Stutzenauskleidung	39,35 Wochen	Die 10.06.25	Mit 25.03.26	2.678 Std.										
A072 DCB Glimmentladungssystem	18,83 Wochen	Don 18.09.25	Mit 11.02.26	1.438 Std.										
A104 QRB Divertor Bolometry	30,2 Wochen	Die 15.07.25	Die 24.02.26	1.456 Std.										
Montagearbeiten MP2.4 ohne Einfluss auf Schliessen PG	52,05 Wochen	Die 10.06.25	Mit 01.07.26											
A030 QHI Heavy Ion Beam Probe (HIBP)	17,8 Wochen	Mon 05.01.26	Die 12.05.26	1.912 Std.										
A215 QRK MANTIS	34,95 Wochen	Mit 13.08.25	Mon 04.05.26	2.024 Std.										
A323 ACK Kühlkreislauf Target/Baffle/Wand/Portliner-Diagnostik (primär) ACK10/40/50/60 (CCB265 / 1-YGD-C0265)	42,7 Wochen	Mon 23.06.25	Die 05.05.26	4.464 Std.										
				Total reduced from 23,000h → 16000h										

Reduced scope of work intense projects:

Repairs: KKL A323ff

Maintenance: Vacuum system PG A036, Glow discharge electrodes A072

New systems: Divertor thermography A069 + associated AEF Port Liner (A003)

Change of registered MP2.4 calibrations

Vorgangname	Dauer	Anfang	Ende	Hälfte 2, 2025					Hälfte 1, 2026										
				J	A	S	O	N	D	J	F	M	A	M	J				
9-EGD-Montageplanung_MP2_4	91,2 Wochen	Mit 28.08.24	Fre 10.07.26	[Gantt chart bars for 2025 and 2026]															
Montage Diagnostik MP2.4	52,2 Wochen	Die 10.06.25	Mit 01.07.26	[Gantt chart bars for 2025 and 2026]															
Arbeiten gemäß CAT Abschalten W7-X	6,5 Wochen	Die 10.06.25	Fre 25.07.25	[Gantt chart bars for 2025 and 2026]															
QTB Raman Kalibrierung ES: xxx bei 300mbar N2	0 Std.	Die 15.07.25	Die 15.07.25	[Gantt chart bars for 2025 and 2026]															
Öffnen und Herstellen PG-Zugang M1-M5	5,73 Wochen	Fre 01.08.25	Don 11.09.25	[Gantt chart bars for 2025 and 2026]															
Modul 4 PG-Zugang am AEE40	3,45 Wochen	Fre 01.08.25	Die 26.08.25	[Gantt chart bars for 2025 and 2026]															
Modul 2 PG-Zugang am AEA21	3,68 Wochen	Mon 04.08.25	Don 28.08.25	[Gantt chart bars for 2025 and 2026]															
Modul 3 Kalibrierung und Demontage Trittschutz Modul 3	1,13 Wochen	Die 26.08.25	Mit 03.09.25	[Gantt chart bars for 2025 and 2026]															
Modul 5 Kalibrierung und Demontage Trittschutz Modul 5	0,43 Wochen	Die 26.08.25	Don 28.08.25	[Gantt chart bars for 2025 and 2026]															
Montagearbeiten MP2.4 ohne Einfluss auf Schliessen PG	52,05 Wochen	Die 10.06.25	Mit 01.07.26	[Gantt chart bars for 2025 and 2026]															
A092 QSS70 Sichtbare Spektroskopie	45,2 Wochen	Die 29.07.25	Mit 01.07.26	[Gantt chart bars for 2025 and 2026]															
Endreinigung, Rückbau Trittschutz/Belüftung und Schließen PG	11,65 Wochen	Mon 19.01.26	Mon 13.04.26	[Gantt chart bars for 2025 and 2026]															
PG-Schließen, Endreinigung	10,75 Wochen	Mon 19.01.26	Don 02.04.26	[Gantt chart bars for 2025 and 2026]															
Diagnostiken MP2.2 im PG fertig	10,75 Wochen	Mon 19.01.26	Don 02.04.26	[Gantt chart bars for 2025 and 2026]															
Demontage Trittschutz M2	4,15 Wochen	Mon 02.03.26	Mon 30.03.26	[Gantt chart bars for 2025 and 2026]															
Inbetriebnahmearbeiten für OP2.4 (9-JBA01-P_Optimized_Commissioning_Draft_240802)	13,4 Wochen	Don 02.04.26	Fre 10.07.26	[Gantt chart bars for 2025 and 2026]															
Ausheizen inkl. Vor- und Nacharbeiten OP2.4	10 Wochen	Mit 29.04.26	Fre 10.07.26	[Gantt chart bars for 2025 and 2026]															
Arbeiten an Diagnostiken nach dem Ausheizen für OP2.4	2 Wochen	Mon 29.06.26	Fre 10.07.26	[Gantt chart bars for 2025 and 2026]															
A092 / P092 QSS70 Simplified observation system	0,5 Wochen	Mon 29.06.26	Mit 01.07.26	[Gantt chart bars for 2025 and 2026]															

- Calibrations (have) moved to start and end of MP (or PV access)!
- Potentially no need for further optimization

Ressource organisation



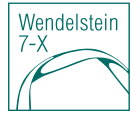
Basic shift

- **7 am – 3.30 pm** by 16 pp core team (7 TH + 5 IPP + 4 ANÜ) ← group is now confirmed
- SL (shift leader) and QM (shift supervisor) present throughout

Optional shift extension from 3.30 pm – 8pm

- To be registered at arbeitsvorbereitung@ipp.mpg.de → integration in 4-week plan and weekly plan
- To be organised via „shifting of working hours“ (Arbeitszeitverlagerung AZV)
- TH will provide shift leader, QM will provide shift supervisor
- Work in plasma vessel requires qualified staff (**group to be named & qualified**)
- Work in periphery to be organized by groups themselves

Status HE 4 enhancement analysis



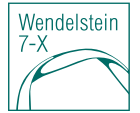
Status Resources:

- Team of DE and EA personnel organized
- Technical lead: M. Khokhlov
- Management lead: M. Banduch
- Three engineers hired for 6 months – 2 years starting 01. Dec 2024 and 1.Feb 2025

Technical status:

- Slow progress to date due to unavailability of resource
- 2024: Diamagnetic loop, ECRH tile design, NBI beamdump and dust collection box calculations performed
- Scope of work has risen to 35 calculation tasks,
- Iterations of scope (size, complexity) and priority started

Prioritization proposal



- No general prioritization, but only in the event of bottlenecks that jeopardise the general schedule
- Operating systems and operating diagnostics take precedence over other systems
- **To be decided case by case**
 - Work packages for operation (repair, maintenance)
 - Change Notes (modification with functional preservation and expansion) and
 - new projects (project scope, project progress, knowl. Project value)
- In case of conflicts decision making to be escalated to board

Summary



1. Most critical: plan works only with adherence to delivery dates
2. MP2.4 time frame reduced but workload, too
3. Insufficient progress in analysis of HE fitness; increase to ca. 35 front ends
4. Required decisions
 - Recent RSR proposals