



Moderator and Reflector Plug (MRP) Verification

Commissioning Workshop

PRESENTED BY MARC KICKULIES

2022-10-05



Verification Strategy

- Concept Verification, e.g. electro beam welding
- Prototype Verification, e.g. cold moderator burst test
- Quality, according to ESS **RESSQ-Mech**
- FAT, e.g. functional dimensions, cold test, pressure and leak test, pressure drop, rotation, etc.
- MUTS, integration with Target Wheel
- Monolith, final integration

Concept Verification

Electro Beam Welding Qualification

2016.12.05
Y. Beßler

WPQR of Moderator & Reflector Plug

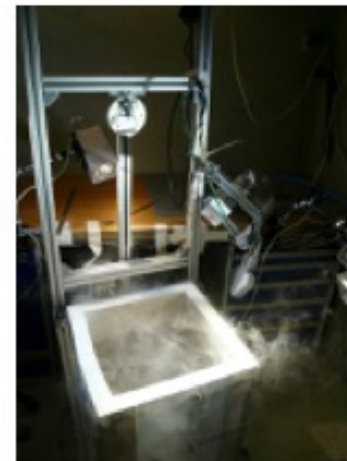
Electron beam welding qualification for the ESS Moderator & Reflector Plug.

Component	Cold Moderator	Thermal Moderator	Beryllium Reflector
Drawing number	212-000207	212-001135	212-000956
Standard	EN ISO 15614-11		
Welding test	-due to the complexity of the weld path, full welding test of cold Moderator vessel -manufacturing and welding of 1 full additional vessel, -3 test vessels, machined in 2016	upper part: flat sheets with 3 mm thickness 200 mm x 100 mm including filler, butt welded (replacement of cover weld acc. 15614-11) water disc (x5): Original geometry with reduced diameter D=100	-flat sheets with 5 mm thickness 200 mm x 100 mm including filler, butt welded (replacement of cylindrical weld acc. 15614-11)
Number of test pieces	4	5 / 5	5
Welding with supervision by TÜV Rheinland			
examinations	-visual inspection - dye penetration test -CT -burst test (4x) - Cut images from critical positions (selected by TÜV) and Microscopic examination	-visual inspection - dye penetration test -CT -tensile test (x5) - Cut images from critical positions (selected by TÜV) and Microscopic examination	-visual inspection - dye penetration test -CT -tensile test (x5) - Cut images from critical positions (selected by TÜV) and Microscopic examination
examination with supervision by TÜV Rheinland			
quality class	C (acc. EN ISO 13919-2), respectively N2 _{Rx} (acc. RCC-MRx)		
Material	6061-T6	6061-T6 / 5754	6061-T6
Filler material	4047	4047	4047



Prototype Verification

Burst Test of Cold Moderator



Mitglied der Helmholtz-Gemeinschaft

		Manufacturing	Installation and operation / maintenance
Safety SSC	MQC1	SSM Special conditions for ESS in Lund	
	MQC2	Code RCC-MRx	
	MQC3	ESS requirements	
Safety Related SSC	MQC4	PED 2014/68/EU AFS 2016:1	AFS 2017:3
Non-Safety		EN 13445, EN 13480 EN 13458	PED 2014/68/EU AFS 2016:1 EN 13445, EN 13480, EN 13458
ESS Rules for Quality Regulation – Mechanical Equipment RESSQ-Mech			

Quality Documentation Thermal Moderator 3_thM

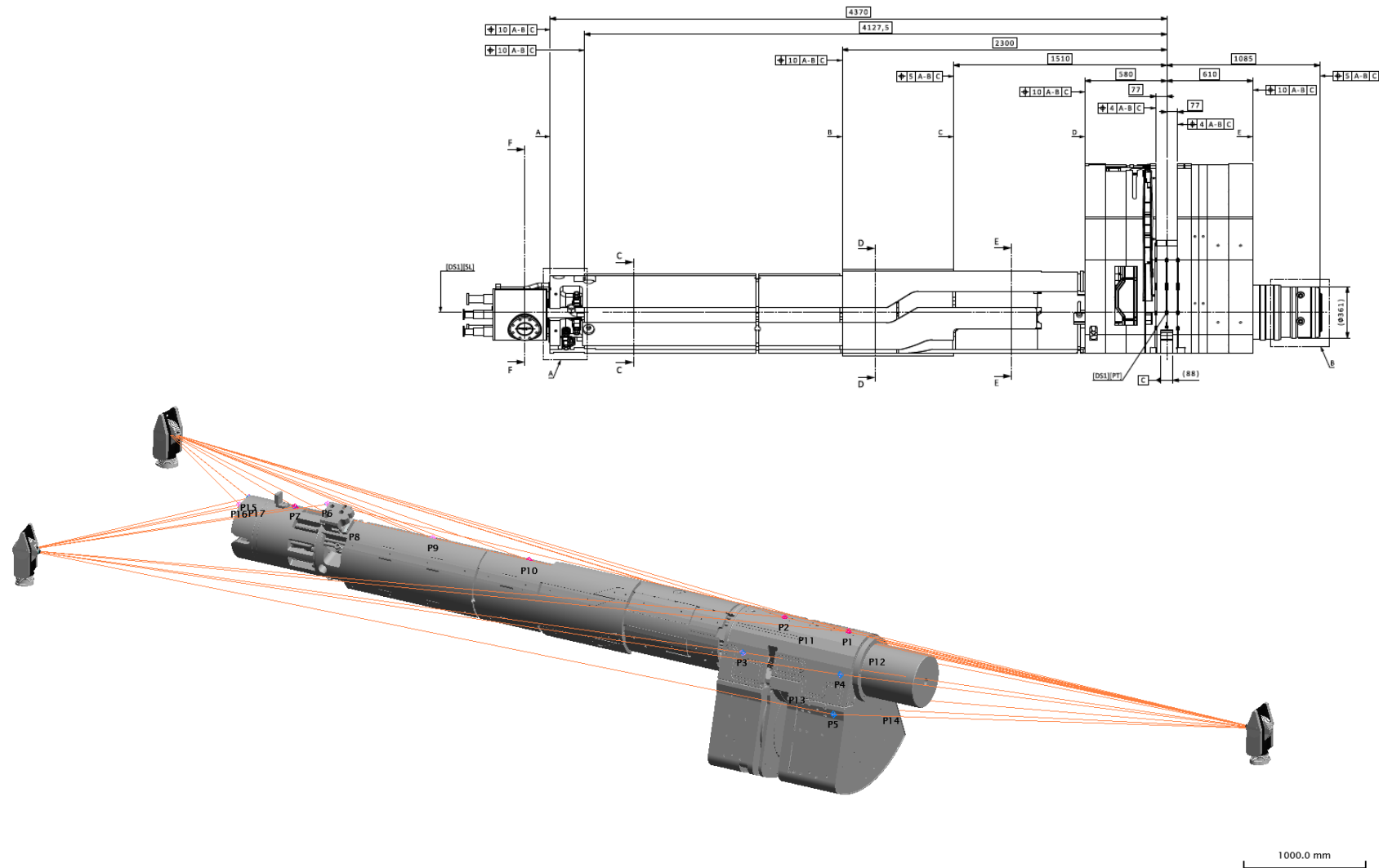
2020-08-04 Thermal Moderator Pre-FAT Documentation

Name
0- certificates-ZEA
20161108153734913.pdf
20161108153751713.pdf
20181010113955861.pdf
material marking.pdf
QM-ZEA
Welder examination certificate .pdf
welding company.pdf
1-thM-Drawings-BOM-final
212-001135_d_upper_thermal_moderator_A0.pdf
212-001135-d-upper_thermal_moderator_BOM.pdf
parts
2-material certificates
3.1-Prüfzeugnis-100Al6061.pdf
2015-10-15-ALSi12-Filler-Blech-20160127085657322.pdf
3-measurement protocol
Beßler_ESS Thermischer Moderator_Einzelteil__91002723gra.pdf
Beßler_ESS_th_Moderator_Fräsen_Erodieren_91002724_Einzelteil_gra.pdf
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Beßler_ESS_th_Moderator_plate_water_cross_91002723_02_gra.pdf
Beßler_ESS_th_Moderator_Stopper_Irradiation_Modul_91002723_01_gra.pdf
Beßler_ESS_th_Moderator_water_adapter_A_91002723_01_gra.pdf
Beßler_ESS_th_Moderator_water_adapter_B_91002723_01_gra.pdf
Geradheit Moderator.pdf
4-inspection report
PB_212-000473.pdf
re-stamping-report.pdf
5-WPS
pre-WPS-thM1-all-in-one.pdf
pre-WPS-thM2-all-in-one.pdf
WPS-cM-thM-3mm
WPS-thM-4mm
6-cleaning-SPC
Process Instruction Cleaning of Aluminium.pdf



FAT

Functional Dimension Check



FAT

Cold Test with LN2



FAT

Pressure and Leak test



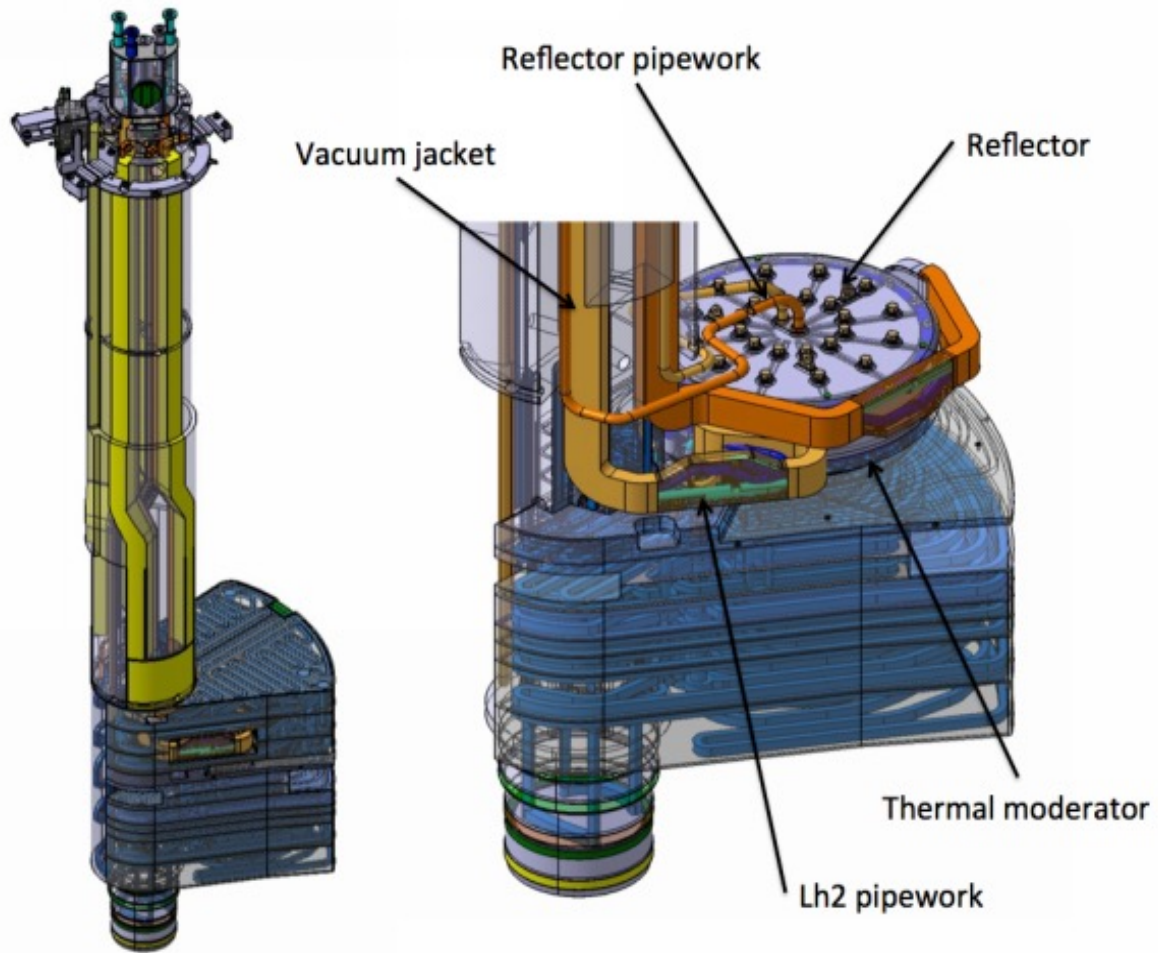
Test Report Twister

	Cold Mo. in/out loop 1	Cold Mo. in/out loop 2	Upper Frame in/out	Lower Frame in/out	Shaft+Foot+ Lower Mounting Socket in/out	Thermal Mo. 1 in/out	Frame Insert in/out	Be Reflector in/out	Thermal Mo. 2 in/out	Shaft + PB channel + Upper Mounting Socket in/out	Vacuum jacket
Nr.	1.1	1.2	2	3	4	5	6	7	8	9	
Media	LH ₂	LH ₂	H ₂ O	H ₂ O	H ₂ O	H ₂ O	H ₂ O	H ₂ O	H ₂ O	H ₂ O	
Mass Flow [kg/s]	0.240	0.240	1.0	1.2	1.6	1.0	0.2	0.8	1.0	0.8	
Diameter [mm]	21/25	21/25	23/28	23/28	23/28	20/25.4	23/28	23/28	20/25.4	23/28	
Pressure [bar]	10	10	4	4	4	4	4	4	4	4	
Design pressure [bar]	17	17	5	5	5	5	5	5	5	5	
Test pressure (1.43*pD) pabs [bar]	25.31	25.31	8.15	8.15	8.15	8.15	8.15	8.15	8.15	8.15	
Measured by E. Rosenthal	25.44	25.6	8.22	8.29	8.2	8.15	8.4	8.3	8.15	8.2	
Leak rate req. [mbar*l/s]	≤1·10 ⁻⁹	≤1·10 ⁻⁹	≤5·10 ⁻⁸	≤5·10 ⁻⁸	≤5·10 ⁻⁸	≤5·10 ⁻⁸	≤5·10 ⁻⁸	≤5·10 ⁻⁸	≤5·10 ⁻⁸	≤5·10 ⁻⁸	N.N.
Measured by C. Hoven	≤1·10 ⁻⁹	≤1·10 ⁻⁹	≤1·10 ⁻⁹	≤1·10 ⁻⁹	≤1·10 ⁻⁹	≤1·10 ⁻⁹	≤1·10 ⁻⁹	≤1.5·10 ⁻⁸	≤1·10 ⁻⁹	≤1·10 ⁻⁹	≤1·10 ⁻⁸

Cold Mo. in/out loop 1



Here we are



MUTS

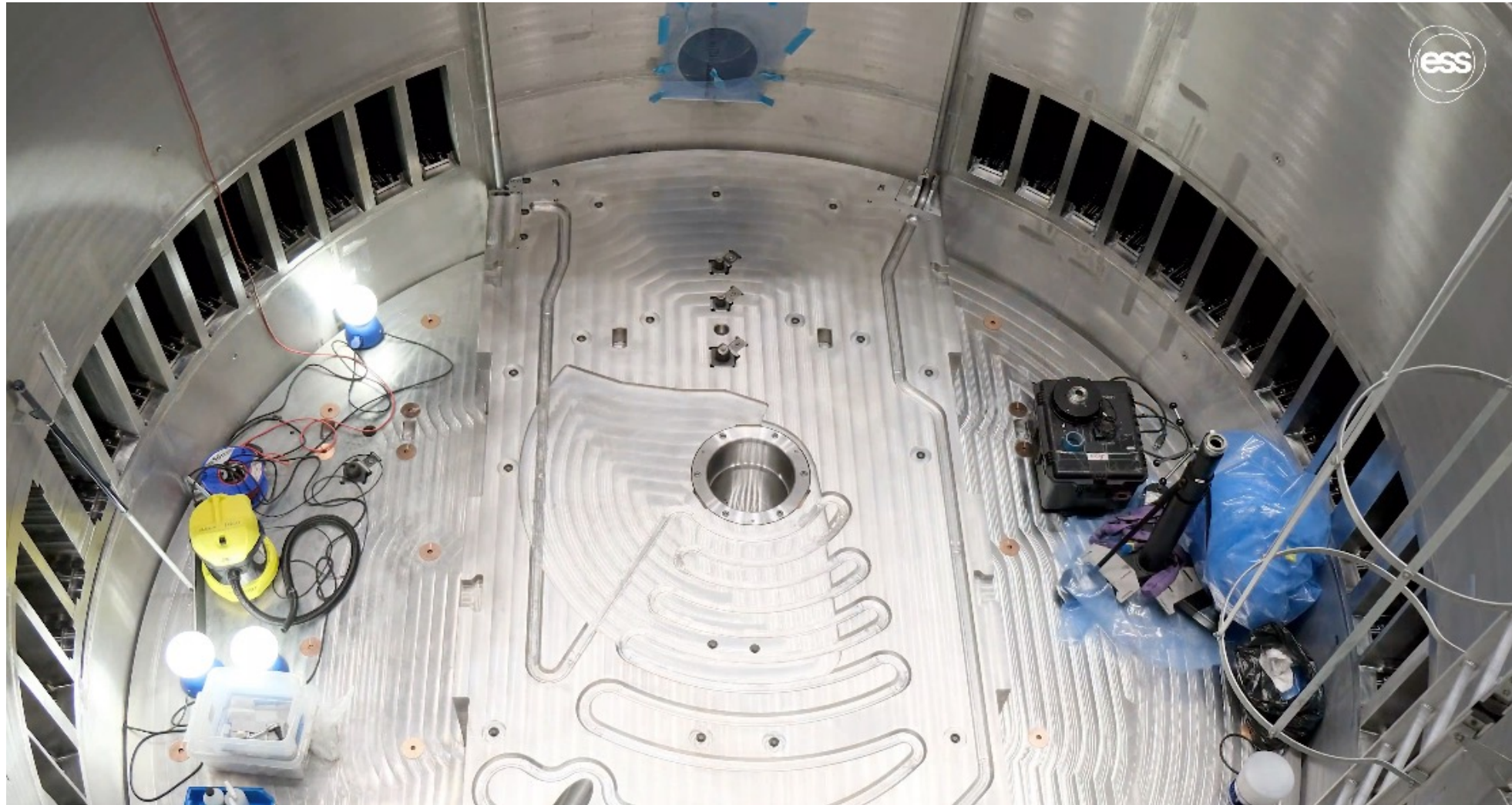
To be done





Monolith

To be done





Finish presentation