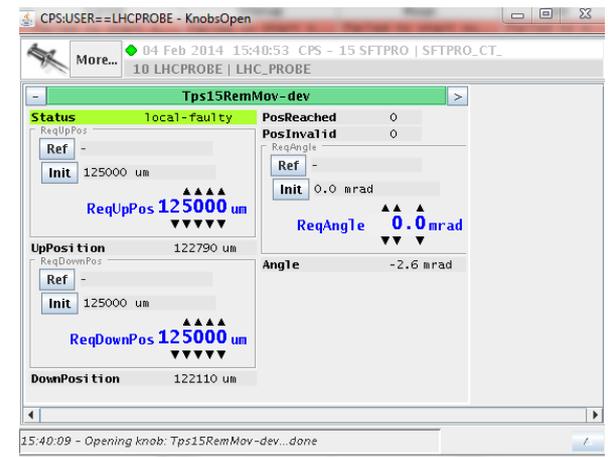- ✓ The TPS15 is a dummy septum that functions as an absorber to protect the SMH16 septum.
- ✓ In order to establish a radial movement 2 induction motors control the blade. These motors operate independently so an angular position can be requested.
- ✓ The motors can be controlled with a 0.1 mm precision through a local HMI or a CCC knob. Position measurement is done with redundant linear potentiometers.
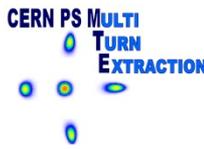

installation in the PS

local HMI and master PLC
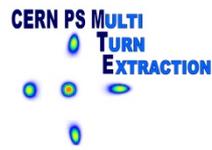(Siemens S7-317F)

CCC remote control

✓ All positions are in a 0 .. 50 mm range, displayed in microns hence 0..50 000 μm;

✓ RPOTs = rotational potentiometers (linearity ±0.25%);

✓ LPOT = linear potentiometers (linearity ±0.50% but mechanically better suited for positioning);

✓ PLC operated, linear calculations ref. y = ax + b;

✓ Automated test procedure to displace the blade to x points within the range while at the same time the dial gauges ('comparators') positions are written down.
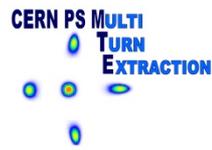
PS PE.TPS15 displacement system

Measurement data from 09/01/2014 (B867 construction and testing)

A	C	D		I	K	L	
UpstreamPosReq	US_manual_um	diff real - req		DownstreamPosReq	DS_manual_um	diff real - req	
4 545	4 510		35	4 545	4 550		-5
9 091	9 090		1	9 091	9 090		1
13 636	13 630		6	13 636	13 690		-54
18 182	18 120		62	18 182	18 190		-8
22 727	22 710		17	22 727	22 720		7
27 273	27 250		23	27 273	27 310		-37
31 818	31 795		23	31 818	31 850		-32
36 364	36 375		-11	36 364	36 380		-16
40 909	40 860		49	40 909	40 890		19
45 455	45 430		25	45 455	45 460		-5
			100				-100

position_data09.01.2014

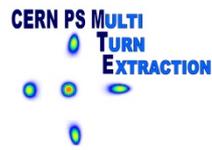Measurement data from 12/02/2014 (installed in PS)

A	C	D		I	K	L	
UpstreamPosReq	US_manual_um	diff real - req.		DownstreamPosReq	DS_manual_um	diff real - req	
4 545	4 470		75	4 545	4 545		0
9 091	9 110		-19	9 091	9 080		11
13 636	13 640		-4	13 636	13 670		-34
18 182	18 130		52	18 182	18 155		27
22 727	22 705		22	22 727	22 705		22
27 273	27 250		23	27 273	27 285		-12
31 818	31 760		58	31 818	31 820		-2
36 364	36 350		14	36 364	36 355		9
40 909	40 840		69	40 909	40 870		39
45 455	45 420		35	45 455	45 435		20
			100				-100

position_data12.02.2014

PS PE.TPS15 displacement system
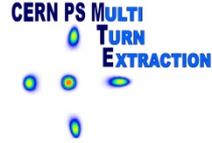
Measurement data from 24/02/2014 (installed in PS)
- ✓ improved displacement algorithm (parameterisable)
- ✓ added more data for better understanding

UpstreamPosReq	US_manual_um	diff real - req	US LPOT displ norml	diff LPOT- req.	diff LPOT - real	US RPOT displ norml	diff RPOT - real	DownstreamPosReq	DS_manual_um	diff real - req
3 571			3 604	33		3 592		3 571		
7 143			7 130	-13		7 093		7 143		
10 714			10 719	5		10 643		10 714		
14 286	14 320	34	14 307	21	-13	14 340	20	14 286	14 310	24
17 857	17 750	-107	17 870	13	120	17 741	-9	17 857	17 850	-7
21 429	21 460	31	21 466	37	6	21 442	-18	21 429	21 425	-4
25 000	24 970	-30	24 971	-29	1	24 957	-13	25 000	24 970	-30
28 571	28 540	-31	28 588	17	48	28 495	-45	28 571	28 570	-1
32 143	32 060	-83	32 122	-21	62	32 043	-17	32 143	32 170	27
35 714	35 670	-44	35 721	7	51	35 651	-19	35 714	35 710	-4
39 286	39 210	-76	39 288	2	78	39 209	-1	39 286	39 230	-56
42 857	42 800	-57	42 854	-3	54	42 793	-7	42 857	42 850	-7
46 429	46 340	-89	46 409	-20	69	46 330	-10	46 429	46 410	-19
		100								-100

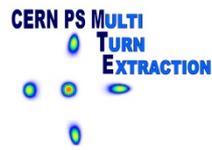position_data24.02.2014

PS PE.TPS15 displacement system

Measurement data from 25/02/2014 (installed in PS)
- ✓ upstream LPOT replaced to exclude it as one of the causes
- ✓ fixed small voltage discrepancy over the upstream LPOT

	A	B	C	D	E	F	G	H	I	J	K	L
	UpstreamPosReq	US_manual_um	diff real - req	US LPOT disp raw	US LPOT displ norml	diff LPOT - real	US RPOT disp raw	US RPOT displ norml	diff RPOT - real	DownstreamPosReq	DS_manual_um	diff real - req
	3 571	3 550	-21	80 524	3 571	0	12 714	3 577	27	3 571	3 530	-41
	7 143	7 170	27	86 828	7 134	-36	19 177	7 267	97	7 143	7 130	-13
	10 714	10 770	56	93 187	10 727	-43	25 435	10 841	71	10 714	10 770	56
	14 286	14 280	-6	99 477	14 286	6	31 612	14 369	89	14 286	14 290	4
	17 857	17 980	123	105 846	17 884	-96	38 036	18 052	72	17 857	17 820	-37
	21 429	21 440	11	112 154	21 451	11	44 047	21 484	44	21 429	21 390	-39
	25 000	25 080	80	118 437	24 998	-82	50 478	25 143	63	25 000	24 980	-20
	28 571	28 560	-11	124 748	28 565	5	56 500	28 582	22	28 571	28 550	-21
	32 143	32 130	-13	131 128	32 169	39	62 783	32 170	40	32 143	32 140	-3
	35 714	35 680	-34	137 411	35 721	41	68 993	35 704	24	35 714	35 680	-34
	39 286	39 260	-26	143 730	39 290	30	75 210	39 279	19	39 286	39 240	-46
	42 857	42 930	73	150 030	42 853	-77	81 656	42 948	18	42 857	42 840	-17
	46 429	46 480	51	156 403	46 455	-25	87 866	46 494	14	46 429	46 360	-69
			100									-100

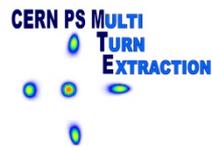position_data26.02.2014
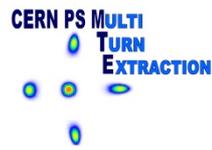
PS PE.TPS15 displacement system

Measurement data from 28/02/2014 (installed in PS)
- ✓ focus on the upstream position only
- ✓ focus on the reoccurring measurement discrepancies points

UpstreamPosReq	US_manual_um	diff real - req	US LPOT disp raw	US LPOT displ norml	diff LPOT - real	US RPOT disp raw	US RPOT displ norml	diff RPOT - real
15 000	15 000	0	100 714	14 981	-19	32 668	14 997	-3
15 429	15 430	1	101 473	15 410	-20	33 374	15 387	-43
15 858	15 870	12	102 244	15 846	-24	34 158	15 823	-47
16 287	16 320	33	103 007	16 277	-43	34 925	16 261	-59
16 716	16 780	64	103 781	16 713	-67	35 775	16 732	-48
17 145	17 210	65	104 519	17 132	-78	36 506	17 164	-46
17 574	17 660	86	105 307	17 577	-83	37 309	17 622	-38
18 000	18 100	100	106 074	18 011	-89	38 072	18 058	-42
18 429	18 520	91	106 801	18 424	-96	38 810	18 479	-41
18 858	18 940	82	107 575	18 859	-81	39 566	18 917	-23
19 287	19 340	53	108 335	19 293	-47	40 278	19 304	-36
19 716	19 770	54	109 101	19 724	-46	41 074	19 758	-12
20 145	20 200	55	109 883	20 163	-37	41 740	20 153	-47
20 574	20 580	6	110 613	20 572	-8	42 391	20 524	-56
21 003	21 000	-3	111 366	21 002	2	43 118	20 923	-77
		100						
		-100						

position_data2.28.2014-second

PS PE.TPS15 displacement system

Measurement data from 06/03/2014 (installed in PS)
- ✓ focus on the upstream position only
- ✓ focus on the reoccurring measurement discrepancies points

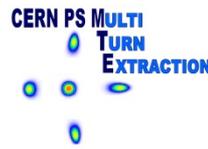| UpstreamPosReq	US_manual_um	diff real - req.	US LPOT disp raw	US LPOT displ norml	diff LPOT - real	US RPOT disp raw	US RPOT displ norml	diff RPOT - real
21 000	21 010	10	111 398	21 020	10	43 132	20 948	-62
21 429	21 430	1	112 140	21 439	9	43 848	21 357	-73
21 858	21 850	-8	112 885	21 860	10	44 582	21 776	-74
22 287	22 280	-7	113 641	22 287	7	45 385	22 220	-60
22 716	22 750	34	114 433	22 737	-13	46 145	22 668	-82
23 145	23 170	25	115 116	23 123	-47	46 933	23 118	-52
23 574	23 610	36	115 905	23 567	-43	47 707	23 560	-50
24 003	24 090	87	116 737	24 035	-55	48 492	23 994	-96
24 432	24 480	48	117 402	24 409	-71	49 165	24 407	-73
24 861	24 910	49	118 158	24 846	-64	49 961	24 831	-79
25 290	25 350	60	118 939	25 280	-70	50 738	25 291	-59
25 719	25 780	61	119 688	25 707	-73	51 509	25 717	-63
26 148	26 200	52	120 429	26 122	-78	52 221	26 140	-60
26 577	26 630	53	121 222	26 572	-58	52 966	26 564	-66
27 006	27 060	54	121 985	27 005	-55	53 683	26 973	-87

PS PE.TPS15 displacement system

Measurement data from 12/03/2014 (installed in PS)
- ✓ smaller consecutive displacements over the full range
- ✓ seems that there appear to be more of these discrepancy points

In general the displacement is done well within the precision specified in the engineering specs, i.e. 100 μm. There are a few reoccurring point however where the upstream linear potentiometer measurement is significantly off.

Possible reasons for these LPOT measurement discrepancies:
- non-linearity of the potentiometer
- non-linearity for the potentiometer – blade transition (spring-driven rod on a circular surface)
- software fault (unlikely because of proper values for downstream)
- mechanical non-linearity, e.g. worm gearbox