Elettra Sincrotrone Trieste

EUROPEAN SPALLATION SOURCE

Document Type	Time Schedule
Document Number	E-ST ESS PC TSC 00y
Date	19 June 2017
Revision	1.1
Status	First Release
Confidentiality Level	Internal

PDR-3 of DC Power Converters for Dipole D1 and Quadrupole Q8 Magnets: Procurement & Time Schedule

DC Dipole and Quadrupole Power Converters
PCD1 and PCQ8

Author	Checked by – date	Approved by – date
Roberto Visintini	M. Cautero – 19-Jun-17	

Table of Contents

1. Procurement strategies

There will be six power converters supplying the quadrupoles Q8 and one power converter for the two dipoles D1. They have the same output current and therefore we could group them in a single procurement procedure, independent from those for the other power converters.

On the other hand, to supply the quadrupoles Q8 we propose a power converter whose output parameters are 50 V / 400 A. This could be realized either as a single device or by putting in parallel two units, 50 V / 200 A each.

In PDR-2, we showed that PCQ5, PCQ6, and PCQ7 require 30 V / 200 A. Increasing their output voltage to 50 V (without affecting the required performances) make them suitable as “building” blocks for PCQ8.

From the survey presented in PDR-2, we know that at least two “COTS” types are already capable of operating in parallel, not considering those that could be built (or modified) “on purpose” by other manufacturers.

Consequently, we could unify the procurement of the six quadrupole PCQ8 (they would become 12 “basic” units) with that one of the other quadrupole PCs. The advantage of such solution is the reduction of different power converters’ types, improving the maintenance and spares strategies. In addition, this solution would increase by ~9% the number of (30) 50 V / 200 A units, and could help in reducing the overall cost.

For what concerns PCD1, the high inductance of the magnet dominates the output voltage, worsened by the fact of having two magnets in series. Considering a 30 s-ramp, the choice (tight but reasonable, considering the safety margins on the magnets, the cable length, and the foreseen ramp range from 10% to 100% of nominal current, about 370 A) is a 100 V / 400 A power converter, as reported in Table 5. This could be realized either as a single device or putting in series two 50 V / 400 A units (the latter is compatible with PCQ8, in case it is realized as a single block).

Summing up, there are four options, two for PCQ8 and two for PCD1.

PCQ8:

a. 6 units, 50 V / 400 A;
b. 12 units, 50 V / 200 A, connected in couples in parallel (these could be included in the same lot of PCQ5, PCQ6, PCQ7).

PCD1:

c. c. 1 unit, 100 V / 400 A;
d. d. 2 units, 50 V / 400 A, connected in series (that could be included in the same lot of PCQ8 in case a.).

Both options b. and d. bring to a reduction of different types of power converters, facilitating maintenance and spare parts managing.

Options c. and d. are compatible with the polarity switcher solution for the degaussing of the dipoles.

We could take into consideration the option of having a single Call for Tender for all large power converters, divided in three lots:

Lot 1 - 133 units 30 (50) V / 200 A for Q5, Q6, and Q7;
Lot 2 - the tenderer can choose and quote option a. or b. for PCQ8;
Lot 3 - the tenderer can choose and quote option c. or d. for PCD1;

with possible mergers of the lots according to the chosen options.

Tenderers can quote single lots or combination of lots and separated lots can be assigned to different tenderers.

This strategy, of course, has to be agreed and developed also with whom will operate the European Call for Tenders.

2. Time Schedule

The advantage of grouping the procurement of all large power converters in a single Call for Tender is to reduce the overall procurement procedure.

The estimated duration of the Call for Tender procedure, from start to order issued, is 6 to 8 months. Once the order is active (t0), the production phase is estimated in 12/14 months. There could be two or three production phases running in parallel, according to the lot assignment.

At least for Lot 1, the delivery of the power converters will occur in batches, according to the time plan agreed and approved after the placing of the order. Figure 1 provides an example of delivery plan (the time scale is months).

								t0-6/8	Call for Tender															
-8	-7	-6	-5	-4	-3	-2	-1	t0	Order signed	1	2	3	4	5	6	7	8	9	10	11	12	13	14
								t0+6	First Batch														
								t0+8	2nd Batch														
								t0+10	3rd Batch														
								t0+12	4th or Last Batch														
								t0+14	Last Batch														

Figure 1 – Example of batch delivery schedule (time in months, t_0 = start of contract)

Figures 2 and 3 provide estimations of possible delivery plans with two different Lot merging, with the following assumptions:

- ✓ *start of Call for Tender procedures on October 16th, 2017*
- ✓ *Call for Tender duration estimated in 7 months*

ID	ESS WBS	ESS WU No.	Task Name	Duration	Start	Finish
1		2	**WU2 - DC Power Converters for quadrupoles PCQ5, PCQ6, PCQ7**	**986 days?**	**Mon 21-09-15**	**Thu 27-06-19**
2			**Pulsed Quads (PPC) Study**	**206 days?**	**Mon 21-09-15**	**Thu 30-06-16**
3			Pulsed Quads (PPC) Study	164 days?	Mon 21-09-15	Tue 03-05-16
4			Tests on prototype V0.1	20 days	Fri 01-04-16	Thu 28-04-16
5	2.1 (D)		PDR: Delivery of Data Package (Pulsed PC)	0 days	Tue 03-05-16	Tue 03-05-16
6	*2.2 (M)*		*PDR: PCQ5, PCQ6, PCQ7 (Pulsed PC)*	*0 days*	*Tue 17-05-16*	*Tue 17-05-16*
7			Studies and verification of Eddy Current Effects on Vacuum Chamber	45 days	Fri 29-04-16	Thu 30-06-16
8			Decision to pass to DC power converters	0 days	Fri 01-07-16	Fri 01-07-16
9			Study of a DC magnet+PC solution	111 days?	Fri 01-07-16	Fri 02-12-16
10			Study of DC solution	0 days?	Fri 02-12-16	Fri 02-12-16
11		2.1	**Tender Documentation and Procurement DC PC**	**416 days**	**Fri 23-09-16**	**Fri 27-04-18**
12			Preparation of Documentation for PDR-2	127 days	Fri 23-09-16	Mon 20-03-17
13	2.3 (D)		PDR-2: Delivery of Data Package	0 days	Tue 21-03-17	Tue 21-03-17
14	2.4 (M)		PDR-2: DC Power Systems (PCQ5, PCQ6, PCQ7)	0 days	Tue 28-03-17	Tue 28-03-17
15			Call for Tender	7 mons	Mon 16-10-17	Fri 27-04-18
16	2.5 (M)		Series Unit Production Start (PCQ5, PCQ6, PCQ7)	0 days	Fri 27-04-18	Fri 27-04-18
17		2.2	Series unit production (in batches) of PCQ5, PCQ6 & PCQ7	12 mons	Mon 30-04-18	Fri 29-03-19
18	2.6 (D)		First Delivery to ESS (Arrival of First batch)	0 days	Fri 12-10-18	Fri 12-10-18
19	2.7 (D)		Final Delivery to ESS (Arrival of Last batch)	0 days	Fri 29-03-19	Fri 29-03-19
20		2.3	**Assembly DC PC cabinets and installation in Gallery**	**145 days**	**Mon 15-10-18**	**Fri 03-05-19**
21			Installation of DC Power Converters in cabinets	20 days	Mon 15-10-18	Thu 25-04-19
22	2.8 (M)		Installation in cabinets of last power converters finished	0 days	Thu 25-04-19	Thu 25-04-19
23			Installation of dressed cabinets in Accelerator Gallery	20 days	Mon 29-10-18	Fri 03-05-19
24	2.9 (M)		Installation of last dressed cabinet in Accelerator Gallery finished	0 days	Fri 03-05-19	Fri 03-05-19
25		2.4	**In situ testing of PCQ5, PCQ6, PCQ7 on real loads**	**149 days**	**Fri 09-11-18**	**Thu 06-06-19**
26			*Start of tests on real load PCQ5, PCQ6, PCQ7*	*0 days*	*Fri 09-11-18*	*Fri 09-11-18*
27			*In situ commissioning of PCQ5-7 with real load*	*80 days*	*Mon 12-11-18*	*Thu 06-06-19*
28			*End of tests on real load PCQ5-7*	*0 days*	*Thu 06-06-19*	*Thu 06-06-19*
29			**PCQ5-7 SAR-2 (PCQ5, PCQ6, PCQ7)**	**64 days**	**Mon 01-04-19**	**Thu 27-06-19**
30			Full Documentation PCQ5, PCQ6, PCQ7 to ESS	50 days	Mon 01-04-19	Fri 07-06-19
31	2.10 (D)		SAR-2: Delivery Data Package (PCQ5, PCQ6, PCQ7)	0 days	Thu 13-06-19	Thu 13-06-19
32	2.11 (M)		SAR-2 (PCQ5, PCQ6, PCQ7)	0 days	Thu 27-06-19	Thu 27-06-19
33		3	**WU3 - DC PC (DCPC) FOR DIPOLE PCD1 & QUADRUPOLE PCQ8**	**460 days**	**Mon 29-05-17**	**Fri 01-03-19**
34			*CDR for C8, Q8 and D1 magnets*	0 days	Tue 27-06-17	Tue 27-06-17
35		3.1	**Tender Documentation and Procurement PCD1 & PCQ8**	**240 days**	**Mon 29-05-17**	**Fri 27-04-18**
36			Preparation of Documentation for PDR-3	17 days	Mon 29-05-17	Tue 20-06-17
37	3.1 (D)		PDR-3: Delivery of Data package PCD1 PCQ8	0 days	Tue 20-06-17	Tue 20-06-17
38	3.2 (M)		PDR-3: (PCD1, PCQ8)	0 days	Wed 28-06-17	Wed 28-06-17
39			Call for Tender	7 mons	Mon 16-10-17	Fri 27-04-18
40	3.3 (M)		Start of Production (PCD1, PCQ8)	0 days	Fri 27-04-18	Fri 27-04-18
41		3.2	Construction and validation on dummy load of PCD1	6 mons	Mon 30-04-18	Fri 12-10-18
42	3.4 (D)		Test Report on Dummy Load (PCD1)	0 days	Fri 12-10-18	Fri 12-10-18
43		3.3	Construction and validation on Dummy load of 6 x PCQ8	2 mons	Mon 15-10-18	Fri 07-12-18
44	3.5 (D)		Delivery of last unit to ESS (PCQ8)	0 days	Fri 21-12-18	Fri 21-12-18
45		3.4	**Installation of PCD1 and PCQ8 in cabinets and in Gallery**	**52 days**	**Mon 29-10-18**	**Tue 08-01-19**
46			Installation of PCD1 and PCQ8 in cabinets	10 days	Mon 29-10-18	Fri 04-01-19
47			Installation of cabinet in Accelerator Gallery	5 days	Mon 12-11-18	Tue 08-01-19
48	3.6 (M)		Installation in Accelerator Gallery finished	0 days	Tue 08-01-19	Tue 08-01-19
49		3.5	**In situ testing of PCD1 and PCQ8 with real loads**	**55 days**	**Wed 28-11-18**	**Tue 12-02-19**
50			*Start of commissioning DCPC*	*0 days*	*Wed 28-11-18*	*Wed 28-11-18*
51			*In situ commissioning of DCPC with real load*	*30 days*	*Wed 28-11-18*	*Tue 12-02-19*
52			*End of tests on real load DCPC*	*0 days*	*Tue 12-02-19*	*Tue 12-02-19*
53			**DCPC SAR-3 (PCD1, PCQ8)**	**30 days**	**Mon 21-01-19**	**Fri 01-03-19**
54			Full Documentation DCPC to ESS	20 days	Mon 21-01-19	Fri 15-02-19
55	3.7 (D)		SAR-3: Delivery data Package (PCD1, PCQ8)	0 days	Fri 15-02-19	Fri 15-02-19
56	3.8 (M)		SAR-3 (PCD1, PCQ8)	0 days	Fri 01-03-19	Fri 01-03-19

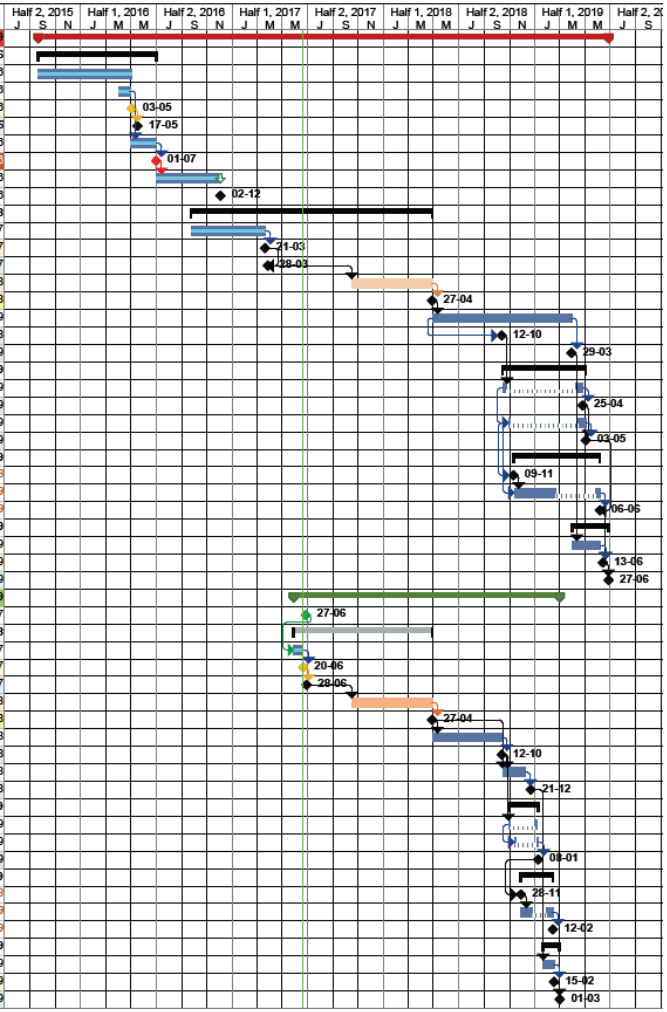

Figure 2 – Possible time plan PCD1 & PQ8 (Call for Tender start in October with a duration of seven months)

ID	ESS WBS	ESS WU No.	Task Name	Duration	Start	Finish	Predecessors
1		2	WU2 - DC Power Converters for quadrupoles PCQ5, PCQ6, PCQ7	1022 days?	Mon 21-09-15	Fri 16-08-19	
2			Pulsed Quads (PPC) Study	206 days?	Mon 21-09-15	Thu 30-06-16	
3			Pulsed Quads (PPC) Study	164 days?	Mon 21-09-15	Tue 03-05-16	
4			Tests on prototype V0.1	20 days	Fri 01-04-16	Thu 28-04-16	
5	2.1 (D)		PDR: Delivery of Data Package (Pulsed PC)	0 days	Tue 03-05-16	Tue 03-05-16	
6	2.2 (M)		*PDR: PCQ5, PCQ6, PCQ7 (Pulsed PC)*	*0 days*	*Tue 17-05-16*	*Tue 17-05-16*	*5FS+10 days*
7			Studies and verification of Eddy Current Effects on Vacuum Chamber	45 days	Fri 29-04-16	Thu 30-06-16	4
8			Decision to pass to DC power converters	0 days	Fri 01-07-16	Fri 01-07-16	7
9			Study of a DC magnet+PC solution	111 days?	Fri 01-07-16	Fri 02-12-16	8
10			Study of DC solution	0 days?	Fri 02-12-16	Fri 02-12-16	
11		2.1	Tender Documentation and Procurement DC PC	416 days	Fri 23-09-16	Fri 27-04-18	
12			Preparation of Documentation for PDR-2	127 days	Fri 23-09-16	Mon 20-03-17	
13	2.3 (D)		PDR-2: Delivery of Data Package	0 days	Tue 21-03-17	Tue 21-03-17	12
14	2.4 (M)		PDR-2: DC Power Systems (PCQ5, PCQ6, PCQ7)	0 days	Tue 28-03-17	Tue 28-03-17	13FF+5 days
15			Call for Tender	7 mons	Mon 16-10-17	Fri 27-04-18	14,38
16	2.5 (M)		Series Unit Production Start (PCQ5, PCQ6, PCQ7)	0 days	Fri 27-04-18	Fri 27-04-18	15
17		2.2	Series unit production (in batches) of PCQ5, PCQ6, PCQ7 & PCQ8	14 mons	Mon 30-04-18	Fri 24-05-19	16
18	2.6 (D)		First Delivery to ESS (Arrival of First batch)	0 days	Fri 12-10-18	Fri 12-10-18	17SS+6 mons
19	2.7 (D)		Final Delivery to ESS (Arrival of Last batch - PCQ8)	0 days	Fri 24-05-19	Fri 24-05-19	17
20		2.3	Assembly DC PC cabinets and Installation in Gallery	145 days	Mon 15-10-18	Fri 03-05-19	
21			Installation of DC Power Converters in cabinets	20 days	Mon 15-10-18	Thu 25-04-19	18
22	2.8 (M)		Installation in cabinets of last power converters finished	0 days	Thu 25-04-19	Thu 25-04-19	21
23			Installation of dressed cabinets in Accelerator Gallery	20 days	Mon 29-10-18	Fri 03-05-19	21SS+10 days
24	2.9 (M)		Installation of last dressed cabinet in Accelerator Gallery finished	0 days	Fri 03-05-19	Fri 03-05-19	22,23
25		2.4	In situ testing of PCQ5, PCQ6, PCQ7 on real loads	149 days	Fri 09-11-18	Thu 06-06-19	
26			*Start of tests on real load PCQ5, PCQ6, PCQ7*	*0 days*	*Fri 09-11-18*	*Fri 09-11-18*	*23SS+10 days*
27			*In situ commissioning of PCQ5-7 with real load*	*80 days*	*Mon 12-11-18*	*Thu 06-06-19*	*23SS+10 days,26*
28			*End of tests on real load PCQ5-7*	*0 days*	*Thu 06-06-19*	*Thu 06-06-19*	*24FF+10 days,27*
29			PCQ5-7 SAR-2 (PCQ5, PCQ6, PCQ7)	60 days	Mon 27-05-19	Fri 16-08-19	
30			Full Documentation PCQ5, PCQ6, PCQ7 to ESS	50 days	Mon 27-05-19	Fri 02-08-19	19
31	2.10 (D)		SAR-2: Delivery Data Package (PCQ5, PCQ6, PCQ7)	0 days	Fri 02-08-19	Fri 02-08-19	28FS+5 days,30
32	2.11 (M)		SAR-2 (PCQ5, PCQ6, PCQ7)	0 days	Fri 16-08-19	Fri 16-08-19	31FS+10 days
33		3	WU3 - DC PC (DCPC) FOR DIPOLE PCD1 & QUADRUPOLE PCQ8	420 days	Mon 29-05-17	Fri 04-01-19	
34			*CDR for C8, Q8 and D1 magnets*	0 days	Tue 27-06-17	Tue 27-06-17	
35		3.1	Tender Documentation and Procurement PCD1 & PCQ8	240 days	Mon 29-05-17	Fri 27-04-18	
36			Preparation of Documentation for PDR-3	17 days	Mon 29-05-17	Tue 20-06-17	34FS-25 days
37	3.1 (D)		PDR-3: Delivery of Data package PCD1 PCQ8	0 days	Tue 20-06-17	Tue 20-06-17	36
38	3.2 (M)		PDR-3: (PCD1, PCQ8)	0 days	Wed 28-06-17	Wed 28-06-17	37FS+6 days
39			Call for Tender	7 mons	Mon 16-10-17	Fri 27-04-18	38
40	3.3 (M)		Start of Production (PCD1)	0 days	Fri 27-04-18	Fri 27-04-18	39
41		3.2	Construction and validation on dummy load of PCD1	6 mons	Mon 30-04-18	Fri 12-10-18	40
42	3.4 (D)	3.3	Test Report on Dummy Load (PCD1)	0 days	Fri 12-10-18	Fri 12-10-18	41
43	3.5 (D)		Delivery of PCD1 to ESS	0 days	Fri 26-10-18	Fri 26-10-18	42FS+10 days
44		3.4	Installation of PCD1 in cabinet and in Gallery	10 days	Mon 29-10-18	Fri 09-11-18	
45			Installation of PCD1 in cabinets	5 days	Mon 29-10-18	Fri 02-11-18	43
46			Installation of cabinet in Accelerator Gallery	5 days	Mon 05-11-18	Fri 09-11-18	45
47	3.6 (M)		Installation in Accelerator Gallery finished	0 days	Fri 09-11-18	Fri 09-11-18	46
48		3.5	In situ testing of PCD1 with real loads	5 days	Fri 09-11-18	Fri 16-11-18	
49			*Start of commissioning DCPC*	*0 days*	*Fri 09-11-18*	*Fri 09-11-18*	*47*
50			*In situ commissioning of DCPC with real load*	*5 days*	*Mon 12-11-18*	*Fri 16-11-18*	*49*
51			*End of tests on real load DCPC*	*0 days*	*Fri 16-11-18*	*Fri 16-11-18*	*50*
52			DCPC SAR-3 (PCD1, PCQ8)	30 days	Mon 26-11-18	Fri 04-01-19	
53			Full Documentation PCD1 to ESS	20 days	Mon 26-11-18	Fri 21-12-18	43FS+20 days
54	3.7 (D)		SAR-3: Delivery data Package (PCD1)	0 days	Fri 21-12-18	Fri 21-12-18	53
55	3.8 (M)		SAR-3 (PCD1)	0 days	Fri 04-01-19	Fri 04-01-19	54FS+10 days

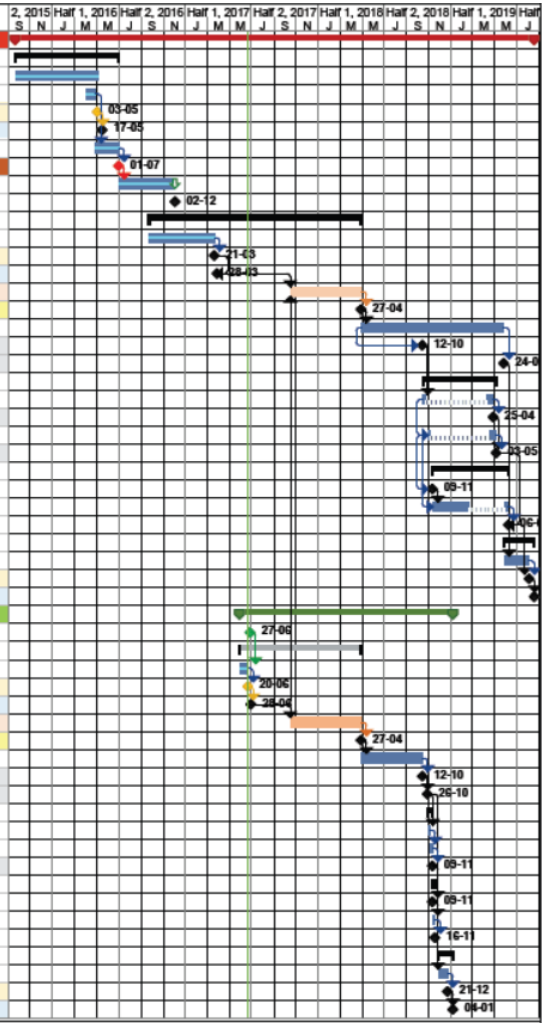

Figure 3 – Possible time plan PCQ5-8 & PCD1 (Call for Tender start in October with a duration of seven months)