Individual and Collective Dose Estimates for Interventions at the PS SS15

Sanja Damjanovic, DGS-RP

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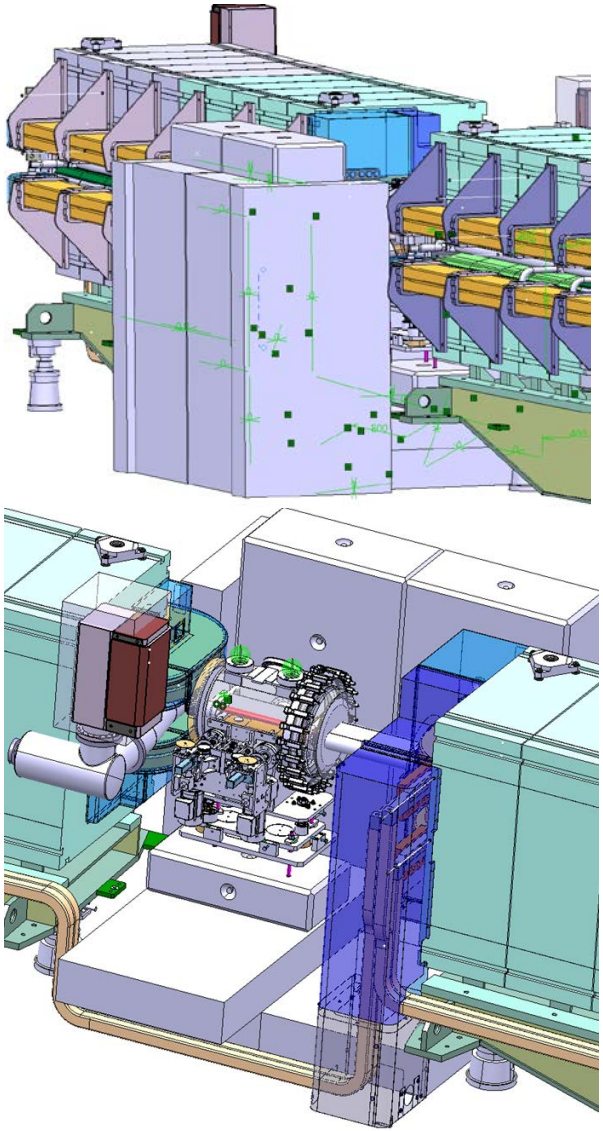
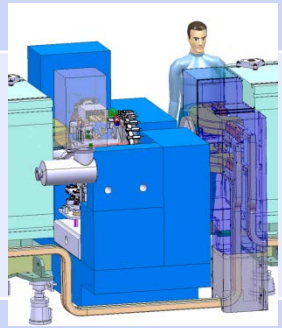
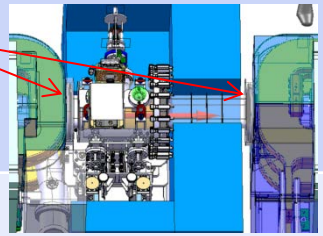
Intervention Scenarios TPS15

Failure	Risk Classification	Operation
1. Blade damage	Catastrophic	Replacement of complete system
2. MU14 or 15 Failure	Catastrophic	Removal (?) and reinstallation of complete system
3. Vacuum leak	Catastrophic / local Intervention	Shielding dismantling + Diagnostics/replacement
4. Beam Instrumentation failure	Medium	Repair may be possible in-situ
5. Drive system	Medium	Manual removal of blade (Manivelle)
6. Water leak on cooling circuit	Medium	Replace joint or cooling hose, or isolate and run “hot”
7. Replacement of ion pump	Low	Replace of ion pump

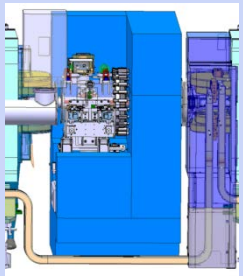


1 & 2, REPLACEMENT OF COMPLETE SYSTEM	Specialist	Time and distance	Comments
Venting of sector	TE-VSC	10 mins, remote intervention	
Dismantling of shielding	EN-HE-HH	0.5 hours, distance >1m	Roof and 2 side blocks
Disconnection of upstream and downstream flanges Reconnect flanges	TE-VSC TE-VSC	2 people, 5 mins, contact 2 people, 7.5min/person, contact	Flanges DN273
Disconnect cabling, compressed air, water cooling, etc. remove camera Reconnect ion of cables, air, water cooling	TE-ABT, BE-BI, TE-VSC	3 people 10 mins, contact 3 people, 10min/person, contact	
Removal of tank assembly	TE-ABT, EN-HE-HH	2 people, 10 mins, distance 1m	
Install spare	TE-ABT, EN-HE-HH TE/VSC	2 People 10 mins, distance 1m	Spare is NOT radioactive
Leek test	TE-VSC	1person, 30 minutes at 1m	
Installation of shielding	EN-HE-HH	3 people, 1h/person	





Mike Hourican TE-ABT

4 & 5, BI failure or Drive System Failure	Specialist	Time and distance	Comments
Diagnostics	TE-ABT or BI	30 mins (close proximity)	
Option 1: BI Equipment	BI	30 mins – 60 mins BI equipment is on radioactive side of assembly, but is relatively easy to access.	Repair option? If repair in-situ is chosen, then dismantling of shielding is NOT necessary
Option 2: Blade displacement system	TE/ABT	30-60 mins, Displace the blade manually or remove shielding (Roof block and 2 side blocks) then perform diagnostics and repair in situ. Specialist NOT protected by side shielding	

Details maintenance procedure for camera, light and filter wheel exchange

Light exchange: (at least once a year since will get brown rapidly)

- Disconnect the cable — 10s
- Dismount the mechanical light support — 15s
- Exchange the lights — 1-2min
- Re-mount the lights support
  - 15s
- Reconnect the cable — 10s

Camera:

- Disconnect the 2 cables — 15s
- Dismount the camera support
  - 20s
- Exchange the camera (3 possibilities)
  - New camera with new support — 2min
  - New camera only — 2min
    - Need optical readjustment in situ — 30s
  - New Vidicon camera tube — 4min
    - Need optical readjustment in situ — 30s
- Put back the camera with support on the septum
  - 30s-1min

In the dummy_15 zone outside the dummy_15 zone/safe area

Risk Classification (I) - Catastrophic

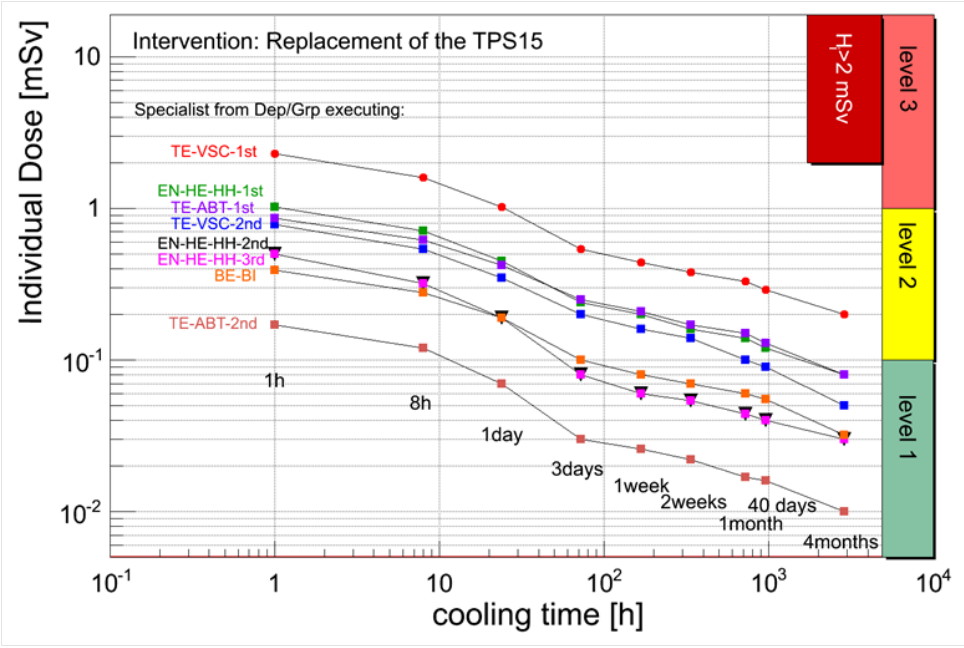
Individual and Collective Doses Estimated for the Intervention
-Replacement of the complete system-

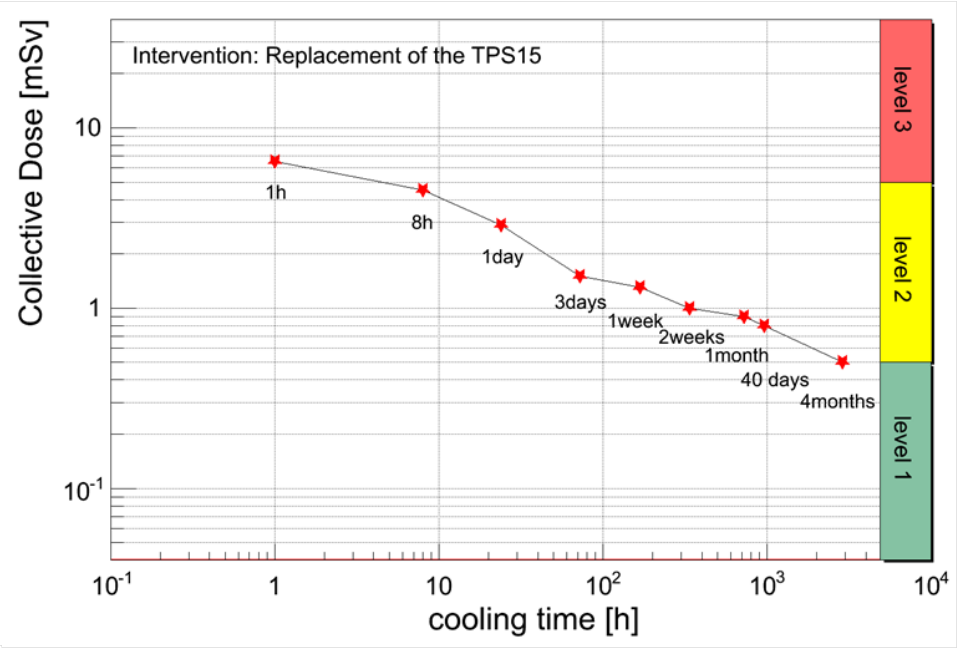
Individual and Collective Doses Estimated for the Intervention -Replacement of the complete system- at PS SS15

Specialist from Dep/Grp executing	Replacement of the complete TPS15 system								
	Accumulated Dose / Person [mSv/person]								
	1h	8h	1 day	3 days	1 week	2 weeks	1 month	40 days	4 months
TE-VSC-1st	2.3	1.6	1.02	0.54	0.44	0.38	0.33	0.29	0.2
TE-VSC-2nd	0.78	0.54	0.35	0.2	0.16	0.14	0.1	0.09	0.05
EN-HE-HH-1st	1.02	0.71	0.45	0.24	0.2	0.16	0.14	0.12	0.08
EN-HE-HH-2nd	0.5	0.32	0.19	0.08	0.06	0.054	0.044	0.04	0.03
EN-HE-HH-3rd	0.5	0.32	0.19	0.08	0.06	0.054	0.044	0.04	0.03
TE-ABT-1st	0.86	0.62	0.42	0.25	0.21	0.17	0.15	0.13	0.08
TE-ABT-2nd	0.17	0.12	0.07	0.03	0.026	0.022	0.017	0.016	0.01
BE-BI	0.39	0.28	0.19	0.1	0.08	0.07	0.06	0.055	0.032
Collective Dose [mSv] – '8 persons'	**6.5**	**4.5**	**2.9**	**1.5**	**1.3**	**1.0**	**0.9**	**0.8**	**0.5**

Minimum waiting time of at least 8 hours required to assure that no person would reach the intervention limit of 2 mSv per intervention

Individual and Collective Doses Estimated for the Intervention -Replacement of the complete system- at PS SS15





Even though the individual doses stay below the design constraint of 2 mSv per person and intervention after cooling time of 8 hours, a minimum waiting time of at least 1-2 days required to avoid the ALARA committee.

Accumulated Dose per person and intervention during the 'Replacement of the complete system' at PS SS15 after cooling time of 1 hour

Intervention scenario 'Replacement of the complete TPS15 system' – cooling time 1 hour							
Work description (Task)	Dep/Grp (executing)	Dose/person (EN-HE-HH_1st/2nd/3rd) [mSv]	Dose/person (TE-VSC_1st) [mSv]	Dose/person (TE-VSC_2nd) [mSv]	Dose/person (TE-ABT-1st/2nd) [mSv]	Dose/person (BE-BI) [mSv]	Total collective dose [mSv]
Actions							**6.5**
Venting of sector	TE-VSC	remote					
Dismantling of shielding	EN-HE-HH	0.31/0.25/0.25					0.81
Disconnection of upstream and downstream flanges	TE/VSC		0.21	0.2			+0.41
Disconnect cabling, compressed air, water cooling, etc.	TE-ABT, BE-BI, TE-VSC		0.26		0.13/0	0.13	+0.52
Removal of tank assembly	TE-ABT, EN-HE-HH	0.3/0/0			0.3/0		+0.6
Installation of spare	TE-ABT, EN-HE-HH	0.17/0/0			0.17/0.17		+0.51
Reconnection of upstream and downstream flanges	TE/VSC		0.27	0.58			+0.85
Reconnection of cables, air, and water cooling	TE-ABT/BE-BI/TE-VSC		0.26		0.26/0	0.26	+0.78
Leak test	TE-VSC		1.3				+1.3
Installation of shielding	EN-HE-HH	0.24/0.24/0.24					+0.72
		1.02/0.5/0.5	2.3	0.78	0.86/0.17	0.39	**6.5**

Accumulated Dose per Person and Intervention during the 'Replacement of the complete system' at PS SS15 after cooling time of 8 hour

Work description (Task)	Dep/Grp (executing)	Dose/person (EN-HE-HH_1st/2nd/3rd) [mSv]	Dose/person (TE-VSC_1st) [mSv]	Dose/person (TE-VSC_2nd) [mSv]	Dose/person (TE-ABT-1st/2nd) [mSv]	Dose/person (BE-BI) [mSv]	Total collective dose [mSv]
Actions							**4.5**
Venting of sector	TE-VSC	remote					
Dismantling of shielding	EN-HE-HH	0.22/0.17/0.17					0.56
Disconnection of upstream and downstream flanges	TE/VSC		0.15	0.14			+0.29
Disconnect cabling, compressed air, water cooling, etc.	TE-ABT, BE-BI, TE-VSC		0.2		0.1/0	0.1	+0.4
Removal of tank assembly	TE-ABT, EN-HE-HH	0.22/0/0			0.22/0		+0.44
Installation of spare	TE-ABT, EN-HE-HH	0.12/0/0			0.12/0.12		+0.36
Reconnection of upstream and downstream	TE/VSC		0.19	0.4			+0.59
Reconnection of cables, air, and water cooling	TE-ABT/BE-BI/TE-VSC		0.18		0.18/0	0.18	+0.54
Leak test	TE-VSC		0.9				+0.9
Installation of shielding	EN-HE-HH	0.15/0.15/0.15					+0.45
		0.71/0.32/0.32	1.6	0.54	0.62/0.12	0.28	**4.5**

Accumulated Dose per Person and Intervention during the 'Replacement of the complete system' at PS SS15 after cooling time of 1 day

Work description (Task)	Dep/Grp (executing)	Dose/person (EN-HE-HH_1st/2nd/3rd) [mSv]	Dose/person (TE-VSC_1st) [mSv]	Dose/person (TE-VSC_2nd) [mSv]	Dose/person (TE-ABT-1st/2nd) [mSv]	Dose/person (BE-BI) [mSv]	Total collective dose [mSv]
Actions							**2.88**
Venting of sector	TE-VSC	remote					
Dismantling of shielding	EN-HE-HH	0.13/0.1/0.1					0.33
Disconnection of upstream and downstream flanges	TE/VSC		0.11	0.09			+0.2
Disconnect cabling, compressed air, water cooling, etc.	TE-ABT, BE-BI, TE-VSC		0.16		0.08/0	0.08	+0.32
Removal of tank assembly	TE-ABT, EN-HE-HH	0.16/0/0			0.16/0		+0.32
Installation of spare	TE-ABT, EN-HE-HH	0.07/0/0			0.07/0.07		+0.21
Reconnection of upstream and downstream flanges	TE/VSC		0.11	0.26			+0.37
Reconnection of cables, air, and water cooling	TE-ABT/BE-BI/TE-VSC		0.11		0.11/0	0.11	+0.33
Leak test	TE-VSC		0.53				+0.53
Installation of shielding	EN-HE-HH	0.09/0.09/0.09					+0.27
		0.45/0.19/0.19	1.02	0.35	0.42/0.07	0.19	**2.88**

Dose per person and intervention accumulated during the 'Replacement of the complete system' at PS SS15 after cooling time of 3 days

Work description (Task)	Dep/Grp (executing)	Dose/person (EN-HE-HH_1st/2nd/3rd) [mSv]	Dose/person (TE-VSC_1st) [mSv]	Dose/person (TE-VSC_2nd) [mSv]	Dose/person (TE-ABT-1st/2nd) [mSv]	Dose/person (BE-BI) [mSv]	Total collective Dose [mSv]
Actions							**1.53**
Venting of sector	TE-VSC	remote					
Dismantling of shielding	EN-HE-HH	0.05/0.04/0.04					0.13
Disconnection of upstream and downstream flanges	TE/VSC		0.09	0.05			+0.14
Disconnect cabling, compressed air, water cooling, etc.	TE-ABT, BE-BI, TE-VSC		0.1		0.05/0	0.05	+0.2
Removal of tank assembly	TE-ABT, EN-HE-HH	0.12/0/0			0.12/0		+0.24
Installation of spare	TE-ABT, EN-HE-HH	0.033/0/0			0.033/0.033		+0.1
Reconnection of upstream and downstream flanges	TE/VSC		0.05	0.15			+0.20
Reconnection of cables, air, and water cooling	TE-ABT/BE-BI/TE-VSC		0.05		0.05/0	0.05	+0.15
Leak test	TE-VSC		0.25				+0.25
Installation of shielding	EN-HE-HH	0.04/0.04/0.04					+0.12
		0.24/0.08/0.08	0.54	0.2	0.25/0.03	0.1	**1.53**

Accumulated Dose per Person and Intervention during the 'Replacement of the complete system' at PS SS15 after cooling time of 1 week

Work description (Task)	Dep/Grp (executing)	Dose/person (EN-HE-HH_1st/2nd/3rd) [mSv]	Dose/person (TE-VSC_1st) [mSv]	Dose/person (TE-VSC_2nd) [mSv]	Dose/person (TE-ABT-1st/2nd) [mSv]	Dose/person (BE-BI) [mSv]	Total collective dose [mSv]
Actions							**1.26**
Venting of sector	TE-VSC	remote					
Dismantling of shielding	EN-HE-HH	0.04/0.033/0.033					0.11
Disconnection of upstream and downstream flanges	TE/VSC		0.08	0.04			+0.12
Disconnect cabling, compressed air, water cooling, etc.	TE-ABT, BE-BI, TE-VSC		0.09		0.05/0	0.046	+0.19
Removal of tank assembly	TE-ABT, EN-HE-HH	0.1/0/0			0.1/0		+0.2
Installation of spare	TE-ABT, EN-HE-HH	0.025/0/0			0.026/0.026		+0.08
Reconnection of upstream and downstream flanges	TE/VSC		0.04	0.12			+0.16
Reconnection of cables, air, and water cooling	TE-ABT/BE-BI/TE-VSC		0.04		0.04/0	0.038	+0.12
Leak test	TE-VSC		0.19				+0.19
Installation of shielding	EN-HE-HH	0.03/0.03/0.03					+0.09
		0.2/0.063/0.063	0.44	0.16	0.21/0.026	0.084	**1.26**

Accumulated Dose per Person and Intervention during the 'Replacement of the complete system' at PS SS15 after cooling time of 2 weeks

Work description (Task)	Dep/Grp (executing)	Dose/person (EN-HE-HH_1st/2nd/3rd) [mSv]	Dose/person (TE-VSC_1st) [mSv]	Dose/person (TE-VSC_2nd) [mSv]	Dose/person (TE-ABT-1st/2nd) [mSv]	Dose/person (BE-BI) [mSv]	Total collective dose [mSv]
Actions							**1.05**
Venting of sector	TE-VSC	remote					
Dismantling of shielding	EN-HE-HH	0.03/0.03/0.03					0.09
Disconnection of upstream and downstream flanges	TE/VSC		0.07	0.035			+0.105
Disconnect cabling, compressed air, water cooling, etc.	TE-ABT, BE-BI, TE-VSC		0.08		0.04/0	0.04	+0.16
Removal of tank assembly	TE-ABT, EN-HE-HH	0.08/0/0			0.08/0		+0.16
Installation of spare	TE-ABT, EN-HE-HH	0.022/0/0			0.022/0.022		+0.066
Reconnection of upstream and downstream flanges	TE/VSC		0.034	0.1			+0.134
Reconnection of cables, air, and water cooling	TE-ABT/BE-BI/TE-VSC		0.03		0.03/0	0.03	+0.09
Leak test	TE-VSC		0.17				+0.17
Installation of shielding	EN-HE-HH	0.024/0.024/0.024					+0.072
		0.16/0.054/0.054	0.38	0.135	0.17/0.022	0.07	**1.05**

Accumulated Dose per Person and Intervention during the 'Replacement of the complete system' at PS SS15 after cooling time of 1 month

Work description (Task)	Dep/Grp (executing)	Dose/person (EN-HE-HH_1st/2nd/3rd) [mSv]	Dose/person (TE-VSC_1st) [mSv]	Dose/person (TE-VSC_2nd) [mSv]	Dose/person (TE-ABT-1st/2nd) [mSv]	Dose/person (BE-BI) [mSv]	Total collective dose [mSv]
Actions							**0.88**
Venting of sector	TE-VSC	remote					
Dismantling of shielding	EN-HE-HH	0.03/0.024/0.024					0.078
Disconnection of upstream and downstream flanges	TE/VSC		0.052	0.023			+0.075
Disconnect cabling, compressed air, water cooling, etc.	TE-ABT, BE-BI, TE-VSC		0.06		0.03/0	0.03	+0.12
Removal of tank assembly	TE-ABT, EN-HE-HH	0.07/0/0			0.07/0		+0.14
Installation of spare	TE-ABT, EN-HE-HH	0.017/0/0			0.017/0.017		+0.051
Reconnection of upstream and downstream flanges	TE/VSC		0.026	0.08			+0.106
Reconnection of cables, air, and water cooling	TE-ABT/BE-BI/TE-VSC		0.03		0.03/0	0.029	+0.09
Leak test	TE-VSC		0.16				+0.16
Installation of shielding	EN-HE-HH	0.02/0.02/0.02					+0.06
		0.14/0.044/0.044	0.33	0.1	0.15/0.017	0.06	**0.88**

Accumulated Dose per Person and Intervention during the 'Replacement of the complete system' at PS SS15 after cooling time of 40 days

Work description (Task)	Dep/Grp (executing)	Dose/person (EN-HE-HH_1st/2nd/3rd) [mSv]	Dose/person (TE-VSC_1st) [mSv]	Dose/person (TE-VSC_2nd) [mSv]	Dose/person (TE-ABT-1st/2nd) [mSv]	Dose/person (BE-BI) [mSv]	Total collective dose [mSv]
Actions							**0.78**
Venting of sector	TE-VSC	remote					
Dismantling of shielding	EN-HE-HH	0.024/0.02/0.02					0.064
Disconnection of upstream and downstream flanges	TE/VSC		0.047	0.021			+0.068
Disconnect cabling, compressed air, water cooling, etc.	TE-ABT, BE-BI, TE-VSC		0.056		0.03/0	0.028	+0.114
Removal of tank assembly	TE-ABT, EN-HE-HH	0.06/0/0			0.06/0		+0.12
Installation of spare	TE-ABT, EN-HE-HH	0.016/0/0			0.016/0.016		+0.048
Reconnection of upstream and downstream flanges	TE/VSC		0.024	0.07			+0.094
Reconnection of cables, air, and water cooling	TE-ABT/BE-BI/TE-VSC		0.027		0.027/0	0.027	+0.08
Leak test	TE-VSC		0.14				+0.14
Installation of shielding	EN-HE-HH	0.017/0.017/0.017					+0.051
		0.12/0.04/0.04	0.29	0.091	0.13/0.016	0.055	**0.78**

Accumulated Dose per Person and Intervention during the 'Replacement of the complete system' at PS SS15 after cooling time of 4 months

Work description (Task)	Dep/Grp (executing)	Dose/person (EN-HE-HH_1st/2nd/3rd) [mSv]	Dose/person (TE-VSC_1st) [mSv]	Dose/person (TE-VSC_2nd) [mSv]	Dose/person (TE-ABT-1st/2nd) [mSv]	Dose/person (BE-BI) [mSv]	Total collective dose [mSv]
Actions							**0.51**
Venting of sector	TE-VSC	remote					
Dismantling of shielding	EN-HE-HH	0.014/0.012/0.012					0.038
Disconnection of upstream and downstream flanges	TE/VSC		0.025	0.013			+0.038
Disconnect cabling, compressed air, water cooling, etc.	TE-ABT, BE-BI, TE-VSC		0.03		0.015/0	0.015	+0.06
Removal of tank assembly	TE-ABT, EN-HE-HH	0.03/0/0			0.03/0		+0.06
Installation of spare tank	TE-ABT, EN-HE-HH	0.016/0/0			0.01/0.01		+0.036
Reconnection of upstream and downstream flanges	TE/VSC		0.016	0.04			+0.056
Reconnection of cables, air, and water cooling	TE-ABT/BE-BI/TE-VSC		0.017		0.027/0	0.017	+0.061
Leak test	TE-VSC		0.11				+0.11
Installation of shielding	EN-HE-HH	0.017/0.017/0.017					+0.051
		0.08/0.03/0.03	0.2	0.053	0.082/0.01	0.032	**0.51**

Risk Classification - Medium

Individual and Collective Doses Estimated for the Intervention

- Detailed maintenance procedure for camera, light and filter wheel exchange -

Details maintenance procedure for camera, light and filter wheel exchange

Light exchange: (at least once a year since will get brown rapidly)	
Disconnect the cable	10s
Dismount the mechanical light support	15s
Exchange the lights	1-2min
Re-mount the lights support	
15s	
Reconnect the cable	10s
Camera:	
Disconnect the 2 cables	15s
Dismount the camera support	
20s	
Exchange the camera (3 possibilities)	
New camera with new support	2min
New camera only	2min
Need optical readjustment in situ	30s
New Vidicon camera tube	4min
Need optical readjustment in situ	30s
Put back the camera with support on the septum	
30s-1min	

In the dummy_15 zone — outside the dummy_15 zone/safe area

Individual and Collective Doses Estimated for the Intervention - Maintenance of camera, light and filter wheel exchange -

assume 15 min needed to reach this place

3 options for the camera exchange

Exchange the camera (3 possibilities)
- New camera with new support — 2min
- New camera only — 2min
  - Need optical readjustment in situ — 30s
- New Vidicon camera tube — 4min
  - Need optical readjustment in situ — 30s

Put back the camera with support on the septum
- 30s-1min

Specialist from Dep/Grp executing	Exchange of BI camera, light and filter wheel								
	Accumulated Dose / Person [mSv/person]								
	1h	8h	1 day	3 days	1 week	2 weeks	1 month	40 days	4 months
BE-BI / Option 1	1.6	1.18	0.91	0.65	0.56	0.47	0.41	0.36	0.16
BE-BI / Option 2	1.63	1.24	0.95	0.68	0.68	0.5	0.43	0.37	0.17
BE-BI / Option 3	2.07	1.54	1.18	0.86	0.76	0.63	0.52	0.48	0.22
Collective Dose – Optin 3 [mSv] – '1 person'	**2.07**	**1.54**	**1.18**	**0.86**	**0.76**	**0.63**	**0.52**	**0.48**	**0.22**

Minimum waiting time of at least 8 hours required to assure that no person would reach the intervention limit of 2 mSv per intervention; minimum of 1-3 days required to avoid the ALARA committee

Accumulated Dose per person and intervention during the 'Maintenance of camera, light and filter wheel exchange' after cooling time of 1 hour

Work description (Task)	Dep/Grp (executing)	Dose/person (BE-BI) [mSv]
Actions		
Reach the place	BE-BI	0.87
Light exchange: Disconnect the cable	BE-BI	0.021
Dismount the mechanical light support	BE-BI	0.032
Exchange the lights	BE-BI	0.26
Remount the light support	BE-BI	0.032
Reconnect the cable	BE-BI	0.021
Camera: disconn. 2 cables	TE/VSC	0.032
Dismount camera support	BE-BI	0.042
Exchange the camera (1)	BE-BI	0.26
Exchange the camera (2)	BE-BI	0.26+0.064=0.32
Exchange the camera (3)	BE-BI	0.52+0.064+0.13=0.7

Accumulated Dose per person and intervention during the ‘Maintenance of camera, light and filter wheel exchange’ after cooling time of 8 hours

Work description (Task)	Dep/Grp (executing)	Dose/person (BE-BI) [mSv]
Actions		
Reach the place	BE-BI	0.64
Light exchange: Disconnect the cable	BE-BI	0.017
Dismount the mechanical light support	BE-BI	0.025
Exchange the lights	BE-BI	0.2
Remount the light support	BE-BI	0.025
Reconnect the cable	BE-BI	0.017
Camera: disconn. 2 cables	TE/VSC	0.025
Dismount camera support	BE-BI	0.034
Exchange the camera (1)	BE-BI	0.2
Exchange the camera (2)	BE-BI	0.2+0.05=0.25
Exchange the camera (3)	BE-BI	0.4+0.05+0.1=0.55

Accumulated Dose per person and intervention during the ‘Maintenance of camera, light and filter wheel exchange’ after cooling time of 1 day

Work description (Task)	Dep/Grp (executing)	Dose/person (BE-BI) [mSv]
Actions		
Reach the place	BE-BI	0.48
Light exchange: Disconnect the cable	BE-BI	0.013
Dismount the mechanical light support	BE-BI	0.02
Exchange the lights	BE-BI	0.16
Remount the light support	BE-BI	0.02
Reconnect the cable	BE-BI	0.013
Camera: disconn. 2 cables	TE/VSC	0.02
Dismount camera support	BE-BI	0.026
Exchange the camera (1)	BE-BI	0.16
Exchange the camera (2)	BE-BI	0.16+0.04=0.2
Exchange the camera (3)	BE-BI	0.32+0.04+0.08=0.44

Accumulated Dose per person and intervention during the 'Maintenance of camera, light and filter wheel exchange' after cooling time of 3 days

Work description (Task)	Dep/Grp (executing)	Dose/person (BE-BI) [mSv]
Actions		
Reach the place	BE-BI	0.32
Light exchange: Disconnect the cable	BE-BI	0.01
Dismount the mechanical light support	BE-BI	0.016
Exchange the lights	BE-BI	0.12
Remount the light support	BE-BI	0.016
Reconnect the cable	BE-BI	0.01
Camera: disconn. 2 cables	TE/VSC	0.016
Dismount camera support	BE-BI	0.02
Exchange the camera (1)	BE-BI	0.12
Exchange the camera (2)	BE-BI	0.12+0.03=0.15
Exchange the camera (3)	BE-BI	0.24+0.03+0.06=0.33

Accumulated Dose per person and intervention during the 'Maintenance of camera, light and filter wheel exchange' after cooling time of 1 week

Work description (Task)	Dep/Grp (executing)	Dose/person (BE-BI) [mSv]
Actions		
Reach the place	BE-BI	0.26
Light exchange: Disconnect the cable	BE-BI	0.009
Dismount the mechanical light support	BE-BI	0.013
Exchange the lights	BE-BI	0.11
Remount the light support	BE-BI	0.013
Reconnect the cable	BE-BI	0.009
Camera: disconn. 2 cables	TE/VSC	0.013
Dismount camera support	BE-BI	0.018
Exchange the camera (1)	BE-BI	0.11
Exchange the camera (2)	BE-BI	0.11+0.027=0.14
Exchange the camera (3)	BE-BI	0.22+0.027+0.055=0.3

Accumulated Dose per person and intervention during the 'Maintenance of camera, light and filter wheel exchange' after cooling time of 2 weeks

Work description (Task)	Dep/Grp (executing)	Dose/person (BE-BI) [mSv]
Actions		
Reach the place	BE-BI	0.23
Light exchange: Disconnect the cable	BE-BI	0.008
Dismount the mechanical light support	BE-BI	0.011
Exchange the lights	BE-BI	0.09
Remount the light support	BE-BI	0.011
Reconnect the cable	BE-BI	0.008
Camera: disconn. 2 cables	TE/VSC	0.011
Dismount camera support	BE-BI	0.015
Exchange the camera (1)	BE-BI	0.09
Exchange the camera (2)	BE-BI	0.09+0.022=0.11
Exchange the camera (3)	BE-BI	0.18+0.022+0.05=0.25

Accumulated Dose per person and intervention during the 'Maintenance of camera, light and filter wheel exchange' after cooling time of 1 month

Work description (Task)	Dep/Grp (executing)	Dose/person (BE-BI) [mSv]
Actions		
Reach the place	BE-BI	0.19
Light exchange: Disconnect the cable	BE-BI	0.006
Dismount the mechanical light support	BE-BI	0.009
Exchange the lights	BE-BI	0.07
Remount the light support	BE-BI	0.009
Reconnect the cable	BE-BI	0.006
Camera: disconn. 2 cables	TE/VSC	0.009
Dismount camera support	BE-BI	0.011
Exchange the camera (1)	BE-BI	0.07
Exchange the camera (2)	BE-BI	0.07+0.02=0.09
Exchange the camera (3)	BE-BI	0.14+0.02+0.04=0.2

Accumulated Dose per person and intervention during the 'Maintenance of camera, light and filter wheel exchange' after cooling time of 40 days

Work description (Task)	Dep/Grp (executing)	Dose/person (BE-BI) [mSv]
Actions		
Reach the place	BE-BI	0.17
Light exchange: Disconnect the cable	BE-BI	0.005
Dismount the mechanical light support	BE-BI	0.008
Exchange the lights	BE-BI	0.06
Remount the light support	BE-BI	0.008
Reconnect the cable	BE-BI	0.005
Camera: disconn. 2 cables	TE/VSC	0.008
Dismount camera support	BE-BI	0.01
Exchange the camera (1)	BE-BI	0.06
Exchange the camera (2)	BE-BI	0.06+0.015=0.075
Exchange the camera (3)	BE-BI	0.12+0.015+0.03=0.17

Accumulated Dose per person and intervention during the ‘Maintenance of camera, light and filter wheel exchange’ after cooling time of 4 months

Work description (Task)	Dep/Grp (executing)	Dose/person (BE-BI) [mSv]
Actions		
Reach the place	BE-BI	0.08
Light exchange: Disconnect the cable	BE-BI	0.003
Dismount the mechanical light support	BE-BI	0.004
Exchange the lights	BE-BI	0.03
Remount the light support	BE-BI	0.004
Reconnect the cable	BE-BI	0.003
Camera: disconn. 2 cables	TE/VSC	0.004
Dismount camera support	BE-BI	0.005
Exchange the camera (1)	BE-BI	0.03
Exchange the camera (2)	BE-BI	0.03+0.008=0.038
Exchange the camera (3)	BE-BI	0.06+0.008+0.02=0.09

Risk Classification - Medium

Individual and Collective Doses Estimated for the Intervention

- BI Failure-

4 BI failure	Specialist	Time and distance	Comments
Diagnostics	TE-ABT or BI	30 mins (close proximity)	
Option 1: BI Equipment	BI	30 mins BI equipment is on radioactive side of assembly, but is relatively easy to access.	 Repair option? If repair in-situ is chosen, then dismantling of shielding is NOT necessary

Individual and Collective Doses Estimated for the Intervention -BI Failure- at PS SS15

Specialist from Dep/Grp executing	BI Failure – diagnostic and repair in-situ								
	Accumulated Dose / Person [mSv/person]								
	1h	8h	1 day	3 days	1 week	2 weeks	1 month	40 days	4 months
BE-BI-1st	2.3	1.8	1.4	0.9	0.8	0.65	0.53	0.47	0.25
BE-BI-2nd	3.0	2.3	1.8	1.4	1.15	0.97	0.77	0.68	0.36
Collective Dose [mSv] – '2 persons'	**5.3**	**4.1**	**3.2**	**2.3**	**1.95**	**1.62**	**1.3**	**1.15**	**0.61**

Minimum waiting time of at least 1 day required to assure that no person would reach the intervention limit of 2 mSv per intervention

To avoid the ALARA committee, a waiting time between 1 and 2 weeks would be needed, requiring a longer period for stop of the LHC beam than planned during the Technical Stops

Individual and Collective Doses Estimated for the Intervention -BI Failure- at PS SS15

Specialist from Dep/Grp executing	BI Failure – diagnostic and repair in-situ								
	Accumulated Dose / Person [mSv/person]								
	1h	8h	1 day	3 days	1 week	2 weeks	1 month	40 days	4 months
BE-BI-1st	2.3	1.8	1.4	0.9	0.8	0.65	0.53	0.47	0.25
BE-BI-2nd	1.5	1.15	0.9	0.7	0.6	0.5	0.4	0.34	0.18
BE-BI-3rd	1.5	1.15	0.9	0.7	0.6	0.5	0.4	0.34	0.18
Collective Dose [mSv] – '3 persons'	**5.3**	**4.1**	**3.2**	**2.3**	**1.95**	**1.62**	**1.3**	**1.15**	**0.61**

Possible solution to allow to perform the intervention during the TS and avoiding the ALARA committee: add a further BE-BI specialist to share the work required for the repair of the BI equipment. In that case a minimum waiting time of 3 days required; the collective dose will not significantly change.