

# Resource estimation to carry out the instrument installation and cold commissioning

Antonio Bianchi  
NSS Installation coordinator  
NSS Project Division

[www.europeanspallationsource.se](http://www.europeanspallationsource.se)

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# Resource discussion during IKON 14 (first 8 instruments)



INSTR.	RESOURCES
<b>BEER</b>	Each staff by NPI suppliers + 2-6 people from HZG (minimum ESS support) Most of the personnel for cave and shielding installation will be provided by NPI suppliers Guide alignment will be part of the contract with manufacturer. For cold and hot commissioning ESS technical groups support
<b>C SPEC</b>	1 Tech each from TUM & 1 from LLB Lead scientist and Engineer Guide, Chopper, and Experimental Cave will be installed by Manufacturer. Beamline shielding, beam stop, cable routing, monitors, collimators, sample equipment, detectors, and cadmium will be installed by CSPEC team (or subcontracted)
<b>BIFROST</b>	DTU – cave fit-out, LLB – choppers, guides by suppliers. ESS support for heavy work (lifting, rigging, ..) & MCA
<b>MAGIC</b>	Instrument teams within 3 - 4 permanently on site
<b>LOKI</b>	Lead Scientist, Lead Engineer, ESS Installation engineer and maximum ESS effort
<b>ESTIA</b>	ESS support with various expertise equal to 2.6 person years (PY) from ESS employees/contractors (Survey & Alignment, Electric Installation, Mechanic Installation, Craning, Workshop Machining, ICS/MCA, PSS, Plumber, DMSC)
<b>ODIN</b>	Lead Scientist (TUM) , 2 Lead Engineers (TUM and PSI), Chopper and Guide company installation teams. Cave interior company installation team. Minor support from ESS required (Survey, ES&H, integration...)
<b>DREAM</b>	Lead Scientist and Lead Engineer from JCNS: Mikhail + 1 Engineer + (2 technicians) shared with other JCNS instruments. LLB : (Lead Engineer+ 2 technicians) shared with 4 other LLB instruments

# Resource prediction status



- The approved Master Schedule takes into account Instruments teams predictions in term of installation time (in-Bunker components, from Bunker to cave, Exp. Cave and cave fit-out...);
- Required resources for instrument installation is still an on-going exercise and it has been partly implemented or not implemented yet from the instruments team;
- Manpower can change significantly according to many factors, like instrument class, length, complexity and amount of components, skills of personnel involved, installation environment, etc... etc.

- Even if any instrument installation plan will include the final estimation about the total amount of resources, since now it can be useful to share our thoughts about “labour” predictions, in order to identify a reliable “order of magnitude”;
- Scope of this estimation is to identify a “*range of FTEs*” necessary to successfully carry out the Phase 4 according to the defined Master Schedule;
- It is also useful to maintain a proper budget to complete the installation and c.c. phase;

- The resource estimation included in this presentation takes into account only the “**Instrument scope of work**” as defined since the scope setting meeting and according to the **T.A.**;
- It includes all the instruments **W.U.** as defined since the scope setting meeting;
- The assumptions take into account different parameters, according to the specific work units;
- Results significantly different from the range provided in this estimation has to be analysed in detail;

# Assumptions and exclusions



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## Assumptions

1 FTE equals to 1.800 working hours

The estimation takes into account both installation and cold commissioning (the whole Phase 4)

*1st category: all the west sector instruments*

*2nd category: medium length Instruments Dream, Vespa, Skadi*

*3rd category: short instruments (Odin, Estia, Loki, Freia)*

## Exclusions

NSS and In Kind Management staff (Coordinators, Lead Scientist, Lead Engineer)

NSS Technology Group support staff for quality assurance/control

Temporary equipment (it is a labour estimation)

Data Acquisition and Analysis Work Unit (ESS scope)

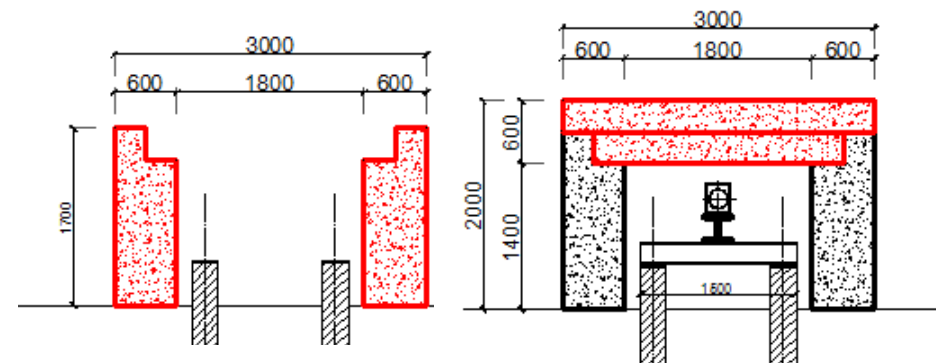
Vacuum Work Unit (ESS scope)

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# Work Unit 1 - Installation of Shielding (and cave structure)

General resource estimation for instrument installation and c.c. (labour)		N.	1st Category West Sector Instr.		2nd Category Dream Vespa Skadi		3rd Category Odin Estia, Loki Freia	
			Work Hours	Total W.H.	Work Hours	Total W.H.	Work Hours	Total W.H.
Description			h	h	h	h	h	h
<b>1.1</b>	<b>Outside the Bunker</b>							
1.1.1	Skilled Technical personnel (Mech. Tech.)	2	520	1040	320	640	240	480
1.1.2	Crane Operator, incl. tempor. cranes	1	520	520	320	320	240	240
1.1.3	Rigger	1	520	520	320	320	240	240
1.1.4	Surveyor	2	80	160	60	120	40	80
1.1.5	Handling/Forklift Operator	1	520	520	320	320	240	240
1.1.6	Support Technical staff	1	80	80	60	60	40	40
<b>1.2</b>	<b>Inside the Bunker</b>							
	Not applicable		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
<b>Sum WU 1</b>				2840		1780		1320
<b>FTE</b>				<b>1.58</b>		<b>0.99</b>		<b>0.73</b>

- Ex cave shielding (pre-cast blocks) - 4 weeks (160 hours)
- Beamline shielding 15m /week (9 weeks in total) - category 1
- Beamline shielding 15m /week (4 weeks in total) - category 2
- Beamline shielding 15m /week (2 weeks in total) - category 3
- Surveying - 2 technicians plus tracker marking limit of shielding and cave footprint - marking before drilling - 80 hours in total west sector



# Work Unit 2 - Installation of Neutron Optics

General resource estimation for instrument installation and c.c. (labour)		1st Category West Sector Instr.		2nd Category Dream Vespa Skadi		3rd Category Odin Estia, Loki Freia		
		N.	Work Hours	Total W.H.	Work Hours	Total W.H.	Work Hours	Total W.H.
Description			h	h	h	h	h	
<b>Outside the Bunker</b>								
2.1.1	Skilled Technical personnel	2	520	1040	200	400	120	240
2.1.2	Crane Operator, incl. tempor. cranes	1	160	160	100	100	80	80
2.1.3	Rigger	1	160	160	100	100	80	80
2.1.4	Surveyor	1	160	160	60	60	60	60
2.1.5	Handling/Forklift Operator	1	80	80	60	60	60	60
2.1.6	Support Technical staff	1	160	160	60	60	60	60
<b>Inside the Bunker</b>								
2.2.1	Skilled Technical personnel	2	120	240	100	200	80	160
2.2.2	Crane Operator, incl. tempor. cranes	1	40	40	20	20	20	20
2.2.3	Rigger	1	40	40	20	20	20	20
2.2.4	Surveyor	1	40	40	40	40	40	40
2.2.5	Handling/Forklift Operator	1	40	40	40	40	40	40
2.2.6	Support Technical staff	1	40	40	40	40	40	40
<b>Sum WU 2</b>				<b>2200</b>		<b>1140</b>		<b>900</b>
<b>FTE</b>				<b>1.22</b>		<b>0.63</b>		<b>0.50</b>

Light shutter (BBG) and NBEX already installed

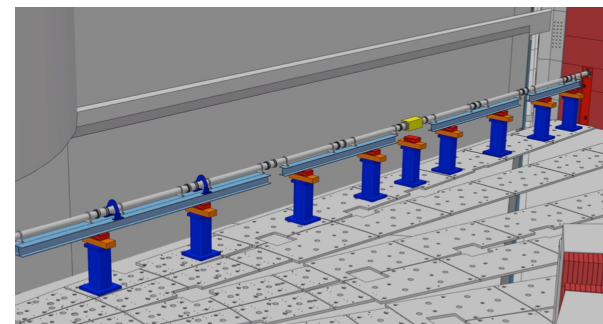
Outside the bunker: 130 m - 1st category (13 weeks required)

Outside the bunker: 50 m - 2nd category (5 weeks required)

Outside the bunker: 30 m - 3rd category (3 weeks required)

Prediction: 10 m/week (all inclusive of supports, guides, vacuum housing, alignment...)

Inside the bunker (and feedtrough): 22m (2-3 weeks)



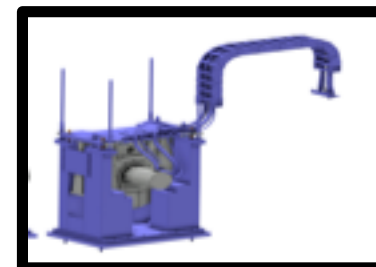


# Work Unit 3 - Installation of Choppers

General resource estimation for instrument installation and c.c. (labour)		1st Category West Sector Instr.		2nd Category Dream Vespa Skadi		3rd Category Odin Estia, Loki Freia		
		N.	Work Hours	Total W.H.	Work Hours	Total W.H.	Work Hours	Total W.H.
Description			h	h	h	h	h	
<b>3.1</b>	<b>Outside the Bunker</b>							
3.1.1	Skilled Technical personnel	2	210	420	210	420	210	420
3.1.2	Crane Operator, incl. tempor. Cranes	1	24	24	24	24	24	24
3.1.3	Rigger	1	24	24	24	24	24	24
3.1.4	Surveyor	1	12	12	12	12	12	12
3.1.5	Handling/Forklift Operator	1	8	8	8	8	8	8
3.1.6	Support Technical staff	1	8	8	8	8	8	8
<b>3.2</b>	<b>Inside the Bunker</b>							
3.2.1	Skilled Technical personnel	2	210	420	210	420	210	420
3.2.2	Crane Operator, incl. tempor. cranes	1	24	24	24	24	24	24
3.2.3	Rigger	1	24	24	24	24	24	24
3.2.4	Surveyor	1	12	12	12	12	12	12
3.2.5	Handling/Forklift Operator	1	8	8	8	8	8	8
3.2.6	Support Technical staff	1	8	8	8	8	8	8
<b>Sum WU 3</b>				992		992		992
<b>FTE</b>				<b>0.55</b>		<b>0.55</b>		<b>0.55</b>

Assumed 6 choppers in total, n. 3 choppers out of bunker/ n. 3 inside the bunker

1 week /chopper (n. 2 Technicians) mechanical installation (70 hours/week including ICS and control racks)

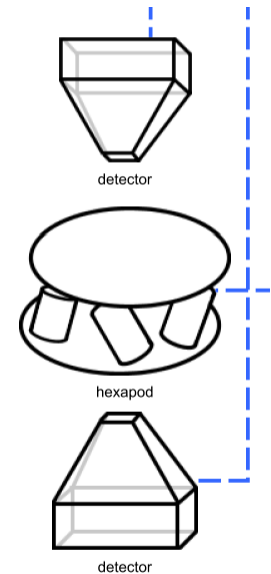


# Work Unit 4 - Installation of Sample Environment

General resource estimation for instrument installation and c.c. (labour)		1st Category West Sector Instr.		2nd Category Dream Vespa Skadi		3rd Category Odin Estia, Loki Freia		
		N.	Work Hours	Total W.H.	Work Hours	Total W.H.	Work Hours	Total W.H.
Description			h	h	h	h	h	
<b>4.1</b>	<b>Outside the Bunker</b>							
4.1.1	Skilled Technical personnel	2	160	320	160	320	160	320
4.1.2	Crane Operator, incl. tempor. cranes	1	40	40	40	40	40	40
4.1.3	Rigger	1	40	40	40	40	40	40
4.1.4	Surveyor	1	80	80	80	80	80	80
4.1.5	Handling/Forklift Operator	1	40	40	40	40	40	40
4.1.6	Support Technical staff	1	40	40	40	40	40	40
<b>4.2</b>	<b>Inside the Bunker</b>							
	Not applicable		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
				560		560		560
				<b>0.31</b>		<b>0.31</b>		<b>0.31</b>

# Work Unit 5 - Detectors and Beam Monitors

General resource estimation for instrument installation and c.c. (labour)		1st Category West Sector Instr.		2nd Category Dream Vespa Skadi		3rd Category Odin Estia, Loki Freia		
		N.	Work Hours	Total W.H.	Work Hours	Total W.H.	Work Hours	Total W.H.
Description			h	h	h	h	h	
<b>5.1</b>	<b>Outside the Bunker</b>							
5.1.1	Skilled Technical personnel	3	960	2880	960	2880	960	2880
5.1.2	Crane Operator, incl. tempor. cranes	1	40	40	40	40	40	40
5.1.3	Rigger	1	40	40	40	40	40	40
5.1.4	Surveyor	1	80	80	80	80	80	80
5.1.5	Handling/Forklift Operator	1	40	40	40	40	40	40
5.1.6	Support Technical staff	1	40	40	40	40	40	40
<b>5.2</b>	<b>Inside the Bunker</b>							
5.2.1	Skilled Technical personnel	2	40	80	40	80	40	80
5.2.2	Crane Operator, incl. tempor. cranes	1	4	4	4	4	4	4
5.2.3	Rigger	1	4	4	4	4	4	4
5.2.4	Surveyor	1	0	0	0	0	0	0
5.2.5	Handling/Forklift Operator	1	4	4	4	4	4	4
5.2.6	Support Technical staff	1	16	16	16	16	16	16
<b>Sum WU5</b>				3228		3228		3228
<b>FTE</b>				<b>1.79</b>		<b>1.79</b>		<b>1.79</b>



Largely dependent from Instrument category (instrument length not relevant)

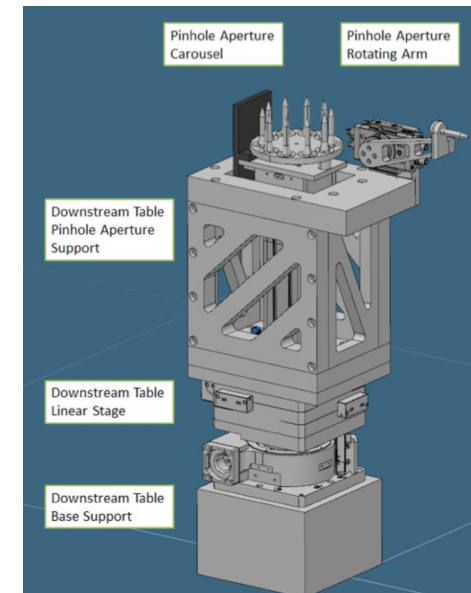
Cold commissioning will take more effort than installation (30% installation / 70 % c.c.)

Indication from Detector group for c.c. (3 technicians x 6 months)

# Work Unit 7 - Motion Control and Automation

General resource estimation for instrument installation and c.c. (labour)		1st Category West Sector Instr.		2nd Category Dream Vespa Skadi		3rd Category Odin Estia, Loki Freia		
		N.	Work Hours	Total W.H.	Work Hours	Total W.H.	Work Hours	Total W.H.
Description			h	h	h	h	h	
<b>7.1</b>	<b>Outside the Bunker</b>							
7.1.1	Skilled Technical personnel	2	320	640	320	640	320	640
7.1.2	Crane Operator, incl. tempor. cranes	1	0	0	0	0	0	0
7.1.3	Rigger	1	0	0	0	0	0	0
7.1.4	Surveyor	1	32	32	32	32	32	32
7.1.5	Handling/Forklift Operator	1	40	40	40	40	40	40
7.1.6	Support Technical staff	1	40	40	40	40	40	40
<b>7.2</b>	<b>Inside the Bunker</b>							
7.2.1	Skilled Technical personnel	2	80	160	80	160	80	160
7.2.2	Crane Operator, incl. tempor. cranes	1	0	0	0	0	0	0
7.2.3	Rigger	1	0	0	0	0	0	0
7.2.4	Surveyor	1	0	0	0	0	0	0
7.2.5	Handling/Forklift Operator	1	16	16	16	16	16	16
7.2.6	Support Technical staff	1	16	16	16	16	16	16
<b>Sum WU 7</b>				944		944		944
<b>FTE</b>				<b>0.52</b>		<b>0.52</b>		<b>0.52</b>

Installation includes cables and control cabinets (cable trays is part of the infrastructure)  
 8 hours / axis for cold commissioning (30 axis average)



# Work Unit 8 - Instruments Specific Technical Equipment

General resource estimation for instrument installation and c.c. (labour)		N.	1st Category West Sector Instr.		2nd Category Dream Vespa Skadi		3rd Category Odin Estia, Loki Freia	
			Work Hours	Total W.H.	Work Hours	Total W.H.	Work Hours	Total W.H.
Description			h	h	h	h	h	h
<b>8.1</b>	<b>Outside the Bunker</b>							
8.1.1	Skilled Technical personnel	2	320	640	320	640	320	640
8.1.2	Crane Operator, incl. tempor. cranes	1	80	80	60	60	40	40
8.1.3	Rigger	1	80	80	60	60	40	40
8.1.4	Surveyor	1	16	16	16	16	16	16
8.1.5	Handling/Forklift Operator	1	16	16	16	16	16	16
8.1.6	Support Technical staff	1	16	16	16	16	16	16
<b>8.2</b>	<b>Inside the Bunker</b>							
8.2.1	Skilled Technical personnel	2	80	160	80	160	80	160
8.2.2	Crane Operator, incl. tempor. cranes	1	16	16	16	16	16	16
8.2.3	Rigger	1	16	16	16	16	16	16
8.2.4	Surveyor	1	16	16	16	16	16	16
8.2.5	Handling/Forklift Operator	1	16	16	16	16	16	16
8.2.6	Support Technical staff	1	16	16	16	16	16	16
<b>Sum WU 8</b>				1088		1048		1008
<b>FTE</b>				<b>0.60</b>		<b>0.58</b>		<b>0.56</b>

Largely dependent from the specific instrument. In many cases it will require more resources

# Work Unit 9 - Instrument Infrastructure

General resource estimation for instrument installation and c.c. (labour)		1st Category West Sector Instr.		2nd Category Dream Vespa Skadi		3rd Category Odin Estia, Loki Freia		
		N.	Work Hours	Total W.H.	Work Hours	Total W.H.	Work Hours	Total W.H.
Description			h	h	h	h	h	
<b>9.1</b>	<b>Outside the Bunker</b>							
9.1.1	Skilled Technical personnel	3	480	1440	320	960	480	
9.1.2	Crane Operator, incl. tempor. cranes	1	24	24	24	24	24	
9.1.3	Rigger	1	24	24	24	24	24	
9.1.4	Surveyor	1	16	16	16	16	16	
9.1.5	Handling/Forklift Operator	1	80	80	80	80	80	
9.1.6	Support Technical staff	1	160	160	80	80	80	
<b>9.2</b>	<b>Inside the Bunker</b>							
9.2.1	Skilled Technical personnel	3	80	240	60	180	120	
9.2.2	Crane Operator, incl. tempor. cranes	1	16	16	8	8	8	
9.2.3	Rigger	1	16	16	8	8	8	
9.2.4	Surveyor	1	0	0	0	0	0	
9.2.5	Handling/Forklift Operator	1	8	8	8	8	8	
9.2.6	Support Technical staff	1	16	16	16	16	16	
				<b>Sum WU 9</b>		2040	1404	864
				<b>FTE</b>		<b>1.13</b>	<b>0.78</b>	<b>0.48</b>

power, pipes, cable trays, control hutch structure, local cranes...  
Instrument length partly relevant.....

# Work Unit 11 - Personnel Safety System



General resource estimation for instrument installation and c.c. (labour)		1st Category West Sector Instr.		2nd Category Dream Vespa Skadi		3rd Category Odin Estia, Loki Freia		
		N.	Work Hours	Total W.H.	Work Hours	Total W.H.	Work Hours	Total W.H.
Description			h	h	h	h	h	
<b>11.1</b>	<b>Outside the Bunker</b>							
11.1.1	Skilled Technical personnel	3	480	1440	320	960	160	480
11.1.2	Crane Operator, incl. tempor. cranes	1	0	0	0	0	0	0
11.1.3	Rigger	1	0	0	0	0	0	0
11.1.4	Surveyor	1	0	0	0	0	0	0
11.1.5	Handling/Forklift Operator	1	80	80	80	80	80	80
11.1.6	Support Technical staff	1	80	80	80	80	80	80
<b>11.2</b>	<b>Inside the Bunker</b>							
11.2.1	Skilled Technical personnel	3	80	240	80	240	80	240
11.2.2	Crane Operator, incl. tempor. cranes	1	40	40	40	40	40	40
11.2.3	Rigger	1	40	40	40	40	40	40
11.2.4	Surveyor	1	0	0	0	0	0	0
11.2.5	Handling/Forklift Operator	1	80	80	80	80	80	80
11.2.6	Support Technical staff	1	80	80	80	80	80	80
	<b>Sum WU 11</b>			2080		1600		1120
	<b>FTE</b>			<b>1.16</b>		<b>0.89</b>		<b>0.62</b>

Indication from ICS Division (3 Technicians for 3 months - Skilled personnel)

# Conclusion

Summary - Instrument Installation and cold commissioning (PHASE 4)	1st Category West Sector Instr.		2nd Category Dream Vespa Skadi		3rd Category Odin Estia, Loki Freia	
	%	Total W.H.	%	Total W.H.	%	Total W.H.
Manpower estimation	h	h	h	h	h	h
Management (Lead scientist - Lead Engineer)						
Work Unit 1 - Shielding	18%	2840	14%	1780	12%	1320
Work Unit 2 - Neutron Optics	14%	2200	9%	1140	8%	900
Work Unit 3 - Choppers (n. 6 choppers)	6%	992	8%	992	9%	992
Work Unit 4 - Sample Environment	4%	560	4%	560	5%	560
Work Unit 5 - Detectors and Beam Monitors (average complexity)	20%	3228	25%	3228	30%	3228
Work Unit 6 - Data Acquisition and Analysis (ESS scope)	0%	0	0%	0	0%	0
Work Unit 7 - Motion Control and Automation	6%	944	7%	944	9%	944
Work Unit 8 - Instruments Specific Technical Equipment	7%	1088	8%	1048	9%	1008
Work Unit 9 - Instrument Infrastructure	13%	2040	11%	1404	8%	864
Work Unit 10 - Vacuum (ESS scope)	0%	0	0%	0	0%	0
Work Unit 11 - Personnel Safety System	13%	2080	13%	1600	10%	1120
Overall Amount	100%	15972	100%	12696	100%	10936
<b>FTE</b>		<b>8.87</b>		<b>7.05</b>		<b>6.08</b>
<b>Hours</b>		<b>15972</b>		<b>12696</b>		<b>10936</b>