

Neutron Scattering Systems Project Update

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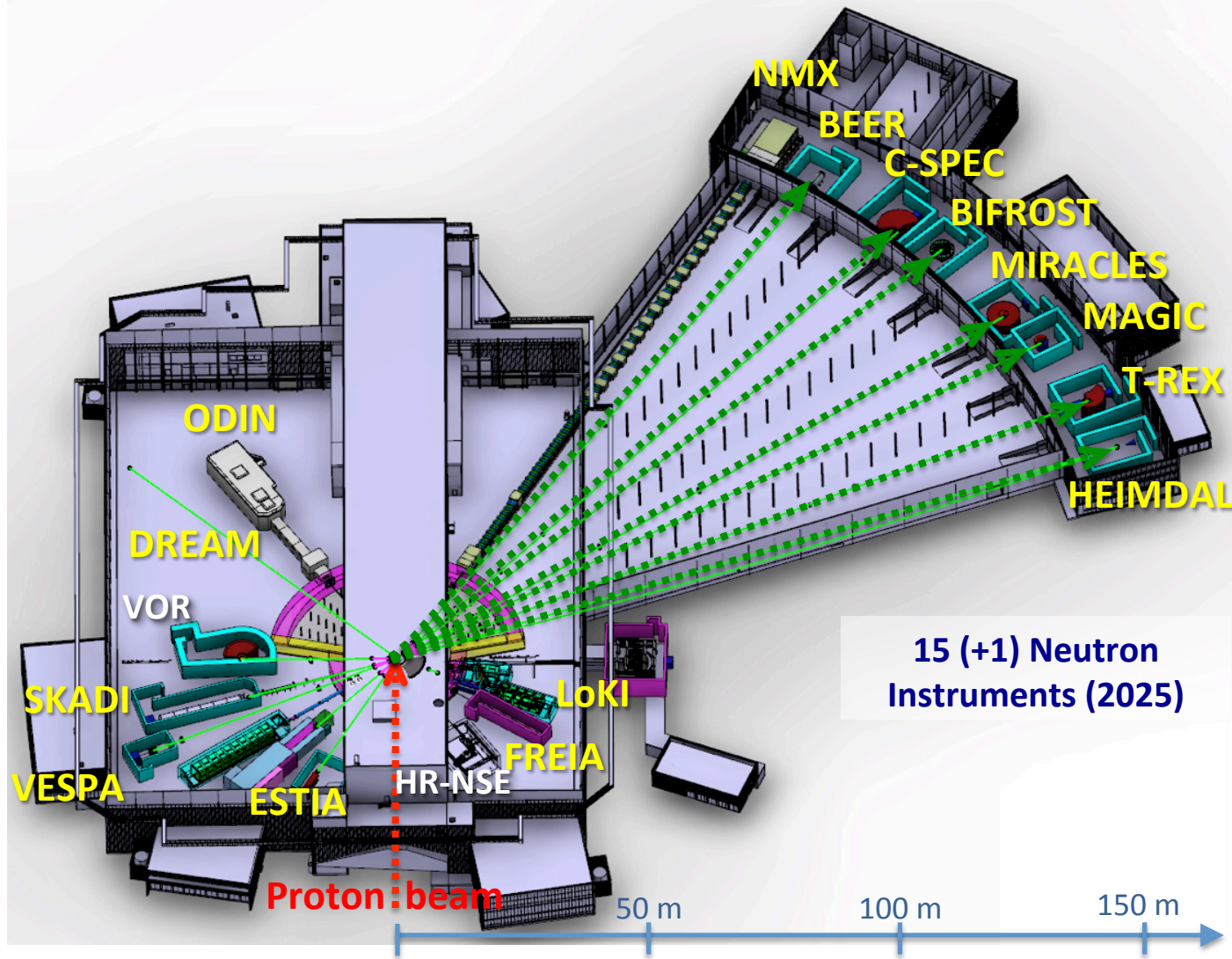
Overview NSS

- In the last year NSS has moved from concept development into project delivery
- All major In Kind partners needed for success are now actively participating
- In- Kind partners will deliver most of the neutron instruments and contribute to enabling developments (detectors, data processing, control systems and sample environment)
- NSS faces major budgetary challenges in 2016

The ESS Neutron Instruments

Instruments 1-16 to be delivered by NSS construction project.

Instruments 17-22 to be delivered during initial operations (up to 2028).



Instrument Layout (Jan 2016)

NSS Organization

1. The In-Kind Delivery model

NSS total budget (ring-fenced) = 350 M€

NSS In-Kind Target (65%) = 227,5 M€

Ring-fenced means nothing comes in, nothing goes out
= NSS project must manage our own budget risk.
= NSS needs robust contingency of its own.

- In-Kind Collaborators – deliver most of the suite of instruments, most of bunker + contribution to sample environments, Key technologies, DMSC and competency development (= 227,5 M€)
- NSS-Lund (= 122,5 M€):
 - Coordinate NSS Project and develop competencies for operations.
 - Provide integrated scientific, engineering and safety infrastructure.
 - Collaborate on instruments.

NSS Partners for construction



Partner Institutes:

Czech Republic: NPI

Denmark: Aarhus University, DTU, KU, Roskilde University

Estonia: Tartu University

France: LLB (CEA-CNRS)

Germany: FZJ, HZG, TUM

Hungary: Wigner Institute, Centre for Energy Research

Italy: CNR (Perugia and Milano University)

Norway: IFE, Bergen University

Spain: ESS Bilbao

Sweden: LU, LiU, UU, KTH

Switzerland: PSI

United Kingdom: STFC

Major In-Kind Contributions to NSS: The Neutron Beam Instruments



Instrument class	Neutron Instrument	Lead Partner(s)	cost (M€)	% IK Target
Large scale structures	LOKI broadband SANS	ISIS (UK)	12.2	94%
	SKADI general-purpose SANS (note 1)	FZJ (DE)	12	100%
	ESTIA focusing reflectometer	PSI (CH)	9	100%
	FREIA liquids reflectometer	ISIS (UK)	9	100%
Diffraction	NMX macromolecular crystallography	ESS	11.7	70%
	DREAM powder diffractometer (bispectral)	FZJ (DE)	12	100%
	HEIMDAL hybrid diffractometer	AU (DK)	12	70%
	MAGIC magnetism single-crystal diffractometer	LLB (FR)	12	100%
Engineering	BEER engineering diffractometer	HZG (DE) + NPI (CZ)	12	100%
	ODIN multi-purpose imaging	TUM (DE) + PSI (CH)	9	90%
Spectroscopy	C-SPEC cold chopper spectrometer	TUM (DE)	15	100%
	BIFROST extreme-environments spectrometer	DTU (DK)	12	71%
	T-REX bispectral chopper spectrometer	FZJ (DE)	15	100%
	VESPA vibrational spectroscopy	CNR (IT)	12	100%
	MIRACLES backscattering spectrometer	ESS-Bilbao (ES)	12	95%
	16th Instrument (VOR or NSE)	TBD	12	90%
16 instruments (cost)			188.9	92.5%

Provisional total budget = 188.9 M€

In-Kind Target 92.5 %

Estimated additional ESS commitment to instruments 51 M€ (including guide bunker & ICS contributions)

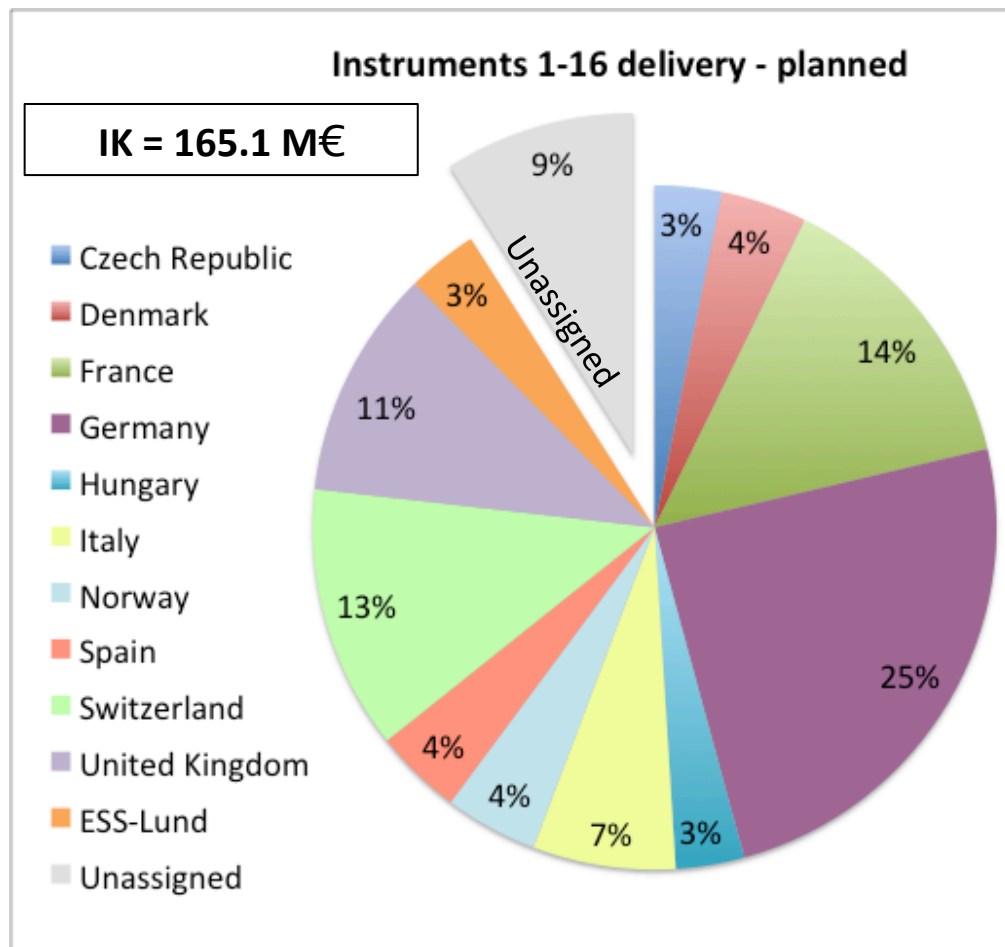
¹Includes SONDE funded detector development, worth ~ 1.5 - 2 M€

Contributions to Neutron Instruments Country Summary

Partner Country	Commitment to Instruments (M€)	% of Instrument budget
Czech Republic	6.0	3.2%
Denmark	7.7	4.1%
France	26.6	14.1%
Germany	46.2	24.5%
Hungary	6.1	3.2%
Italy	12.8	6.8%
Norway	7.8	4.2%
Spain	7.8	4.1%
Switzerland	23.6	12.5%
United Kingdom	20.5	10.8%
ESS-Lund	6.3	3.3%
Unassigned	17.5	9.3%
total	188.9	100%

Main unassigned scope

- 16th Instrument (6th Spectrometer)
- 25% each of VESPA & MIRACLES
- 6% of NMX



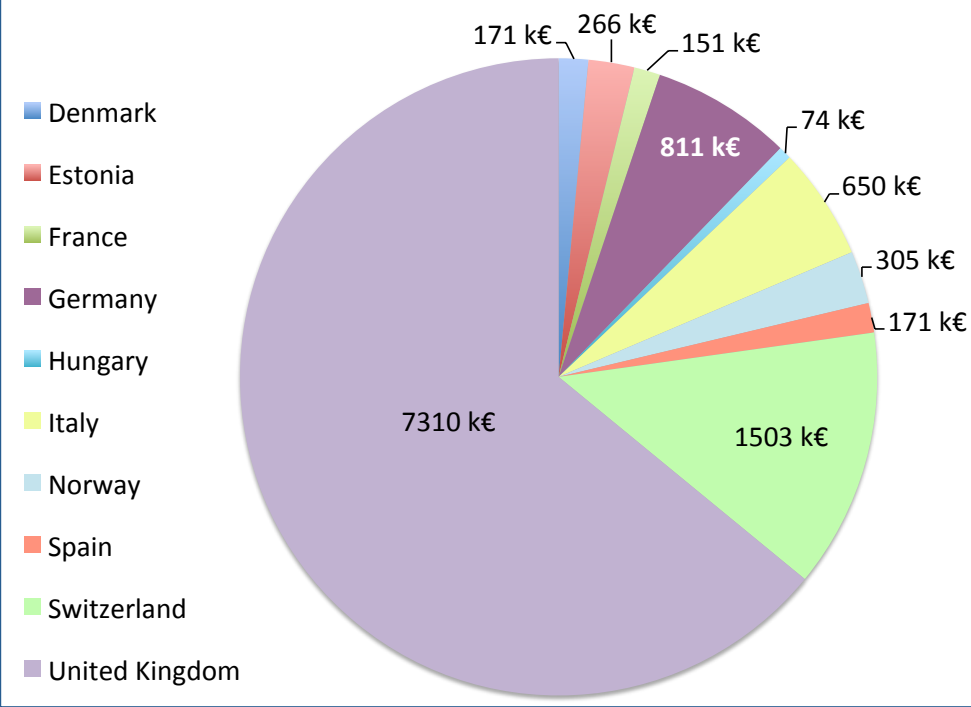
NSS other In-Kind Contributions Country Summary

Main IK items outside of Instrument delivery

- Experiment control systems (PSI) 1.5 M€
- BandGEM detectors (CNR) 0.5 M€
- Data reduction & streaming (STFC) 3.3 M€
- Detector readout system (STFC) 3.0 M€
- User Laboratories (STFC) 1.0 M€
- Other contributions (EE, DK...) 2.1 M€

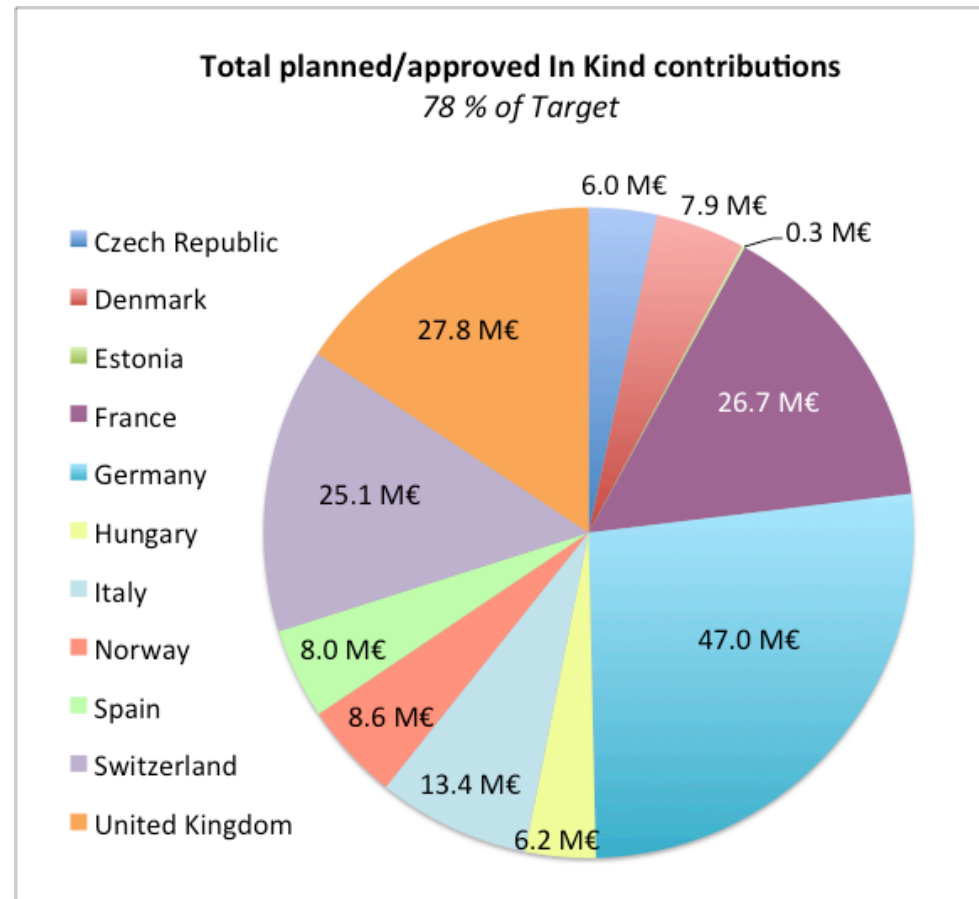
Total value 11.4 M€

Other planned/approved In Kind contributions: 11.4 M€



NSS total In-Kind Contributions Country Summary

Partner Country	Potential value (M€)	Committed to NSS (M€)	% of potential commitment to NSS
Czech Republic	11.3	6.0	53%
Denmark	7.9	7.9	100%
Estonia	0.5	0.3	53%
France	35.0	26.7	76%
Germany	93.0	47.0	51%
Hungary	8.0	6.2	77%
Italy	20.1	13.4	67%
Norway	12.0	8.2	68%
Spain	32.5	8.0	25%
Switzerland	41.0	25.1	61%
United Kingdom	31.4	27.8	89%
total	292.6	176.5	



Total Value assigned = 176.5 M€

NSS In-Kind Contributions under Discussion

Country Summary



Main IK items under discussion

• 16 th Instrument	12 M€
• 25% VESPA	3 M€
• 25% MIRACLES	3 M€
• 6% NMX	0.7 M€
• Neutron Guide Bunker	12 M€
• Other non-instrument	~ 4.5 M€

Total IK Value assigned = 176.5 M€

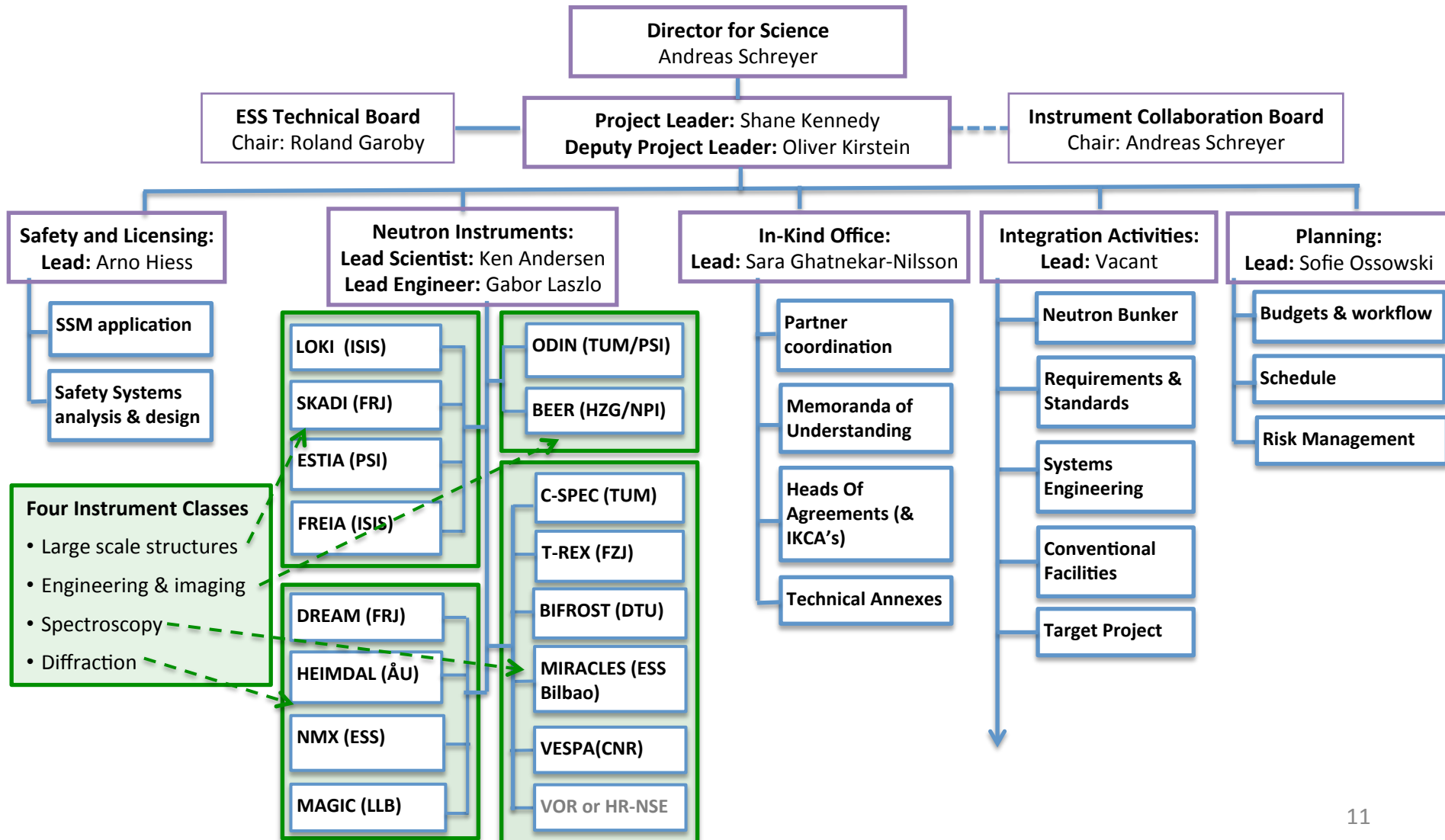
Value of IK contributions under discussion = 35.2 M€

Total (assigned + discussed) = 211.7 M€

- This would bring NSS to ~ 93 % of target (enough for this stage of the project).
- Plan to keep ~7 % in contingency, and reassess later.

NSS Organization

2. Project management



Potential order of commencement of operation of first 8 instruments (August 2023)

2nd Annual Review Recommendation (0.5)

Prioritisation of instruments within budget must ensure that the first tranche of instruments (8) is ready to deliver world-class science at the start of user operations (2023)

Matching early success in delivery of scientific outputs with the capacity of Lead In-Kind partners to deliver on schedule (ISIS, PSI, FZJ, LLB, HZG/NPI, TUM/PSI, TUM/LLB & DTU lead consortium).

Instrument Class	Sub-class	Candidates
Large Scale Structures	Small Angle Scattering	LOKI (ISIS) or SKADI (FZJ)
	Reflectometry	ESTIA (PSI) or FREIA (ISIS)
Diffraction	Powder Diffraction	DREAM (FZJ) or HEIMDAL (ÅU)
	Single crystal diffraction	MAGIC (LLB) or NMX (ESS)
Engineering	Strain scanning	BEER (HZG/NPI)
	Imaging and tomography	ODIN (TUM/PSI)
Spectroscopy	Direct Geometry	C-SPEC (TUM) or T-REX (FZJ)
	Indirect Geometry	BIFROST (DTU) , MIRACLES (Bilbao), VESPA (CNR)

Instruments in Bold type to be operational by Aug 2023

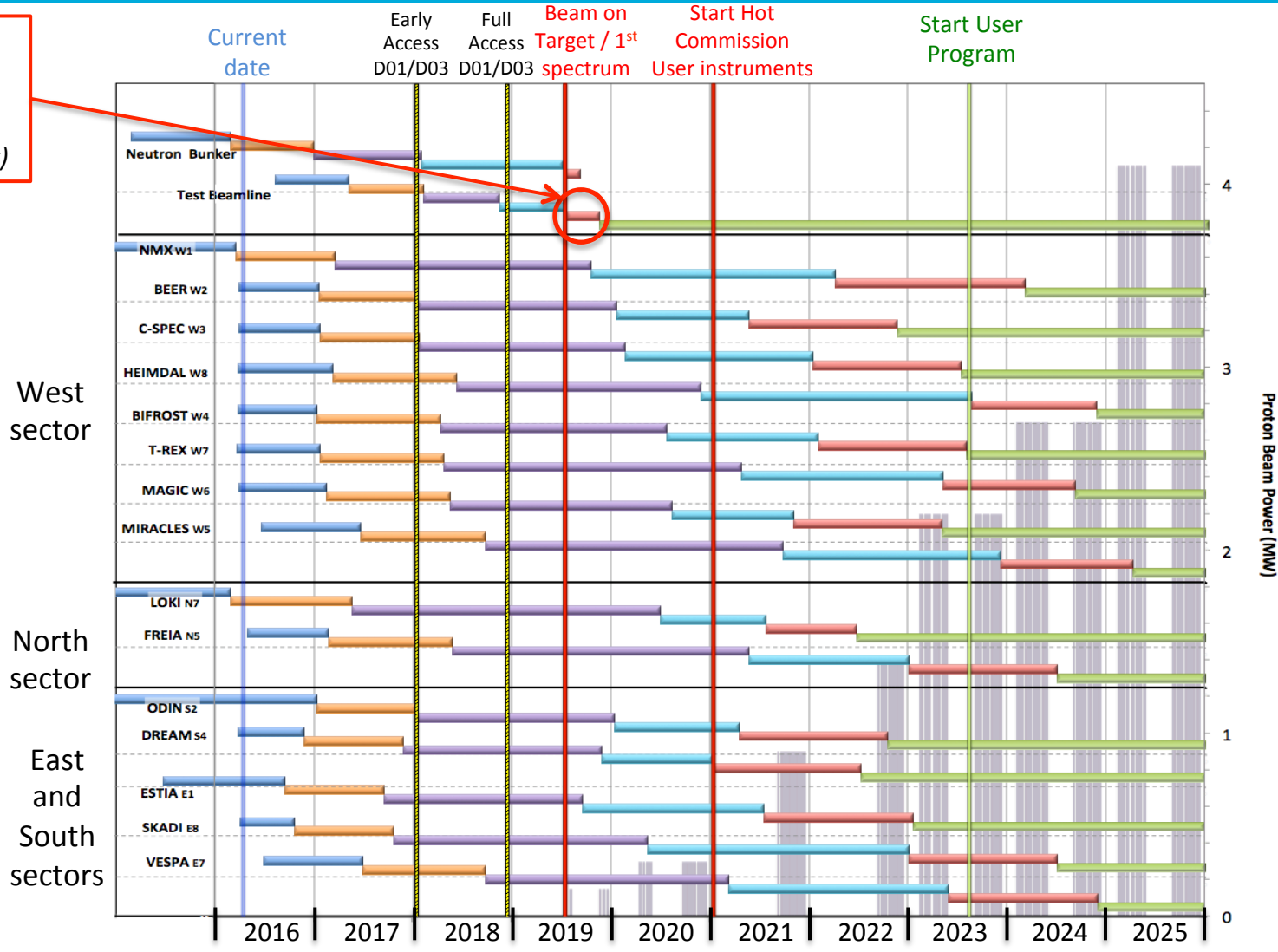
Neutron Beam Instrument Draft Schedule

V1.6, 7th April 2016

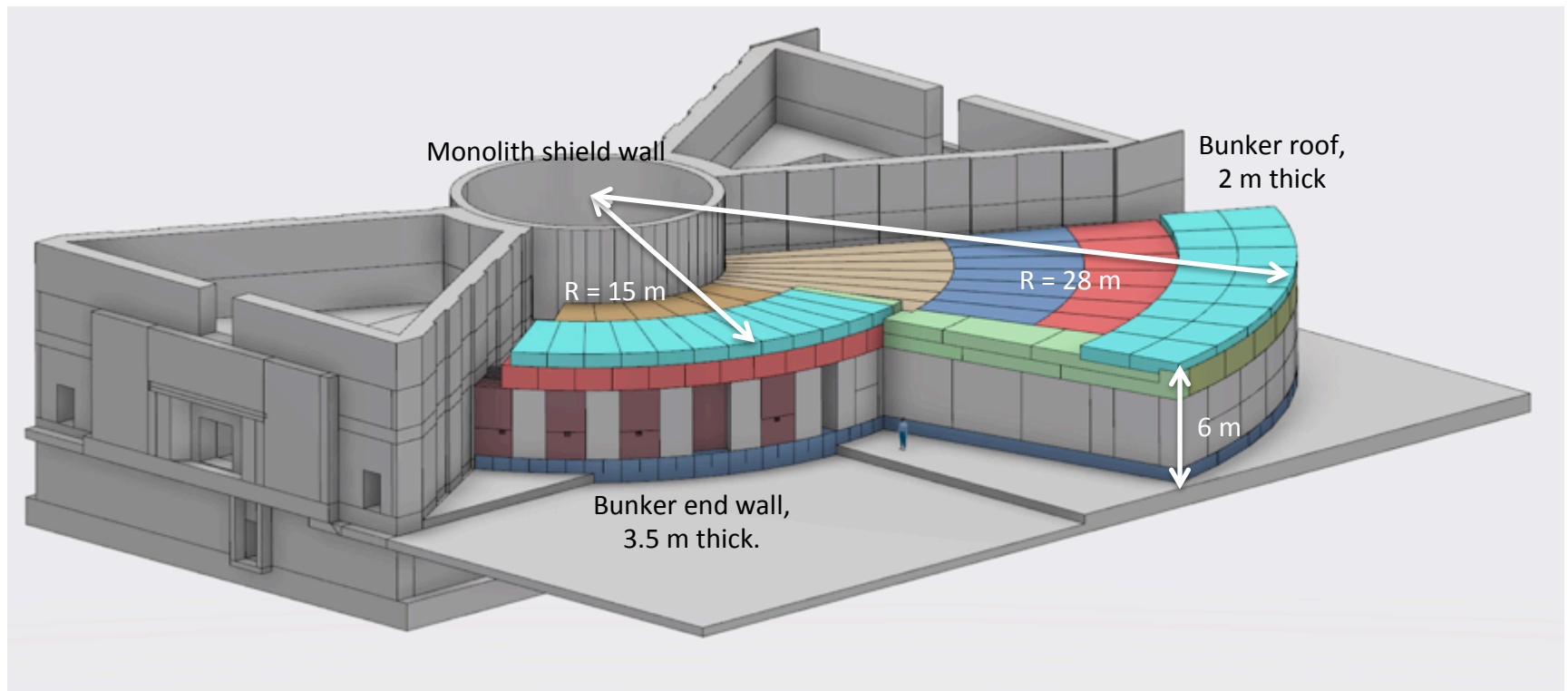
Commissioning of test beam
– to demonstrate performance
and inform instrument projects
(test beamline not yet in budget)

Notes;

- The order of completion 1- 8 chosen for science and deliverability
- Shift 9-16 to focus on 1-8 for early science success
- HC start;
 - E ≥ 200 MeV
 - P ≥ 200 kW
 - January 2021

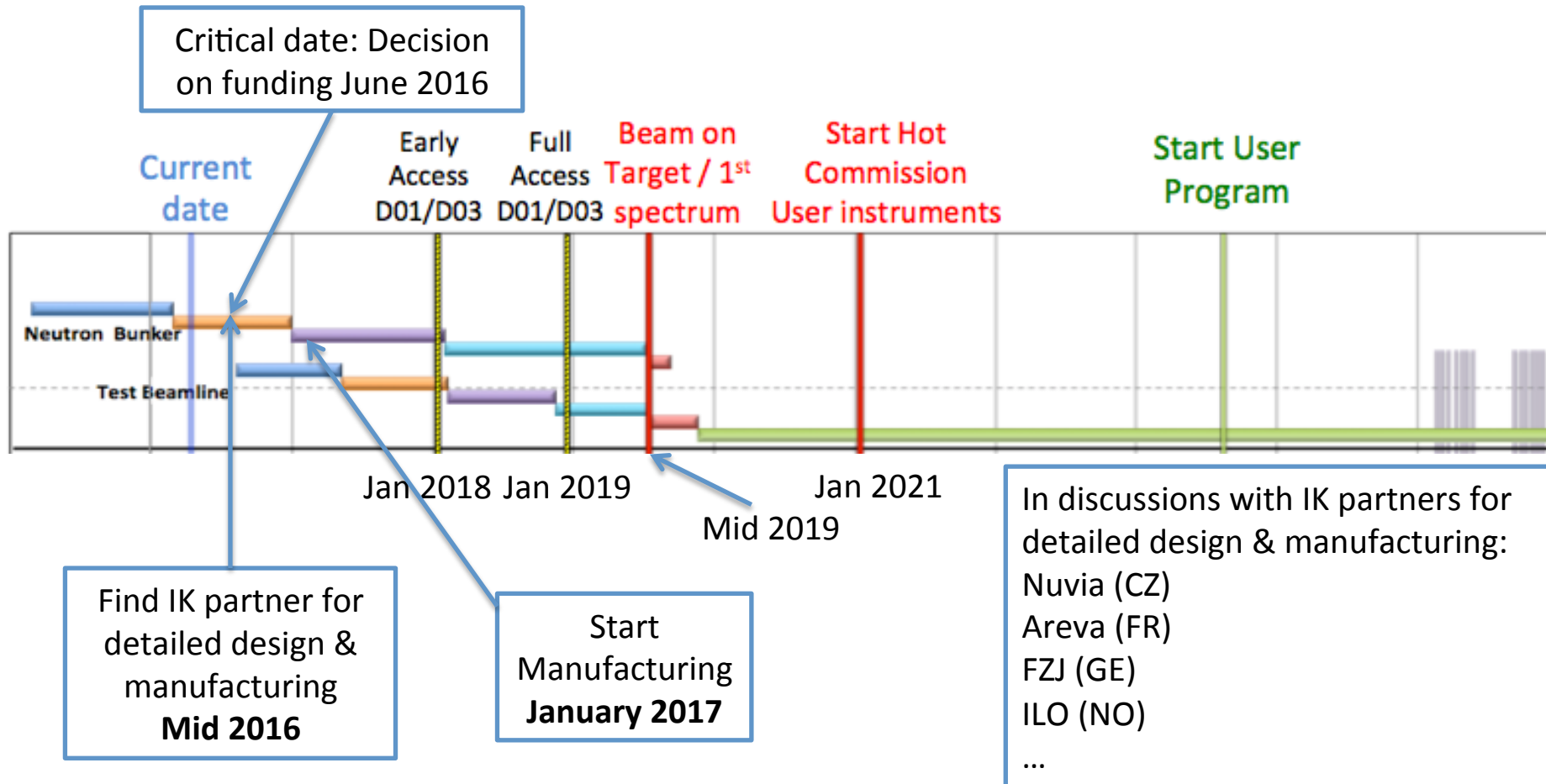


The Neutron Bunker (Budget = 14.6 M€)



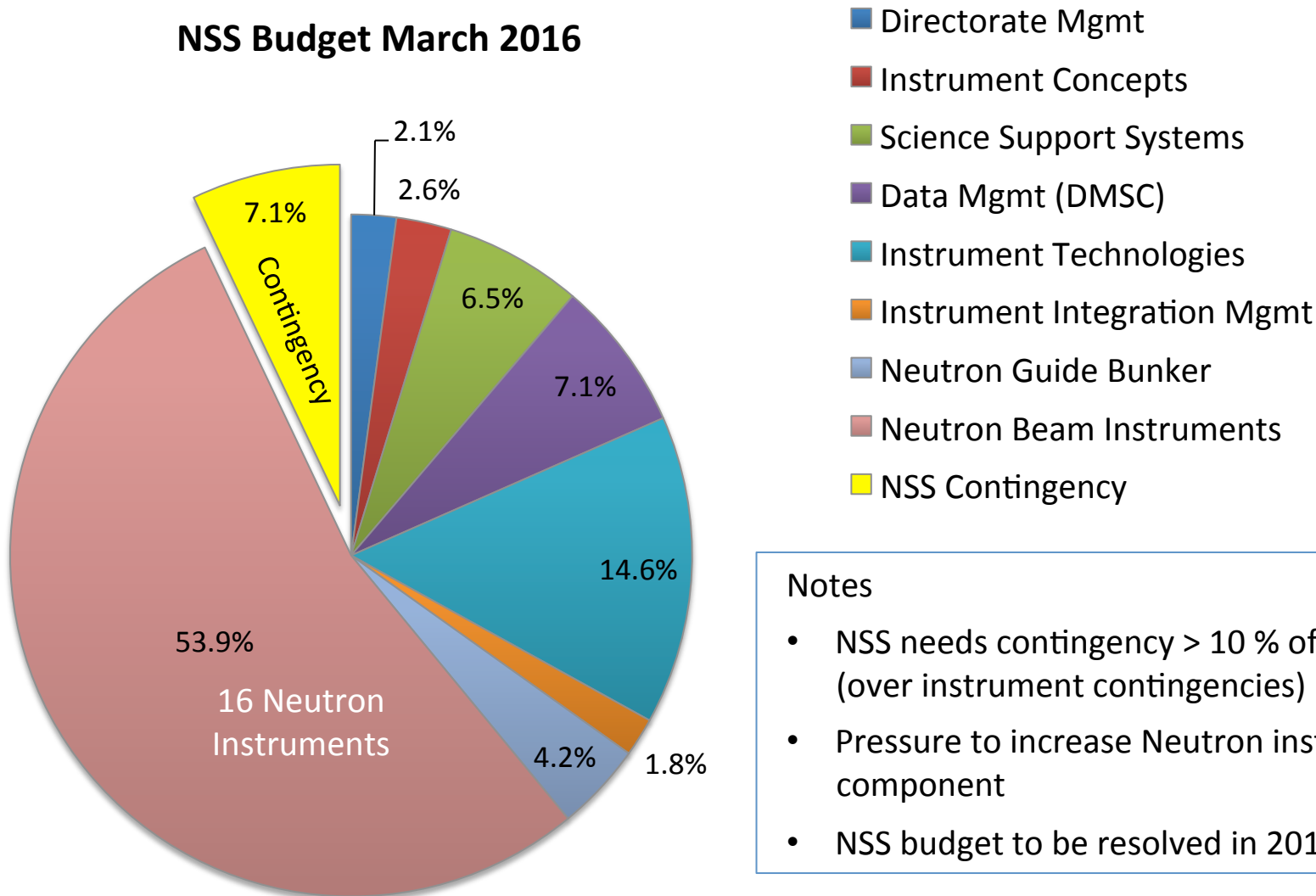
Schedule for the Neutron Guide Bunker

Delivery of the Neutron guide bunker is on the critical path



NSS Budget Breakdown by Work Package

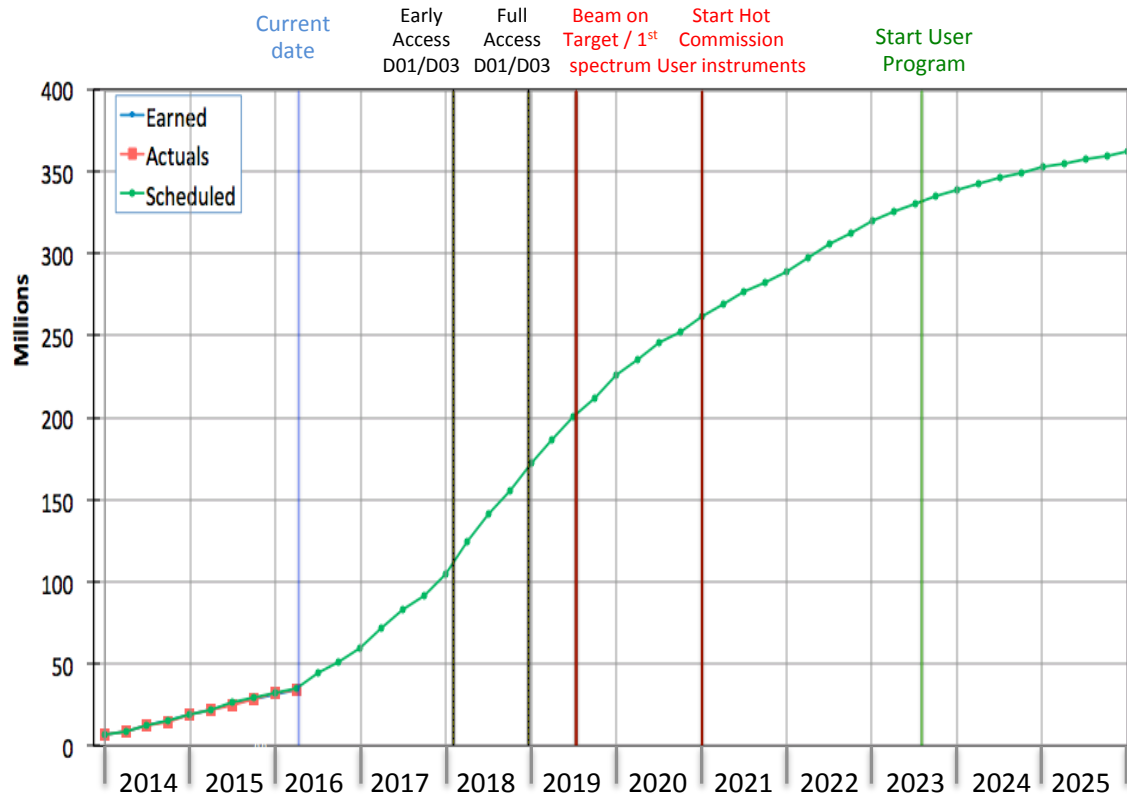
NSS Budget March 2016



Notes

- NSS needs contingency > 10 % of cost to complete (over instrument contingencies)
- Pressure to increase Neutron instrument component
- NSS budget to be resolved in 2016

NSS Total Expenditure (Cash + In-Kind)



Notes

- Budget plan includes escalation on cash component of 11.9 M€ (i.e. Total = 361.9 M€)
- Expenditure plan not currently aligned with instrument delivery schedule
- To be revisited at end of 2016 (when Instrument delivery schedules are known)

NSS plan (P6) showing scheduled/actual expenditure + earned value

NSS budget pressures

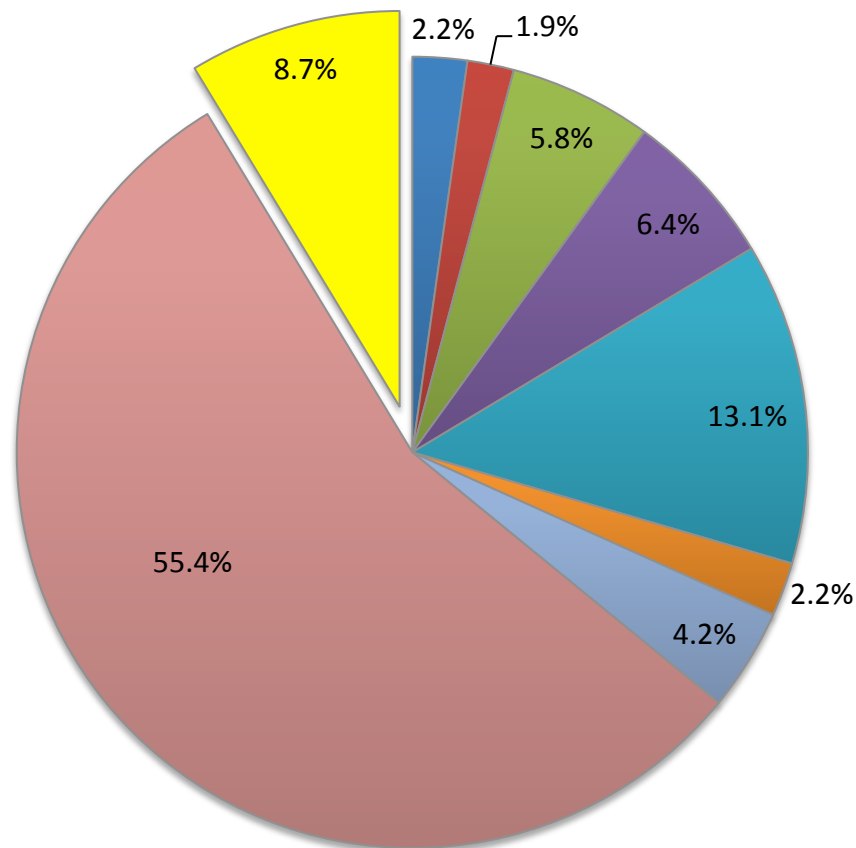
- Proposed budgets for the 16 Instruments endorsed by SAC total ~248 M€ (~ 59 M€ higher than provisional NSS Instrument allocation of 189 M€)
- NSS expects Instrument teams will argue strongly for increased budget during scope setting process. (possibly totalling ~ 27 M€)
- NSS top level contingency must increase > 10 % of cost to complete before fixing cost book (over instrument contingencies of 10%)
- Integration, management and NOSG budgets need to increase

Science Directorate operations budget plan for 1st & 2nd 5-year periods include;

- 25 M€ for additional scope for Instruments 1 -16
- 17.5 M€ for Hot Commissioning of Instruments 1 -16
- 85 M€ for construction + 6.4 M€ for Hot Commissioning of instruments 17-22
- 3.3 M€ per year for instrument spares

Possible NSS Budget Scenario: 2017 and beyond

Budget Scenario (5+22 M€) Dec 2016

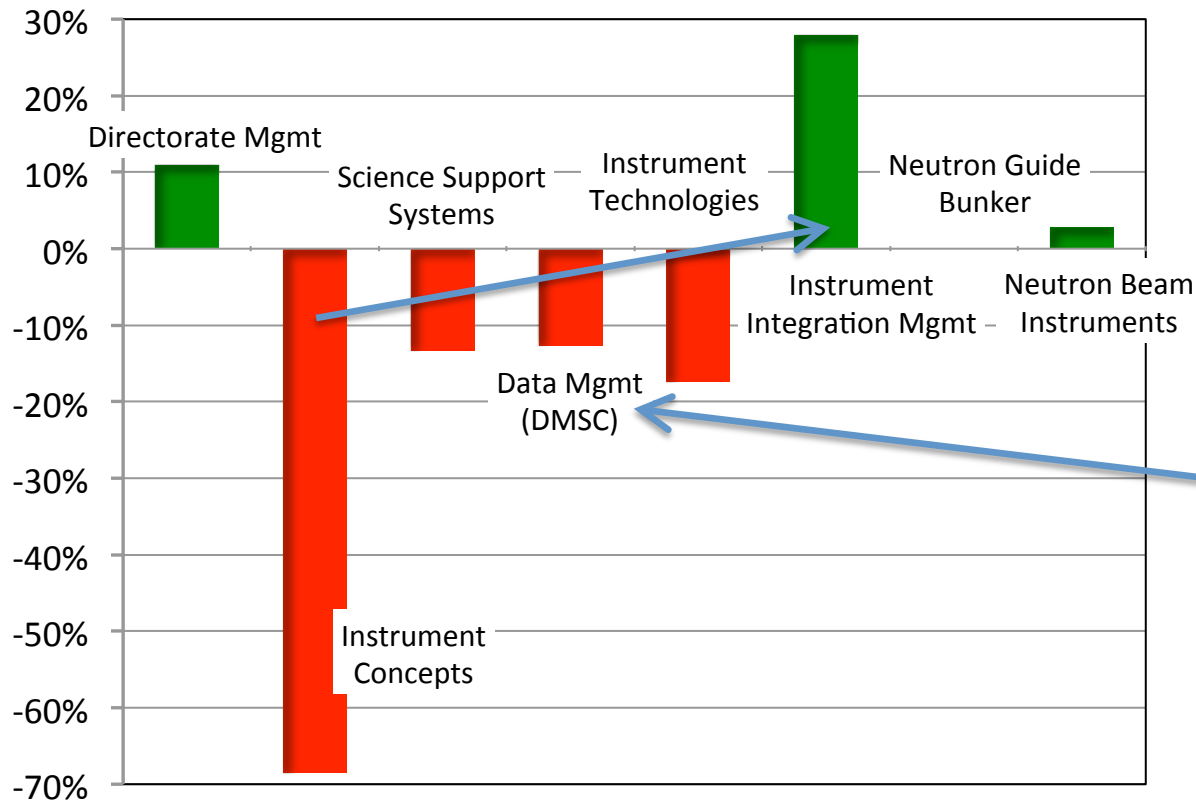


Assumptions

- NSS Instrument budget grows by 5 M€ with additional provision of 22 M€ for Instruments 3-16 from Initial Operations budget
- Other increases as shown previously
- Budgets for Science Support Systems, DMSC and Instrument Technologies adjusted accordingly

Possible NSS Budget Scenario: 2017 and beyond

Budget Scenario: % change in remaining budget



Budgets for;

- Science Support Systems,
- DMSC
- Instrument Technologies

reduced by average of 10%
(~ 15 % of remaining budget)

Transfer from Instrument Concepts, mainly to Instrument Integration Management, due to shift from concept development to co-ordination of IK Instrument teams

Major activities planned by end of 2016

- Move up to 12 Instrument projects through scope setting (assign cost book values)
- Review scope of other major work packages: Science support systems, DMSC and Instrument Technology
- Detailed design of neutron guide bunker, and engage with manufacturer(s)
- Optimize project scope (with ERIC Council)
- Establish detailed delivery schedule for first tranche of instruments with In-Kind Partners