Conforming to radiation safety regulations, what you need to know when you supply into Research Infrastructures

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Outline

Context for Research Infrastructures

European Spallation Source In-Kind model case

- Procurement requirements, Quality and ILO network
- European regulations and legislations
- Examples of Applications to Accelerator, Target and Instrument

What you could know about Research Infrastructures…

- A novel way to learn: ESS Learning Lounge
- Innovations based on RI
- Learning more about Physics

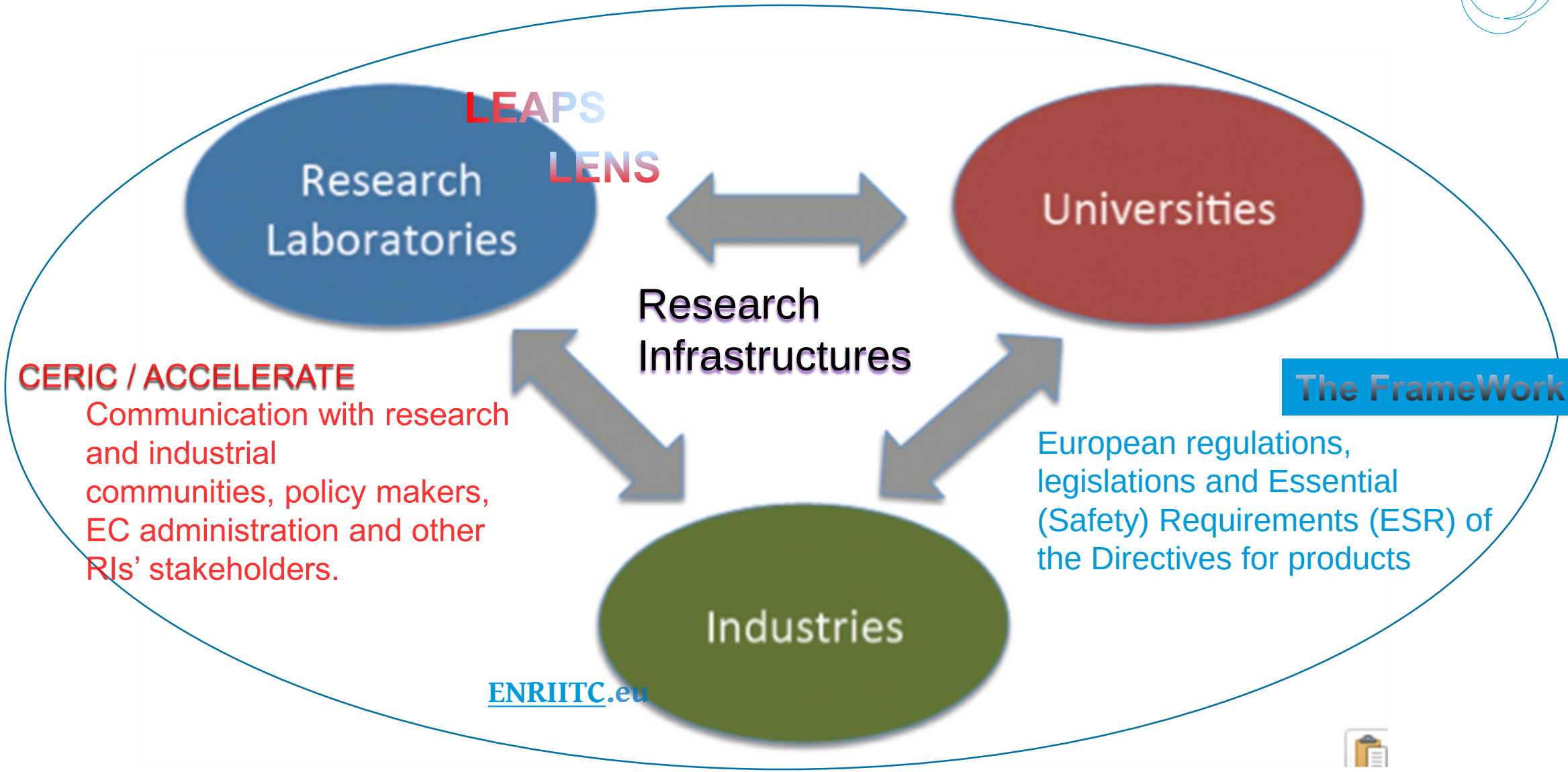
ABOUT ACCELERATE

ACCELERATE is a Horizon 2020 project, supporting the long-term sustainability of large scale research infrastructures (RIs) through the development of policies and legal and administrative tools for a more effective management and operation of RIs, with a special focus on ERICs and CERIC in particular.

To help secure RIs' sustainability, relevance and effectiveness, the project develops frameworks to improve the offer of tailored services to private and public entities, ensuring outreach to new scientific and industrial communities worldwide and defining common protocols for monitoring and assessing RIs' socio-economic impact.

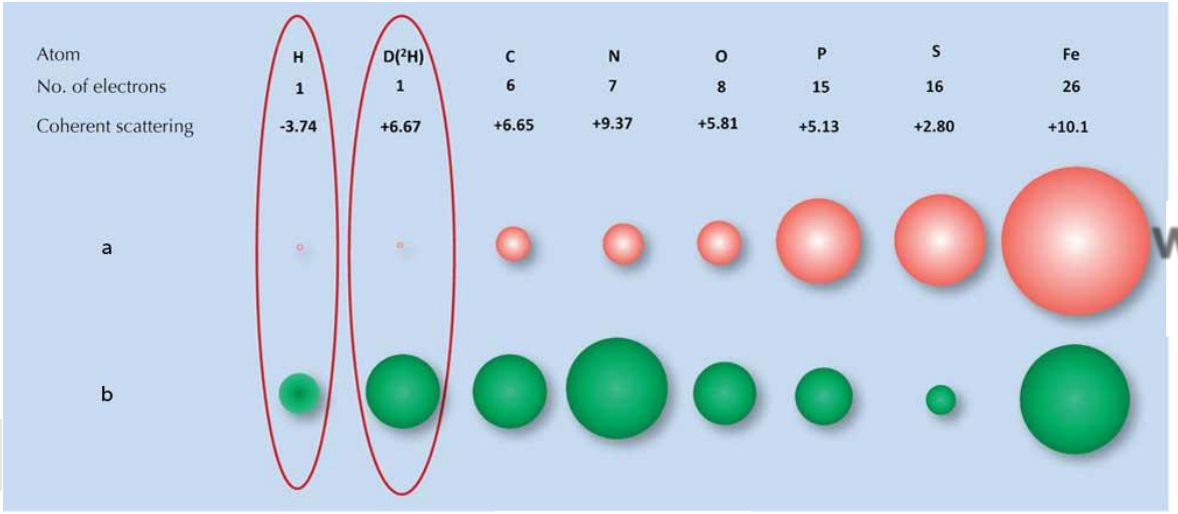
Finally, a major focus is on capacity building to develop current and future RIs' staff competences in the field of management, Industrial Liaison and Technology Transfer.

Ecosystem for LS and NS Communities

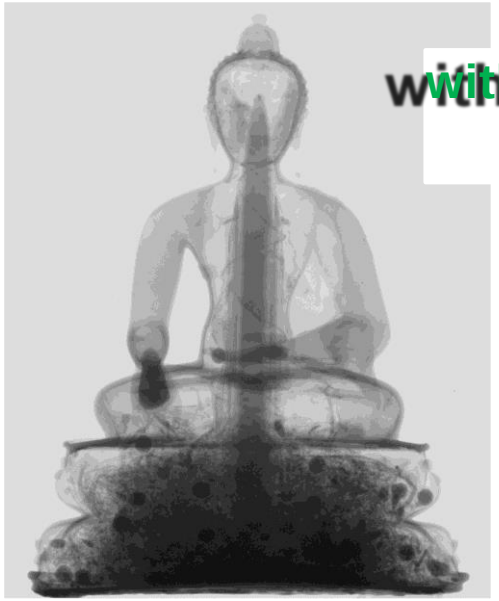


RI with focus on Light and Neutron

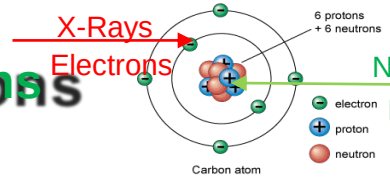
Courtesy Lenny Rivkin/PSI

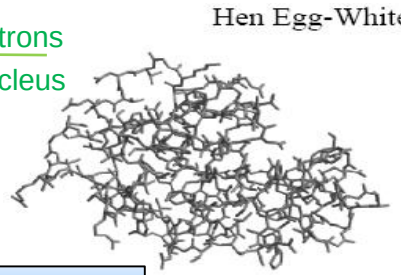


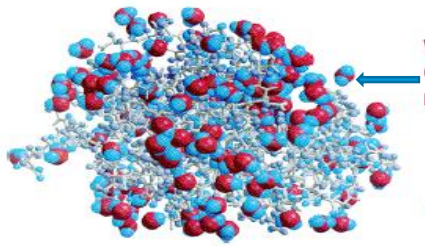
with X-Rays eyes



with Neutrons eyes







X-rays

Neutrons

H atoms make up *~50% of atoms of biological macromolecules* (lipids, proteins, nucleic acids, carbohydrates)

Protein

From structure to function

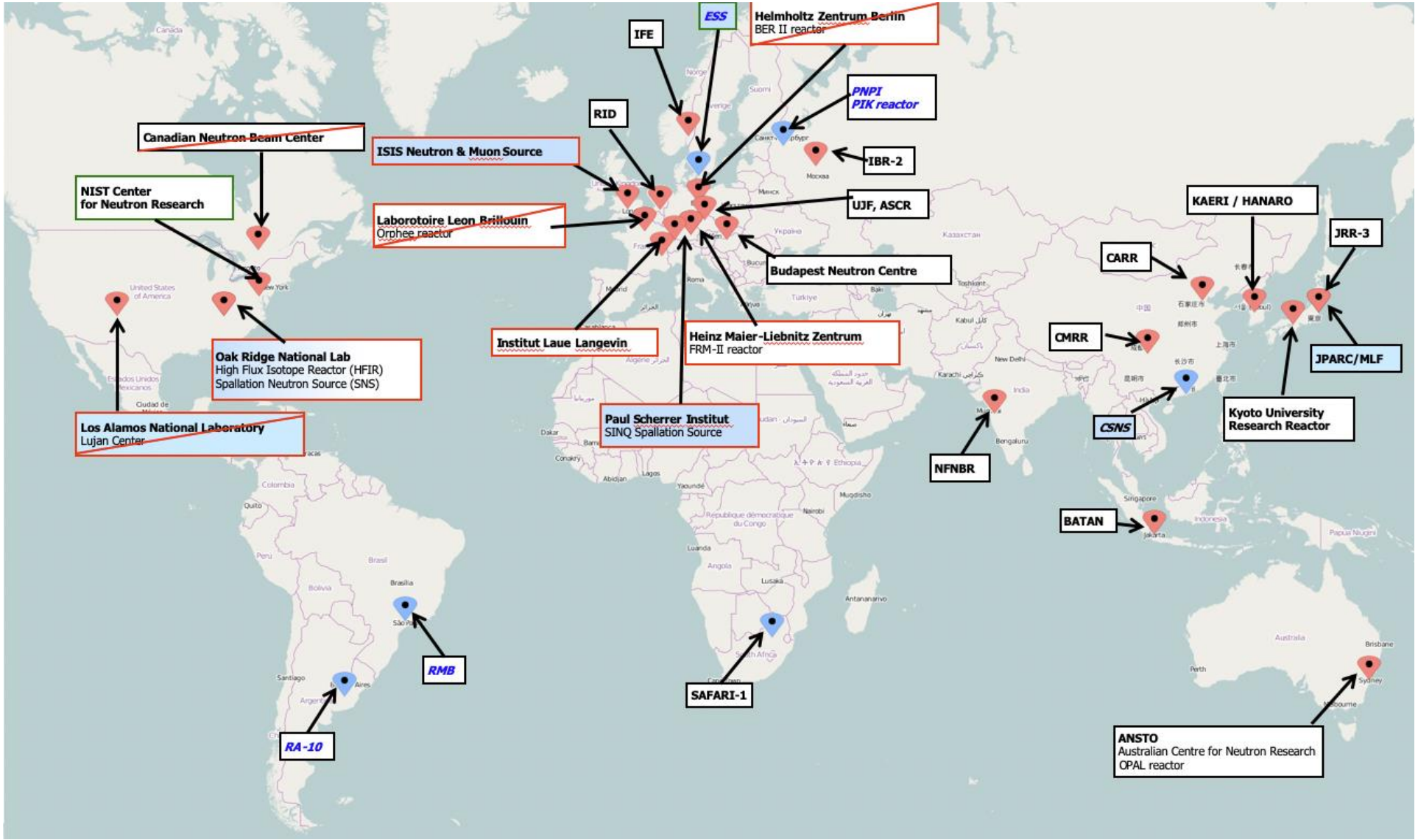
Light Sources distribution

[See Introduction to synchrotron radiation physics and applications at ASP2016]

Courtesy Caterina Biscari, ALBA LS Director

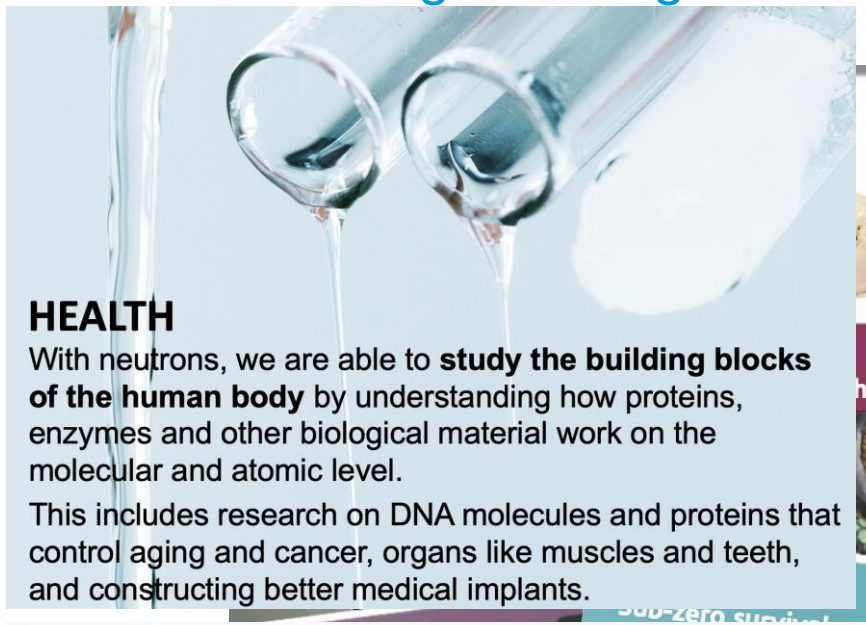
Neutron Scattering Facilities

See Connecting Industrial R&D Staff to State-of-the-Art Neutron Methods



Science with Neutrons

Addressing challenges in energy, materials and health



HEALTH

With neutrons, we are able to **study the building blocks of the human body** by understanding how proteins, enzymes and other biological material work on the molecular and atomic level.

This includes research on DNA molecules and proteins that control aging and cancer, organs like muscles and teeth, and constructing better medical implants.

NEW MATERIALS

Mobile phone and computer technology are developing fast while new technologies like LED lighting are emerging. **New products full of advanced materials** surround us in our everyday life.

Today's materials must be lighter, stronger, cheaper and sustainable. Neutrons help us not only understand the atomic structure of materials, but also their behavior.

ENERGY

Neutrons enable the potential for **developing more environmentally friendly products** and processes.

Fuel cells driven by hydrogen, materials used for solar power, and telephone batteries are some of the areas that benefit from neutron technology.

FOOD

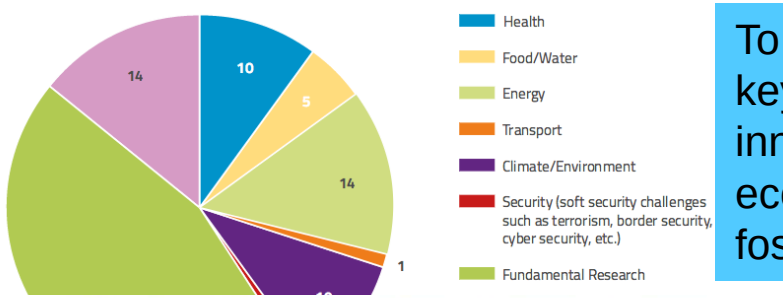
Consumers demand safe and healthy food, creating a need for companies to understand **the complex structure of food and ingredients.**

Neutrons are used to **study enzyme structures and what happens during chemical processes.** The non-destructive analysis techniques can reveal protein and emulsion structures and reduce energy consumption in food production.

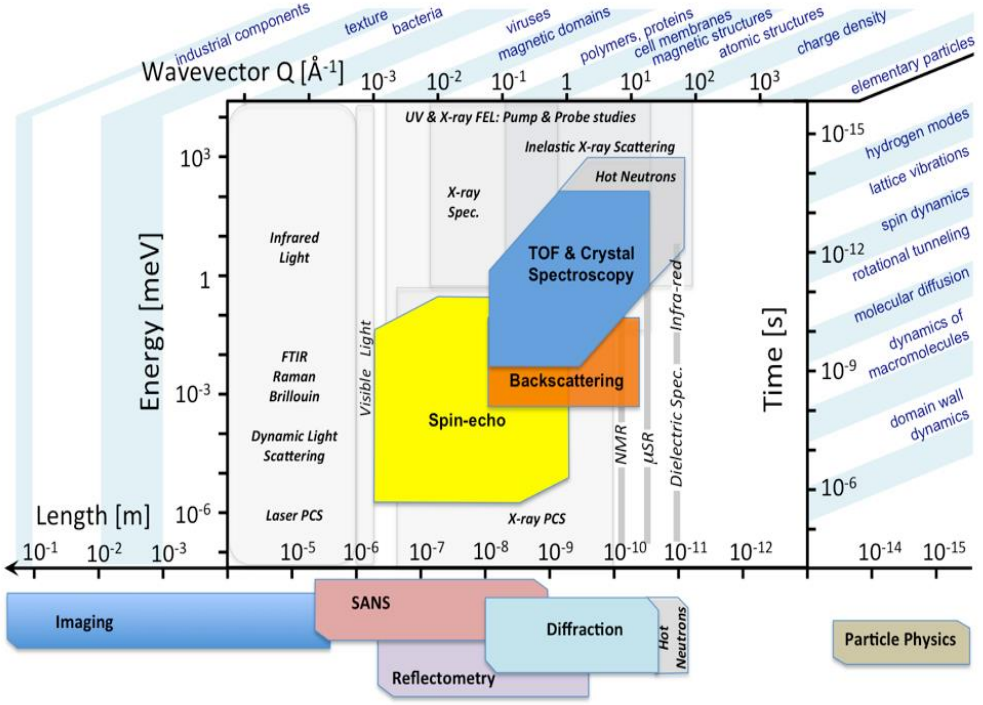
BrightnESS survey

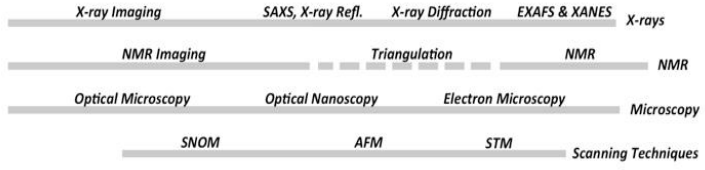
Fig 3.15 Europe: Science fields per method expressed as a percentage of experiments

Fig 3.14 Europe: Horizon 2020 topics and challenges expressed as a percentage of research, averaged over all participating neutron sources



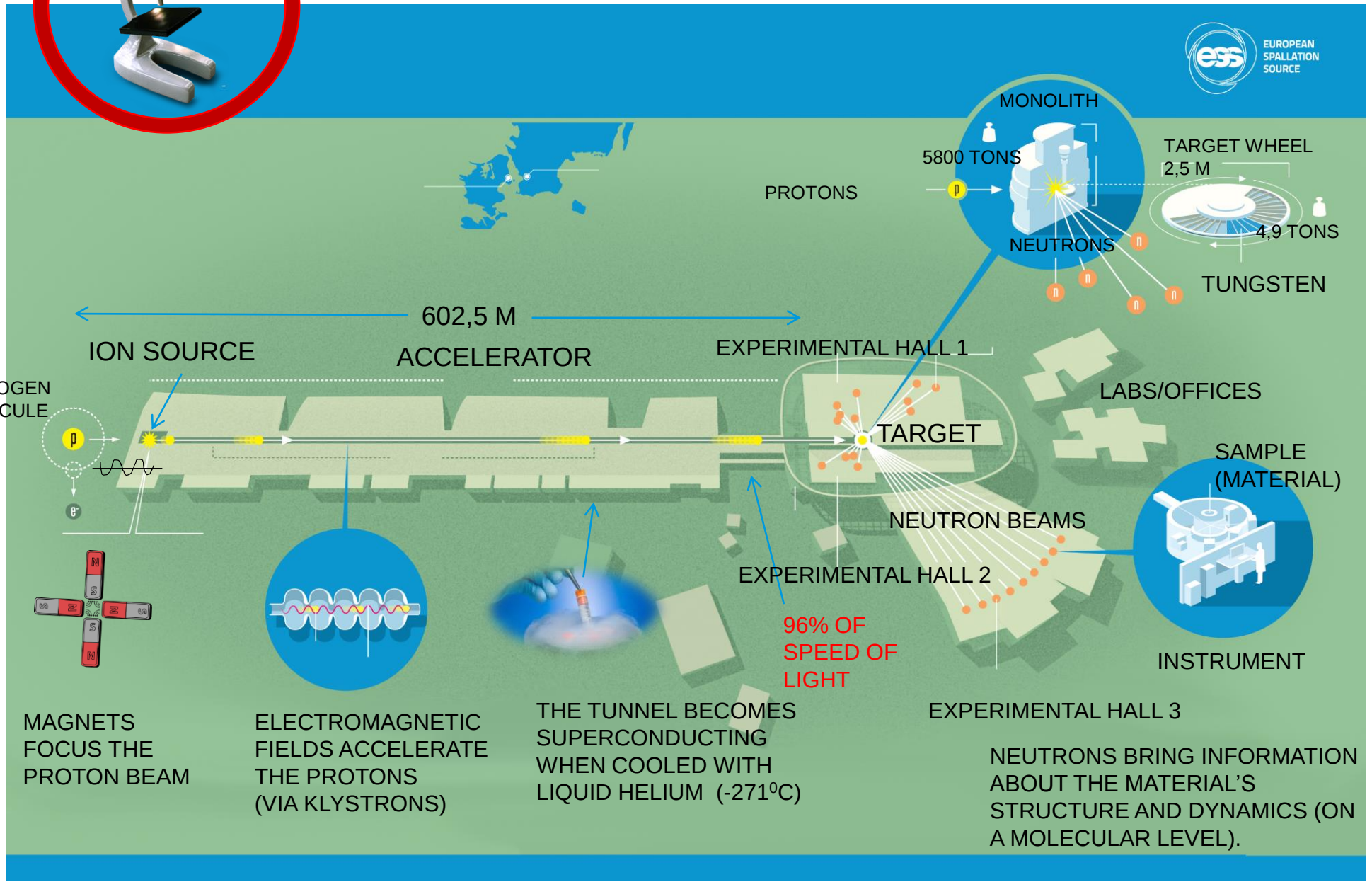
To understand the role of key players in the innovation ecosystem that ESS will foster !





Neutron Scattering Techniques

The ESS Machine



European Spallation Source In-Kind model case

- Procurement requirements, Quality and ILO network
- European regulations and legislations
- Examples of Applications to Accelerator, Target and Instrument

In-Kind Model

ESS is working with more than 40 European partner institutions, and more than 130 collaborating institutions worldwide under the in-kind model

Partnership and Collaboration to build the ESS

Aarhus University
Atomki - Institute for Nuclear Research
Bergen University
CEA Saclay, Paris
Centre for Energy Research, Budapest
Centre for Nuclear Research, Poland, (NCBJ)
CNR, Rome
CNRS Orsay, Paris
Cockcroft
Elettra
ESS
Fo
In
Res
Ruthe
Laborato

Kopenhagen University
Laboratoire Léon Brilouin (CEA – CNRS – LLB)
Lund University
Nuclear Physics Institute of the ASCR
Oslo University
Paul Scherrer Institute (PSI)
Polska **zna - PGE**
R
ogy
ology
Zurich **plied Sciences (ZHAW)**

~516
Employees

~57
Nationalities

> 40
Collaborating Institutions

A Pan-European Project

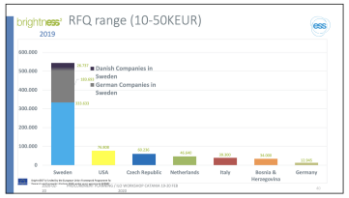
Financing includes cash and deliverables

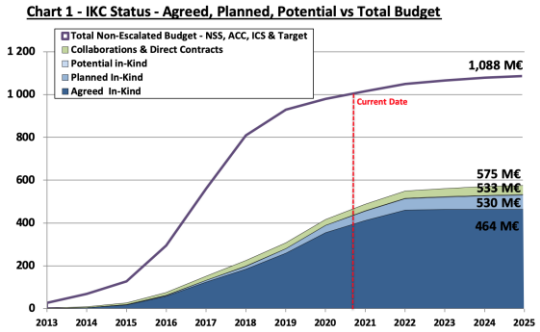
The European Spallation Source ERIC

ERIC legal framework was created by the European Commission in 2009 (.pdf)

Host Countries Sweden and Denmark

Construction47.5% Cash Investment ~ 97%
Operations 15%

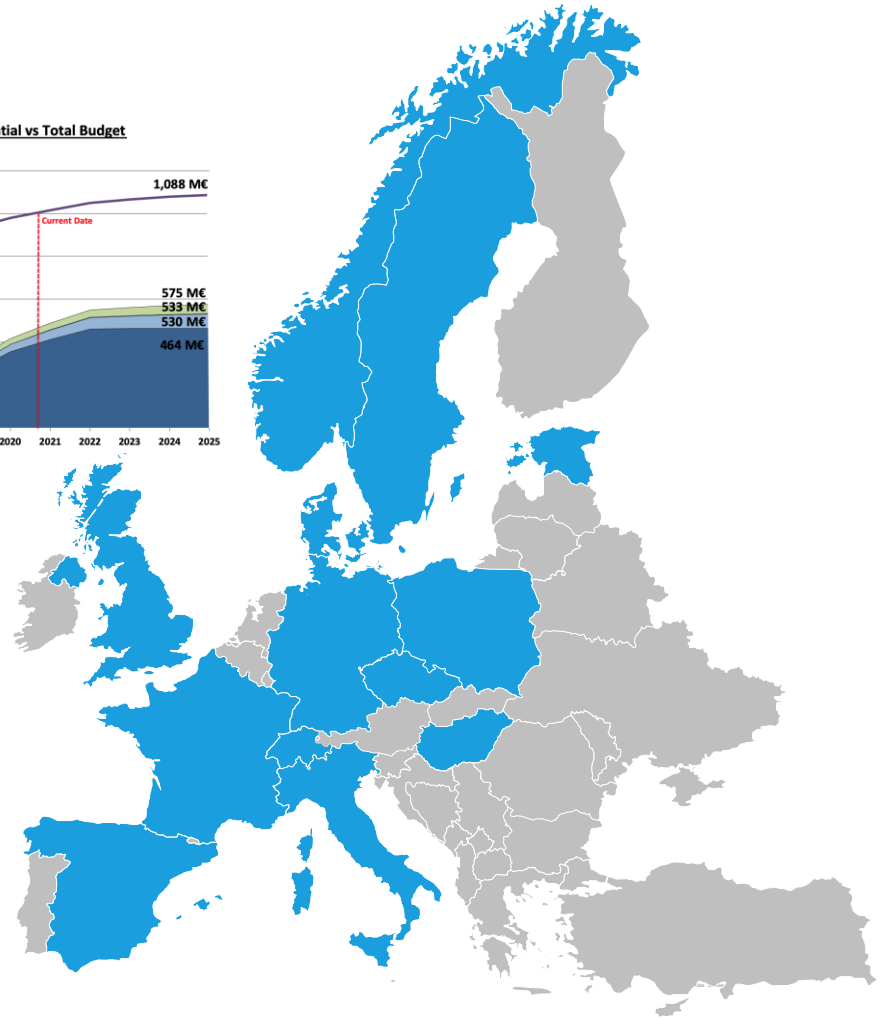




Non Host Member Countries

Construction52.5% In-kind Deliverables ~ 70%
Operations 85%

13+2 European Member and Observer Countries

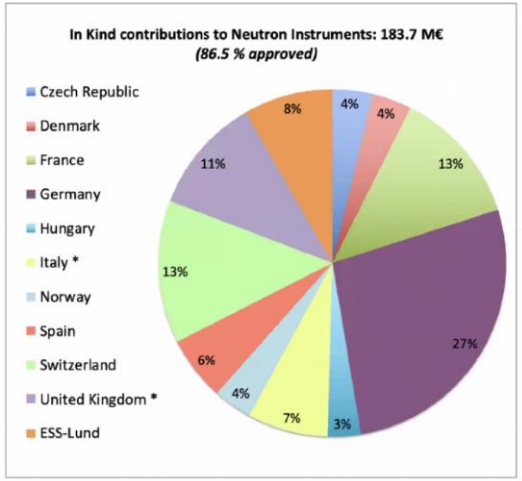


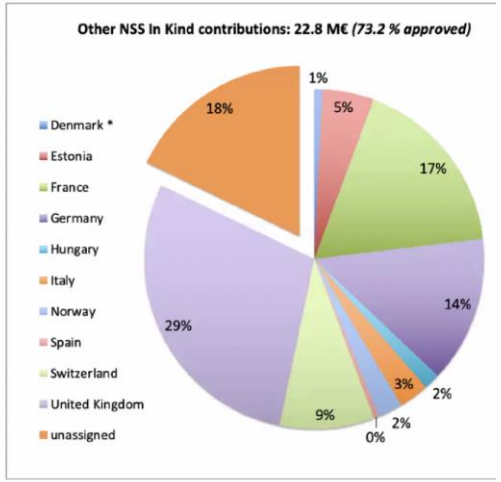
Procurement for In-Kind and In-House

Example of Instruments

In-Kind Contributions: Summary by Country

IKC constitutes 60 % of NSS scope

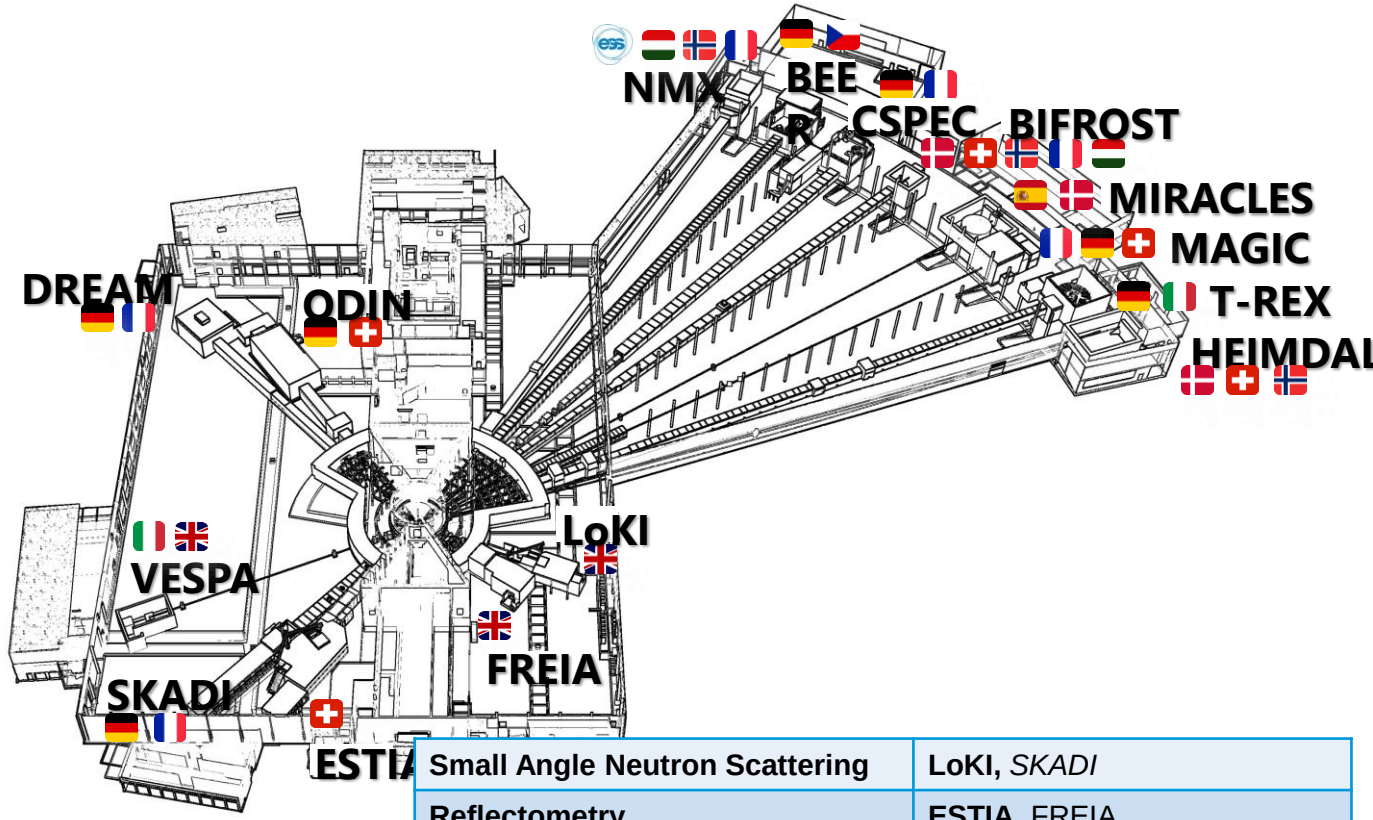




Total IK contributions (approved, planned & potential): 209.4 M€ (92 % of the NSS IK target)

** Nominal split of IT (90%) & UK (10%) contributions to VESPA under review - could shift delivery further to UK & ESS*

May 2020



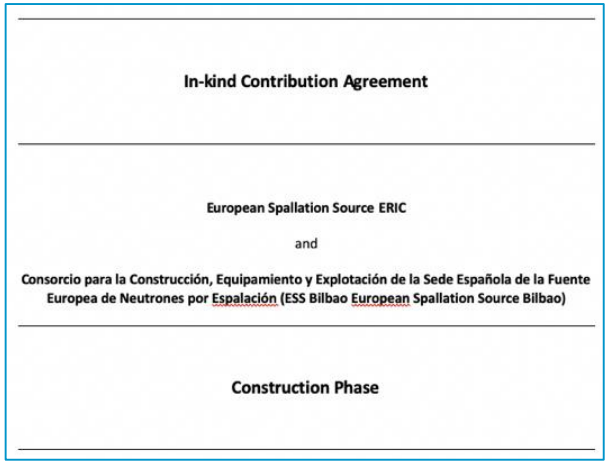
Small Angle Neutron Scattering	**LoKI,** *SKADI*
Reflectometry	**ESTIA**, FREIA
Single-Crystal Diffraction	**MAGiC**, ***NMX***
Powder Diffraction	**DREAM**, HEIMDAL
Imaging & Engineering	**ODIN**, **BEER**
Direct-Geometry Spectroscopy	**CSPEC**, *T-REX*
Indirect-Geometry Spectroscopy	**BIFROST**, MIRACLES, VESPA

ESS to drive:

Neutron bunker, radiation shielding, design support for common projects such as choppers, detectors, beam monitors and shutter systems

In-Kind Agreement Process

.. And complying with European Directives



In-kind Contribution Agreement

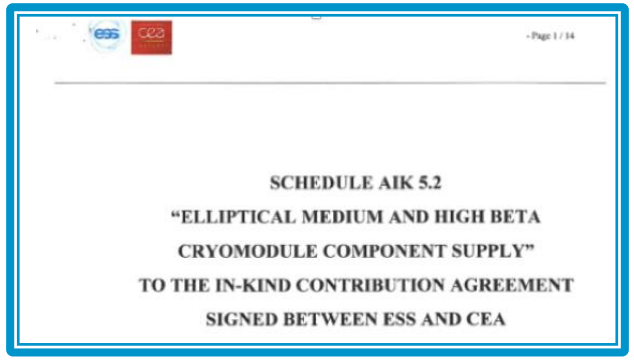
European Spallation Source ERIC

and

Consorcio para la Construcción, Equipamiento y Explotación de la Sede Española de la Fuente Europea de Neutrones por Espalación (ESS Bilbao European Spallation Source Bilbao)

Construction Phase

- Contracts between ESS and In-Kind partners are composed of IKCA and Technical Annexes
  - Technical requirement/scope
  - Product compliance with European Directives
  - National regulation and harmonized standards
  - Project Quality Plan

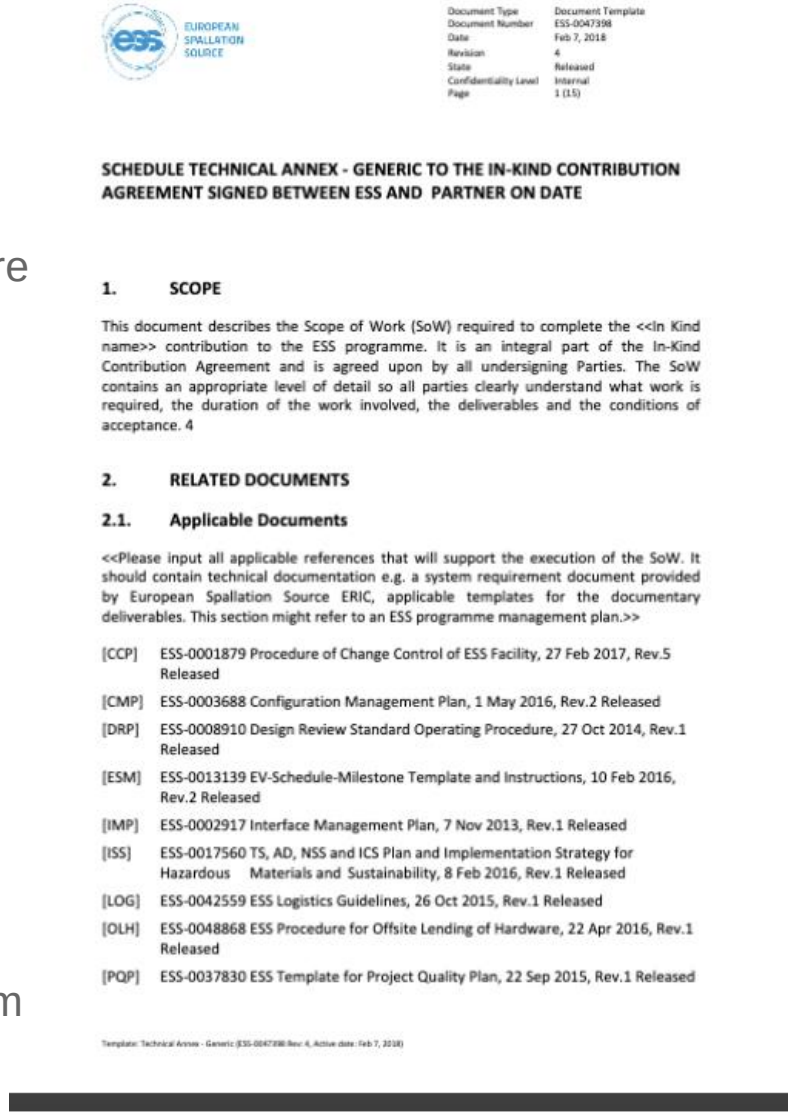


SCHEDULE AIK 5.2

"ELLIPTICAL MEDIUM AND HIGH BETA CRYOMODULE COMPONENT SUPPLY"

TO THE IN-KIND CONTRIBUTION AGREEMENT SIGNED BETWEEN ESS AND CEA

- → Methodology supported by ESS Management System and ESS handbooks
- → Tools to facilitate data transfer and integration
- → Continuous follow up from technical experts from In-Kind partner and ESS



Document Type: Document Template
Document Number: ESS-0047398
Date: Feb 7, 2018
Revision: 4
State: Released
Confidentiality Level: Internal
Page: 1 (15)

SCHEDULE TECHNICAL ANNEX - GENERIC TO THE IN-KIND CONTRIBUTION AGREEMENT SIGNED BETWEEN ESS AND PARTNER ON DATE

1. SCOPE

This document describes the Scope of Work (SoW) required to complete the <<In Kind name>> contribution to the ESS programme. It is an integral part of the In-Kind Contribution Agreement and is agreed upon by all undersigning Parties. The SoW contains an appropriate level of detail so all parties clearly understand what work is required, the duration of the work involved, the deliverables and the conditions of acceptance. 4

2. RELATED DOCUMENTS

2.1. Applicable Documents

<<Please input all applicable references that will support the execution of the SoW. It should contain technical documentation e.g. a system requirement document provided by European Spallation Source ERIC, applicable templates for the documentary deliverables. This section might refer to an ESS programme management plan.>>

[CCP] ESS-0001879 Procedure of Change Control of ESS Facility, 27 Feb 2017, Rev.5 Released

[CMP] ESS-0003688 Configuration Management Plan, 1 May 2016, Rev.2 Released

[DRP] ESS-0008910 Design Review Standard Operating Procedure, 27 Oct 2014, Rev.1 Released

[ESM] ESS-0013139 EV-Schedule-Milestone Template and Instructions, 10 Feb 2016, Rev.2 Released

[IMP] ESS-0002917 Interface Management Plan, 7 Nov 2013, Rev.1 Released

[ISS] ESS-0017560 TS, AD, NSS and ICS Plan and Implementation Strategy for Hazardous Materials and Sustainability, 8 Feb 2016, Rev.1 Released

[LOG] ESS-0042559 ESS Logistics Guidelines, 26 Oct 2015, Rev.1 Released

[OLH] ESS-0048868 ESS Procedure for Offsite Lending of Hardware, 22 Apr 2016, Rev.1 Released

[PQP] ESS-0037830 ESS Template for Project Quality Plan, 22 Sep 2015, Rev.1 Released

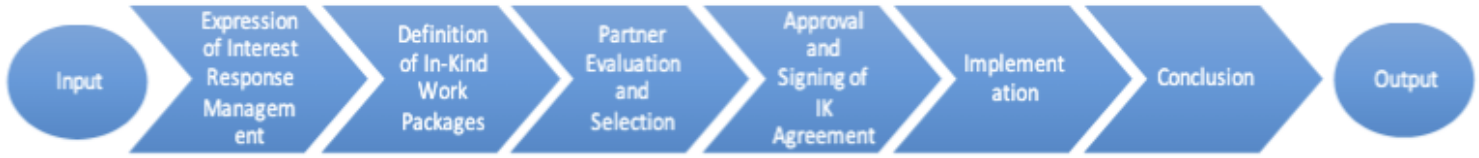
Template: Technical Annex - Generic (ESS-0047398 Rev. 4, Active date: Feb 7, 2018)

Document Type: Document Template
Document Number: ESS-0047398
Revision: 4
Date: Feb 7, 2018
State: Released
Confidentiality Level: Internal

[RCM] ESS-0127031 ESS Rules for CE Marking, 29 Dec 2017, Rev.1 Released

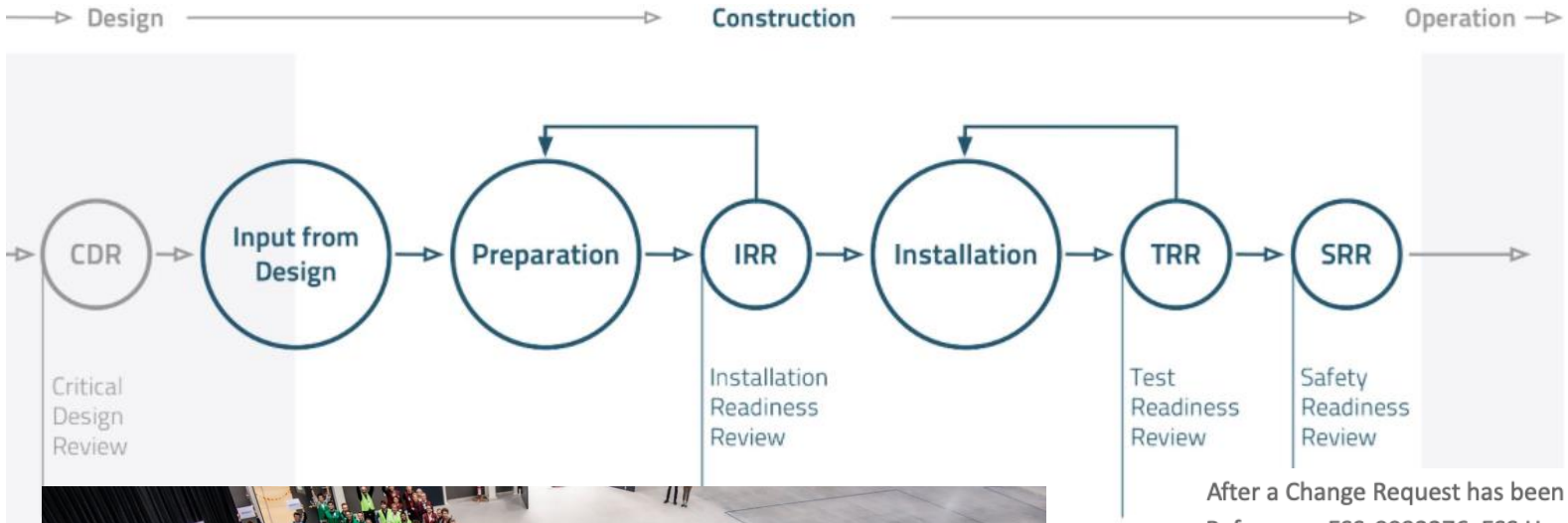
[RMP] ESS-0000263 ESS Process for Risk Management Process, 24 Nov 2014, Rev. 4 Released

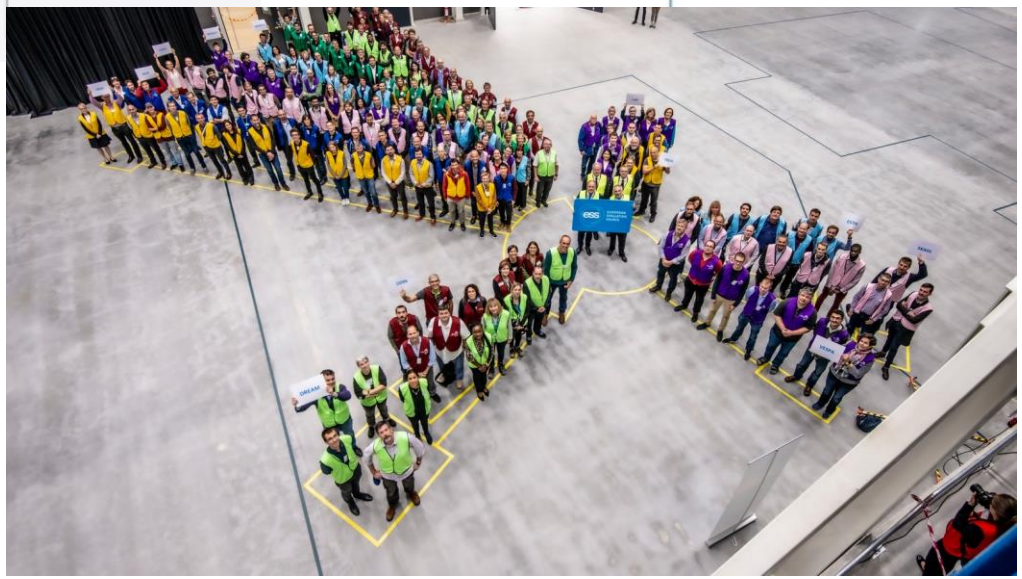
[SEM] ESS-0002908 System Engineering Management Plan, 17 Feb 2012, Rev. 1 Released



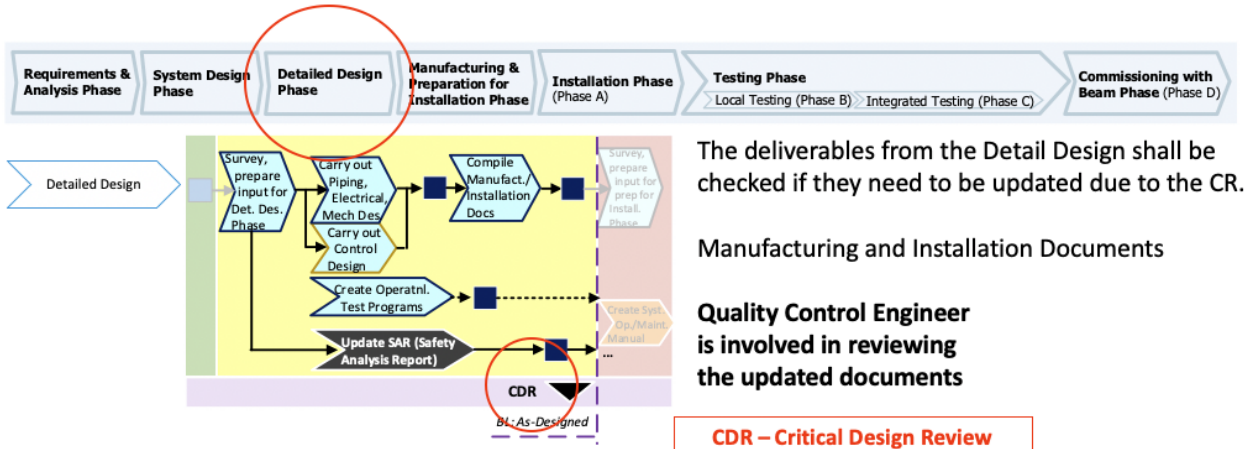
Work-Packages and Project follow-up

Engineering Handbook and ESS Guidances (**ESS Management System**)





After a Change Request has been accepted, the project/WP will go back to the Engineering phase.
Reference: ESS-0092276 ESS Handbook for Engineering Management



The deliverables from the Detail Design shall be checked if they need to be updated due to the CR.

Manufacturing and Installation Documents

Quality Control Engineer is involved in reviewing the updated documents

CDR – Critical Design Review

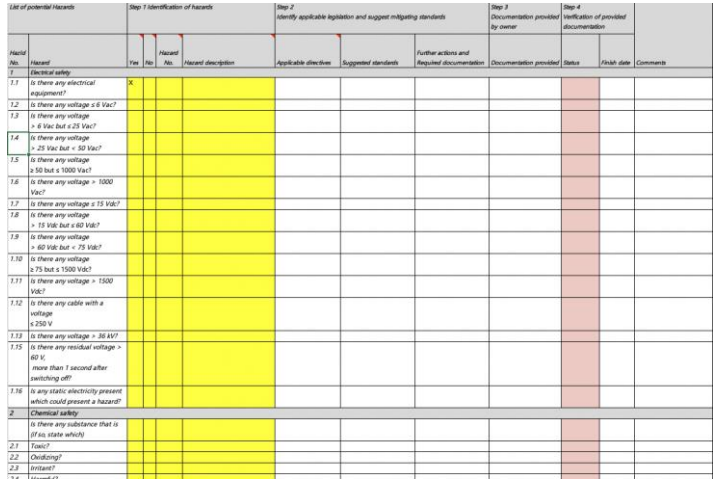
Quality Control is part of the review committee

Work-Packages and Project follow-up

Alignment with European regulations, legislations and Essential (Safety) Requirements (ESR) of the Directives for In-Kind products

Identify (safety) Hazard in the following field:

- Electrical
- Chemical
- Biological
- Cryogenic, ODH
- Ionization radiation
- Artificial optical radiation
- Magnetic field/EM waves
- Hazard due to cold/heat/fire
- Mechanical
- Pressure
- Workplace
- Ergonomic



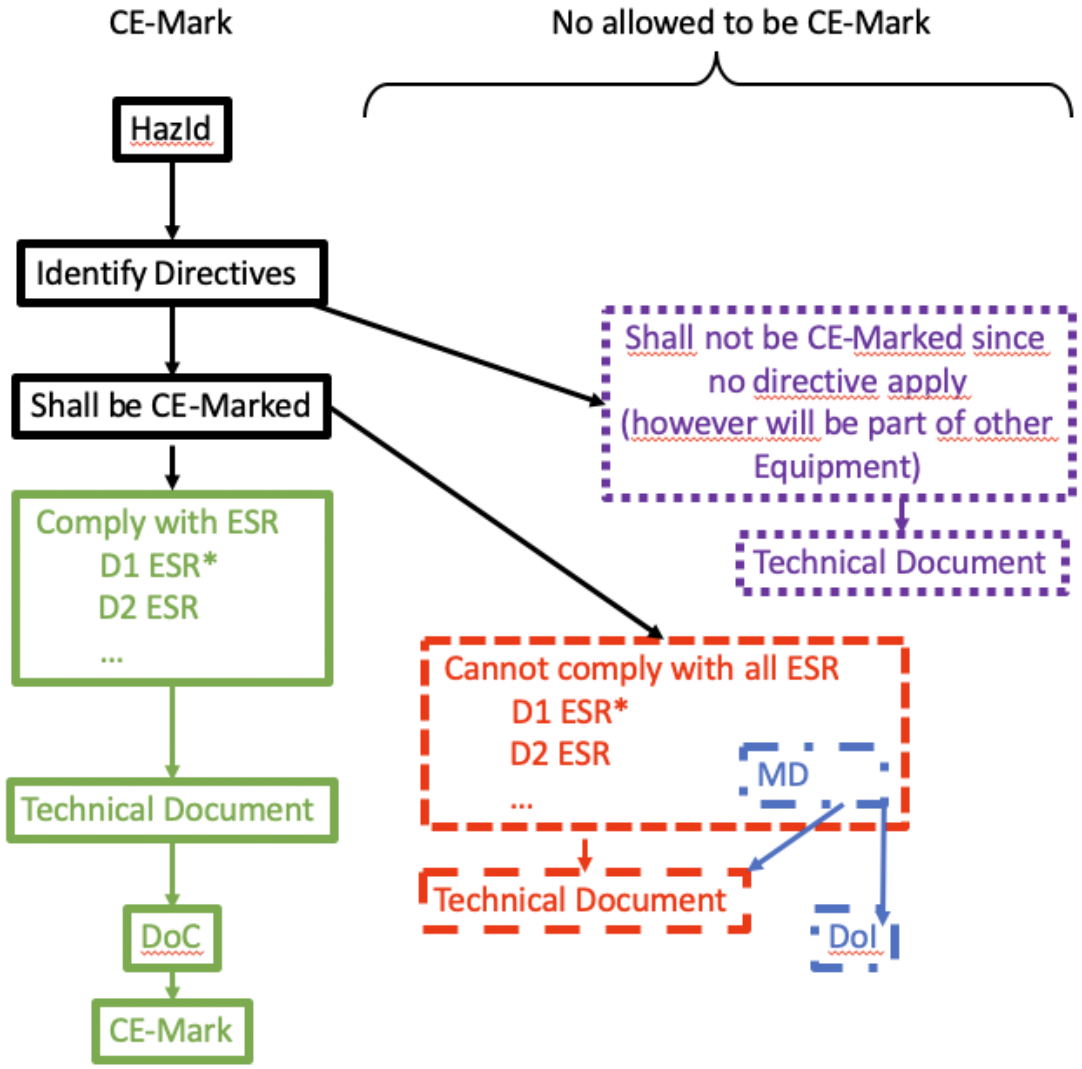
1. HazId → Directives identified
2. Risk Assessment and proposed mitigations
3. Implement the mitigation
4. **Compile technical documentation**
5. DoC is issued
6. CE-mark is applied to the equipment

e.g. ESS electrical handbook is based on several different standards, among which is EN 60204-1

… in difference to minimum harmonized legislation for installation and use, which is covered by ESS while complying to Swedish laws. The official guidelines to interpret the Product Directives can be found in the Blue Guide.

Work-Packages and Project follow-up

Complying with European Directives



Technical Files
User Instructions

1 - No Applicable Directive

2 - Directive applicable and complying to ESR

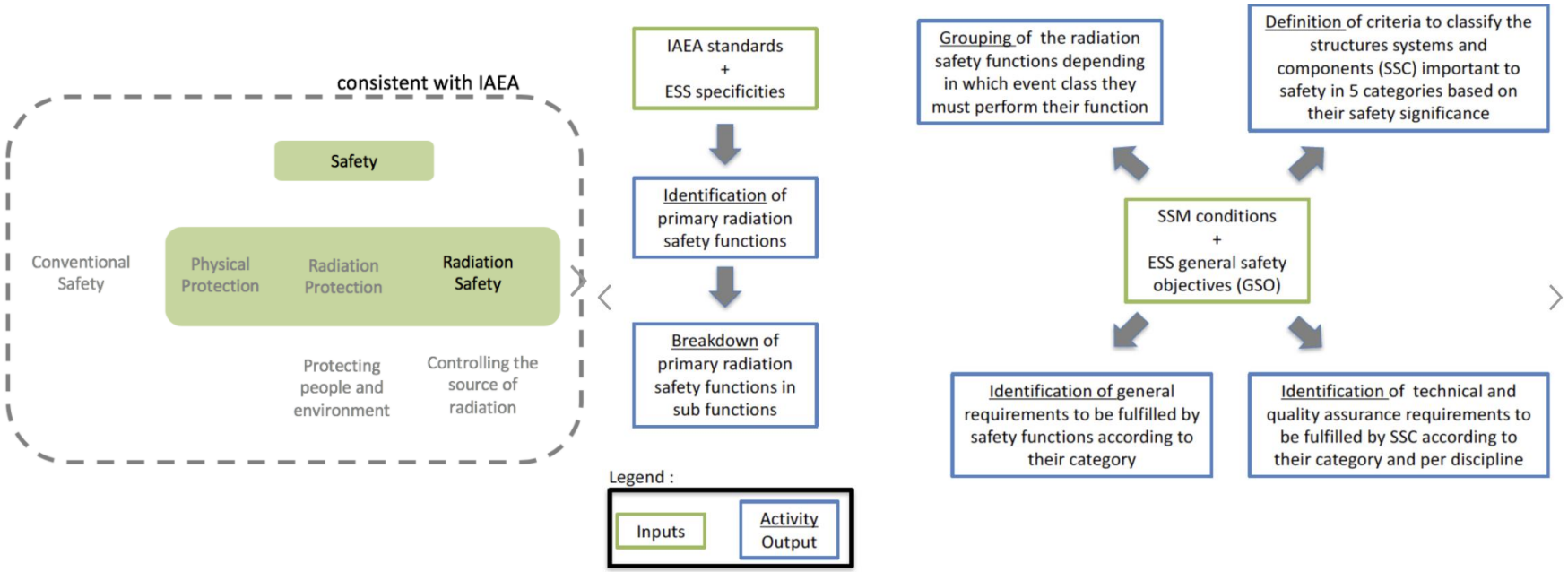
3 - Directive applicable and not complying to ESR

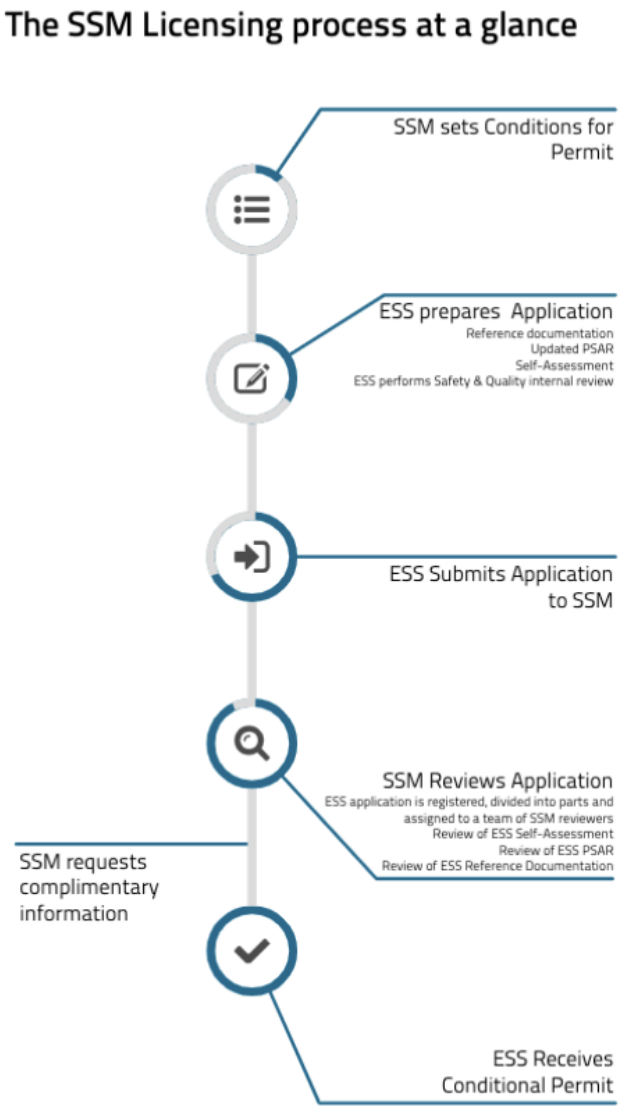
4 - Partially completed machinery

Safety Radiation and Licensing

IAEA and National Regulations, Swedish Radiation Safety Authority (SSM)

ESS is not considered as a nuclear facility but as a complex facility which has to comply to special conditions issued by SSM in addition to the relevant parts of the existing regulation.





Radiological hazard identification

IAEA and National Regulations

ESS objectives (effective dose)				
Operating conditions and likelihood (per year) of initiating event	Exposed worker with safety task	Exposed worker without safety task	Non-exposed worker	Public (off-site)
Normal operation, H1 (including events with F≥1)	Dose limit 20 mSv/year Dose constraints (*) 2 mSv/year		Dose limit 1 mSv/year Dose constraints (*) 0.1 mSv/year	Dose limit 1 mSv/year Dose constraint 0.1 mSv/year
Anticipated events, H2 $F \geq 10^{-2}$	Design criteria 20 mSv/event	Plan protective action based on realistic estimations for typical cases and applying ALARA via a respective ESS committee and an established ESS guideline [6].		Design criteria 0.1 mSv/event
Unanticipated events, H3 $10^{-4} \leq F < 10^{-2}$				Design criteria 1 mSv/event
Improbable events, H4A $10^{-6} \leq F < 10^{-4}$				Design criteria 20 mSv/event
Improbable events, H4B $10^{-4} \leq F$ H2 and H3 combined with CCF		N/A	N/A	Design criteria 20 mSv/event
Highly improbable events, H5 $10^{-7} \leq F < 10^{-6}$	Design criteria 100 mSv/event	Excluded from further evaluation since it is an acceptable residual risk.		Design criteria 100 mSv/event
Extremely improbable events $F < 10^{-7}$	Excluded from further evaluation since it is an acceptable residual risk.			

Risk assement to define category:
Radiation safety objectives expressed as dose limits, dose constraints and design criteria, for each event class, or the different categories of workers and for the public.
Events and circumstances that can affect the facility and its environment are ranked based on their likelihood

The radiation safety functions RSF are the functions implemented to stay below the limits defined for the public

The workers radiation safety functions WRSF are the functions implemented to stay below the limits defined for the workers

The RSF are identified through the radiation safety analysis using deterministic approach and DiD principle

The WRSF are identified through a general risk assessment

Radiological hazard identification

TASK FORCE (TF) IN ACTION

Courtesy Francois Javier

The TF is driving the effort to:

- Implement and clarify the ESS approach for radiation safety analysis, RSF/WRSF identification and classification, and categorisation of SSCs
- Confirm and detail the deliverables
- Update existing radiation safety analyses and RSF, WRSF identification
- Execute complementary radiation safety analyses and RSF/WRSF identification
- Update/complement classification of RSF & categorisation of corresponding SSCs

Common and consistent ESS approach

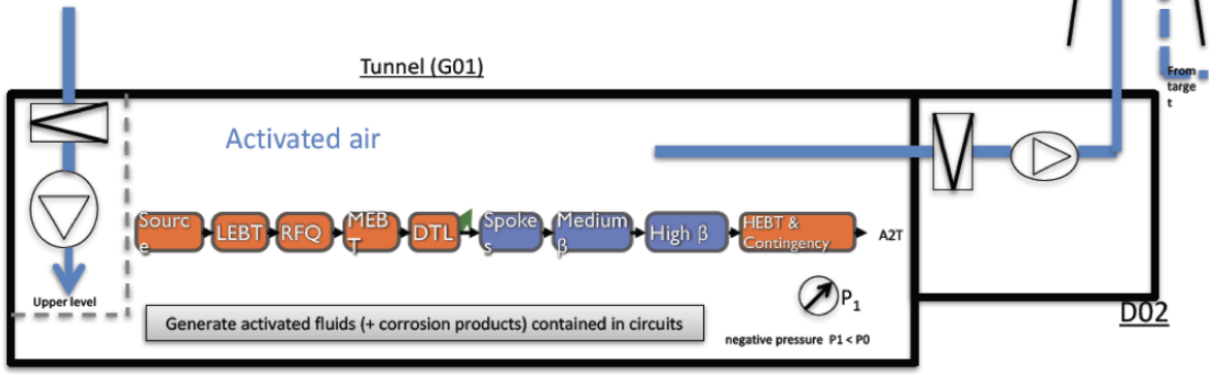
Explain
Align
Train
Do
Coordinate
Deliver

ESS Safety Radiation

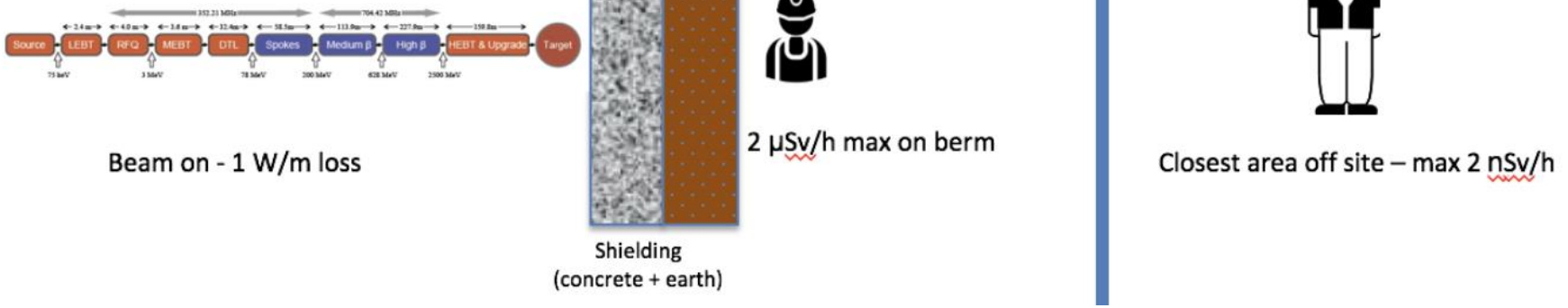
Accelerator

Radioactive inventory from activated air from prompt radiation with beam losses of 1 W/m

15 DAC (Derived Airborne Contamination) max (14 GBq) in the tunnel during operation and beam on (1 W/m loss) with renewal HVAC = 0 (with rHVAC = 0.5, 10 GBq corresponding to 9 DAC)

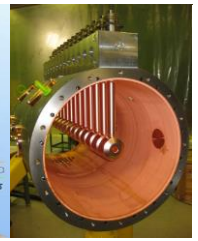


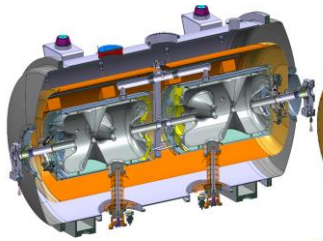
Prompt radiation

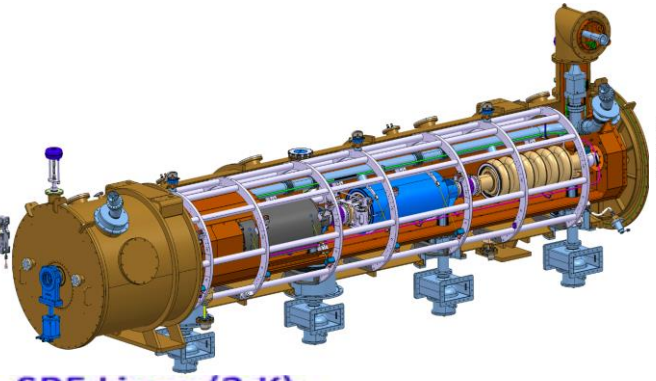


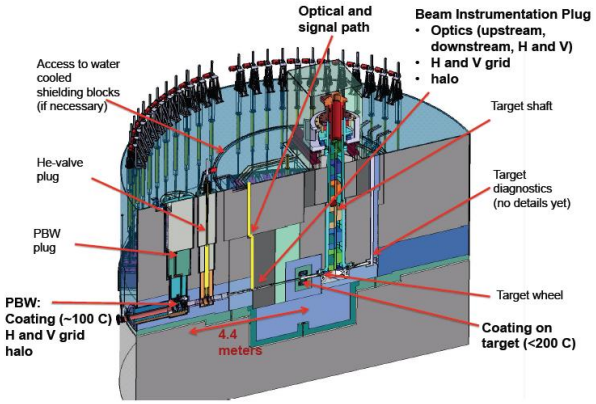
Accelerator ionization radiation

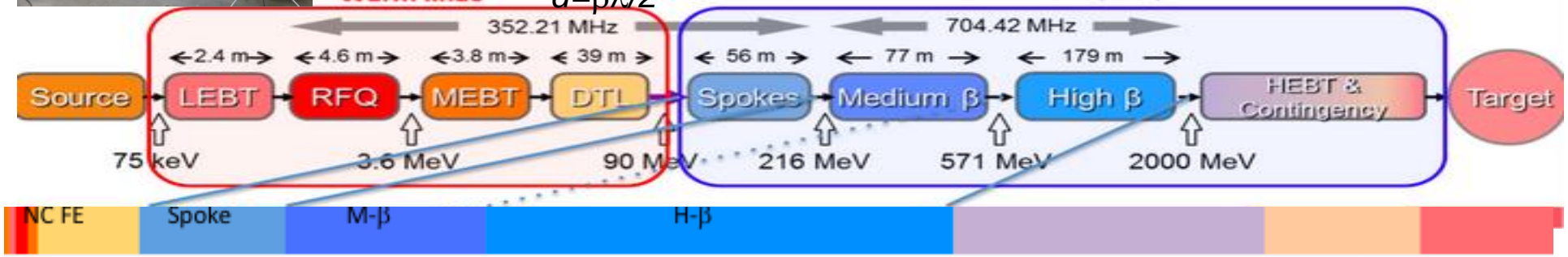
see Episode dating October 10, 2020











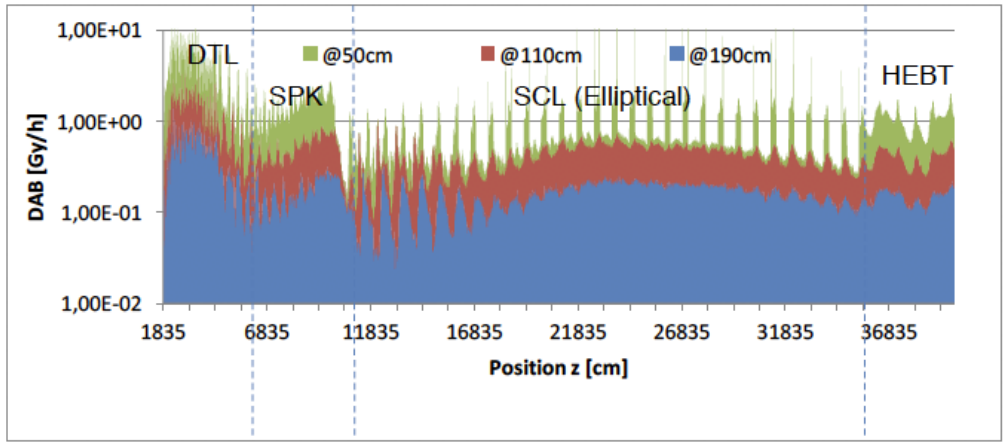


Figure 5 - Absorbed dose maps for 50, 110 and 190 cm from the beam centre [Gy/h]

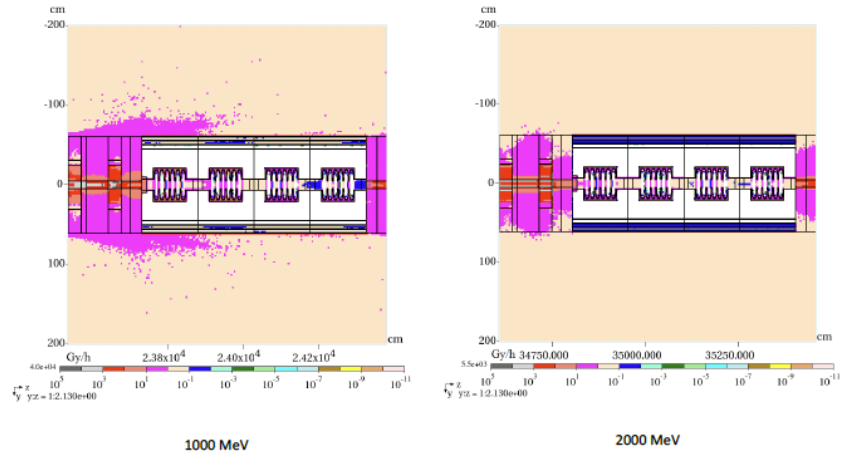


Figure 7 – Dose absorbed at ~ 200, 500, 1000 and 2000 MeV [Gy/h]

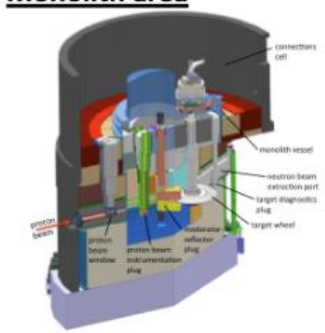
Product specification by IK following ESS requirements, e.g.:

- Radiation-hard (e.g. electronics, materials, instrumentation,)
- Risk Analysis
- Preventive maintenance and monitoring

ESS Safety Radiation and Target

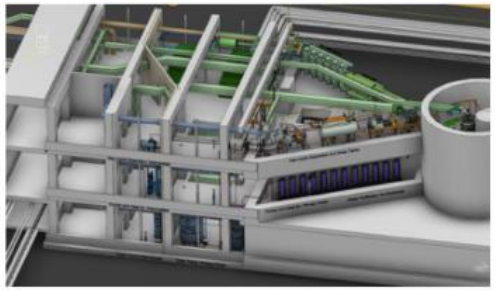
Radioactive inventory

Monolith area



~ 4.10^{17} Bq

Utility area

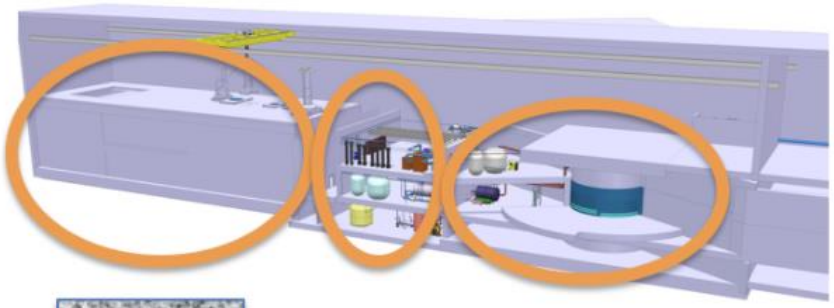


~ 4.10^{12}Bq

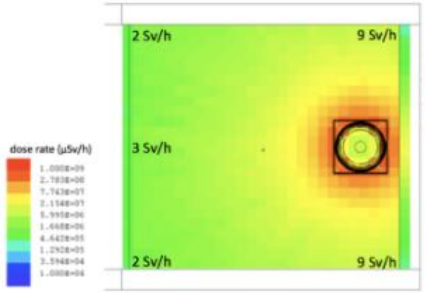
Active cells facility

~ 8.10^{16} Bq

Prompt and residual dose rate



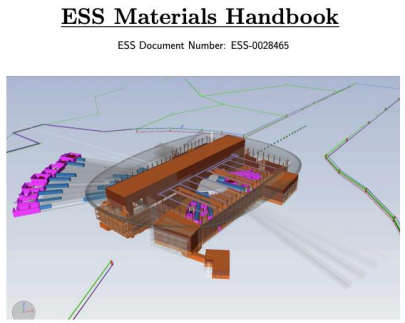
Designed to attenuate with a criterion of 3 µSv/h



Dose map of the target wheel (irradiated 5 years + 14 days of cooling time) in the active cell. (2000 Sv/h contact)

Target design

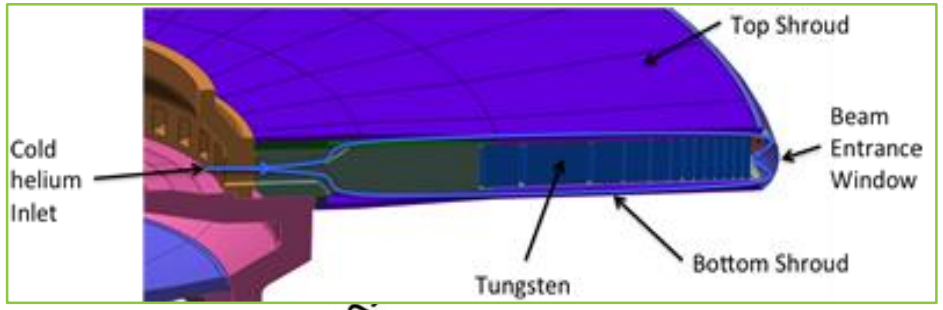
Materials specification

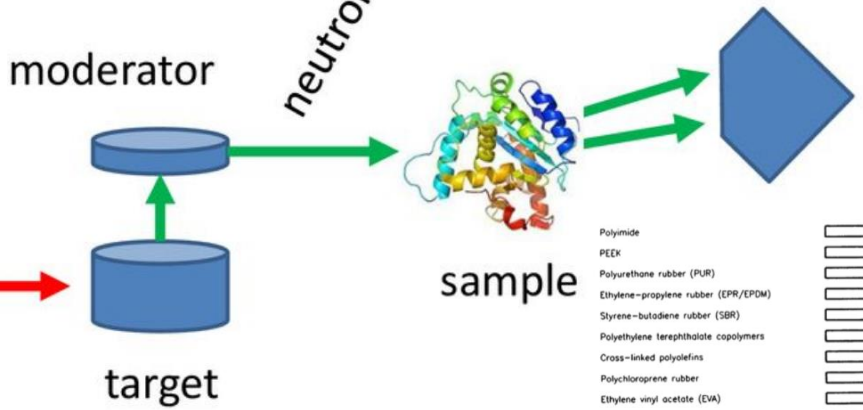

ESS Materials Handbook

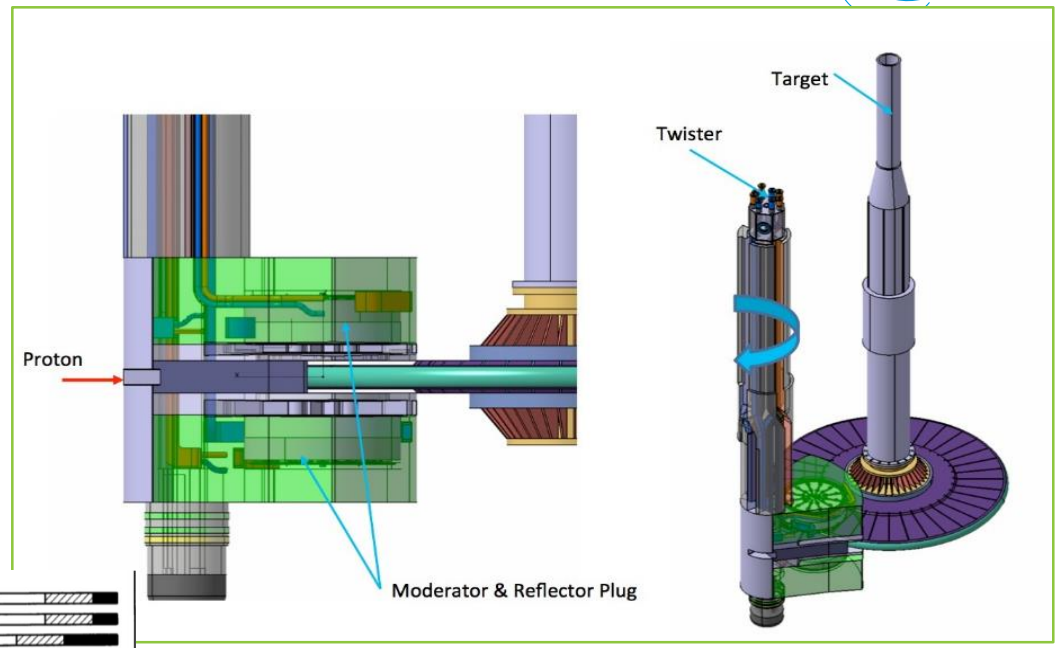
ESS Document Number: ESS-0028465

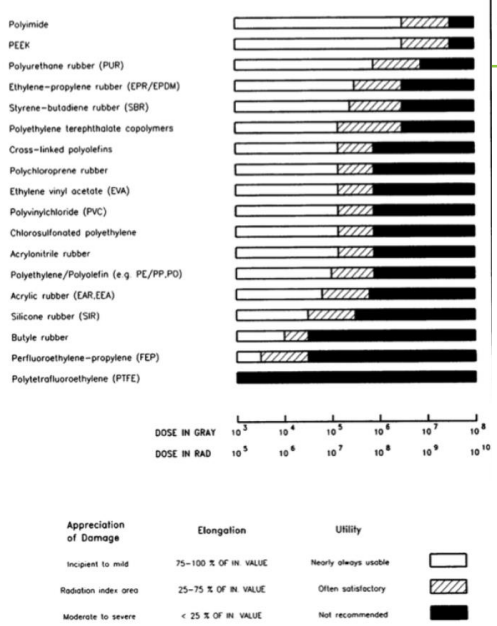
Editor	Yong Joong Lee	Target Division
Authors	Yong Joong Lee Monika Hartl	Target Division Scientific Activities Division
Reviewers	Günter Muhrer	Group Leader, Spallation Physics Group
Approver	Rikard Linander	Head of Target Division

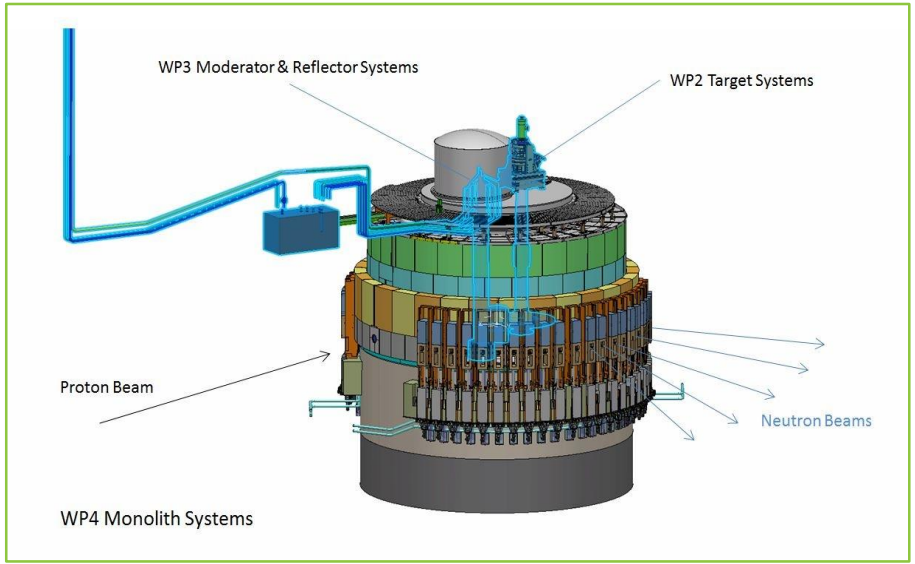
Last Update on July 9, 2020
towards Revision 6











Examples of specification transmitted to suppliers:

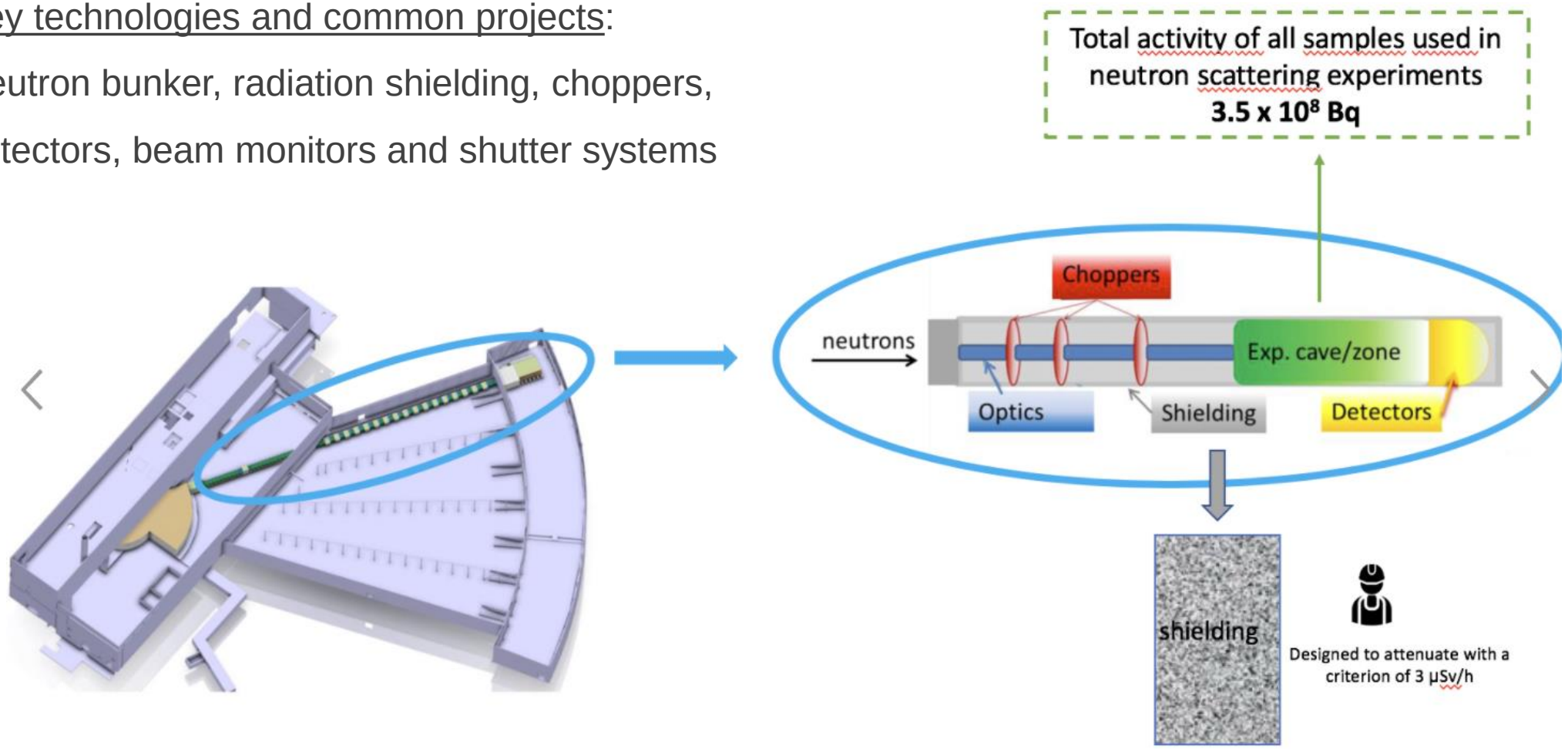
- Steel, iron (and Cobalt content) (Test @ ISOLDE and analysis @ DTU)
- Be, lead (and antimony content)
- Maximum grain size for Beryllium (20um) and Niobium (0.064 mm)

ESS Safety Radiation and Instrument

Radioactive inventory and prompt radiation

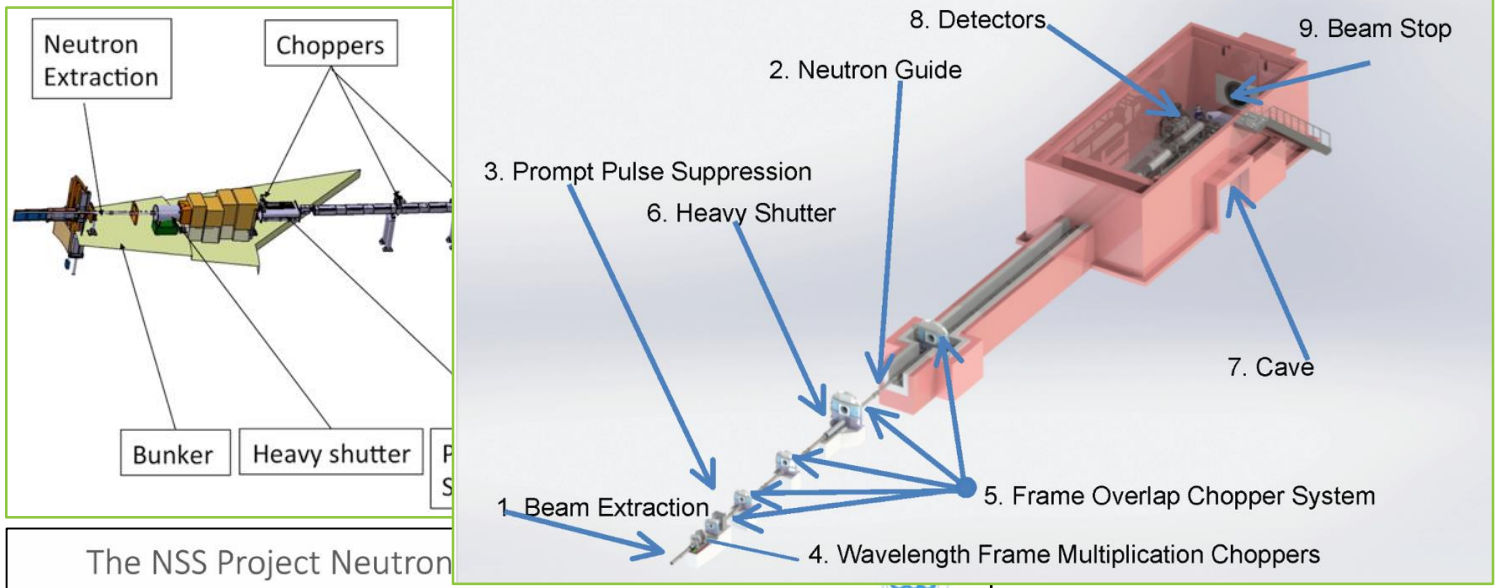
Key technologies and common projects:

Neutron bunker, radiation shielding, choppers, detectors, beam monitors and shutter systems



Procuring Equipment for Instrument

Example of Common chopper



The NSS Project Neutron

Including contribution common shielding and common chopper projects

	Neutron Instrument	Common Shielding Project	Common Chopper Project	Budget (M€)	Partners *(% includes ESS common projects)*
86.7 % of Instrument IK scope is in signed TAs	LOKI (Broad band SANS)			12.85	ISIS (81%) + ESS (19%)
	SKADI (General Purpose SANS)			11.50	FZJ (50%) + LLB (50%)
	ESTIA (Focusing Reflectometer)			11.80	PSI (100%)
	FREIA (Liquids Reflectometer)			13.20	ISIS (78%) + ESS (22%)
Confirmed (racks only)	DREAM (Bispectral powder diffractometer)	●	●	13.66	FZJ (76%) + LLB (20%) + ESS (4%)
Potential	HEIMDAL (Hybrid diffractometer)	●	●	13.55	Åarhus U. (30%) + PSI (35%) + IFE (25%) + ESS (10%)
	MAGIC (magnetism single xtal diffraction)	●	●	13.10	LLB (52%) + FZJ (24%) + PSI (16%) + ESS (8%)
	NMX (Macromolecular crystallography)	●	●	11.67	ESS (24%) + WI/IER(53%) + Bergen (22%) + LLB (7%)
	BEER (Engineering diffractometer)	●	○	14.99	NPI (50%) + HZG (50%)
ESS Common Shielding saves time and > 2.5 M€	ODIN (multi-purpose imaging)	●		11.76	TUM (60%) + PSI (36%) & ESS (4%)
	BIFROST (extreme environment spectro.)	●	○	13.45	DTU/KU (23%) +PSI (27%) +IFE(14%) +LLB (20%) +ESS (16%)
ESS Common Choppers saves time and ~ 1.5M€	C-SPEC (cold chopper spectrometer)	●	○	16.50	TUM (50%) + LLB (40%) + ESS (10%)
	T-REX (bispectral chopper spectrometer)	○	○	16.85	FZJ (75%) + Perugia U. (25%)
	VESPA (vibrational spectroscopy)	●	○	12.00	CNR (100%)
	MIRACLES (backscattering spectrometer)	●	●	13.4	ESS-Bilbao (89%) + KU (2%) + ESS (9%)
				200.28	

August 2020 7

Common chopper CE-Marked Adaptation to Instrument:

1. HazId → Directives identified
2. Risk Assessment and proposed mitigations
3. Implement the mitigation
4. Compile technical documentation
5. DoC is issued
6. CE-mark is applied to the equipment

Project Status

Heavy Shutter

	Task no.	TA ID	Deliverables – Project Results	Delivery Date	Status	
TUM	WU 03	2-8	Heavy Shutter*	Oct 2021	Tender Sep 2021	

In-Bunker main components:

- Installation window: 11.8.21 – 25.2.22
- Heavy shutter (TUM):
- Design constraints
  - Pillars + Roof beams + Expansion gap (floor)
  - Max length required: 1.6m
  - Dose requirement: max 3μSv/h in Cave, and 25μSv/h in FOC5 pit
  - Safety factor: 2
- Stopper preliminary design ready:
  - Total thickness 1.2m ✓
  - Maximum attenuation: 1cm B4C + 24cm Steel + 96cm Copper
  - Total Dose: 0.5μSv/h (Cave) and 1.4μSv/h (FOC5 Pit) ✓
  - Guide vacuum vessel: scope of Axilon/SNAG ✓

* Item agreed to be procured by ESS for TUM

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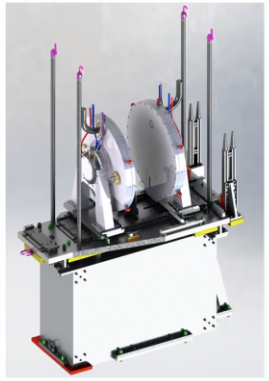
Project Status

Choppers

	Task no.	TA ID	Deliverables – Project Results	Delivery Date	Status	
TUM	WU 05	16-25	Choppers*	Jun 2021	subTG3 accomplished	ok

In-Bunker main components:

- Installation window: Jun 21 – Feb 22
- Choppers (TUM)
  - Contract signed with AIRBUS in June 2019
  - subTG3 done Aug 2020 ✓
  - FAT scheduled in March 2021
  - SAT: July 2021
  - Pedestals, WFMC Motion Table and Alignment Interfaces designed and procured by TUM.
  - Choppers on schedule ✓
  - Status OK

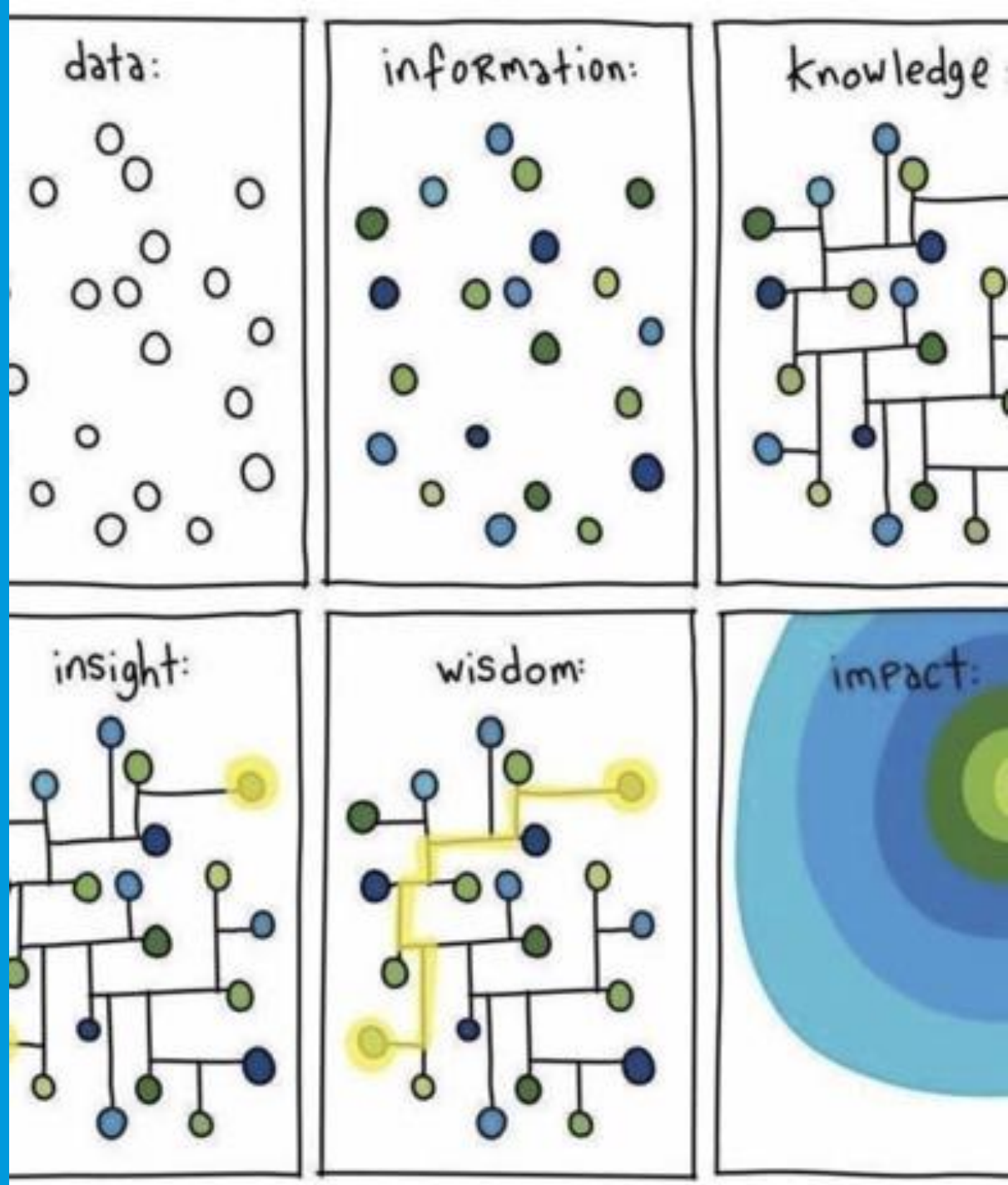


* Item agreed to be procured by ESS for TUM

23

What you could know about Research Infrastructures…

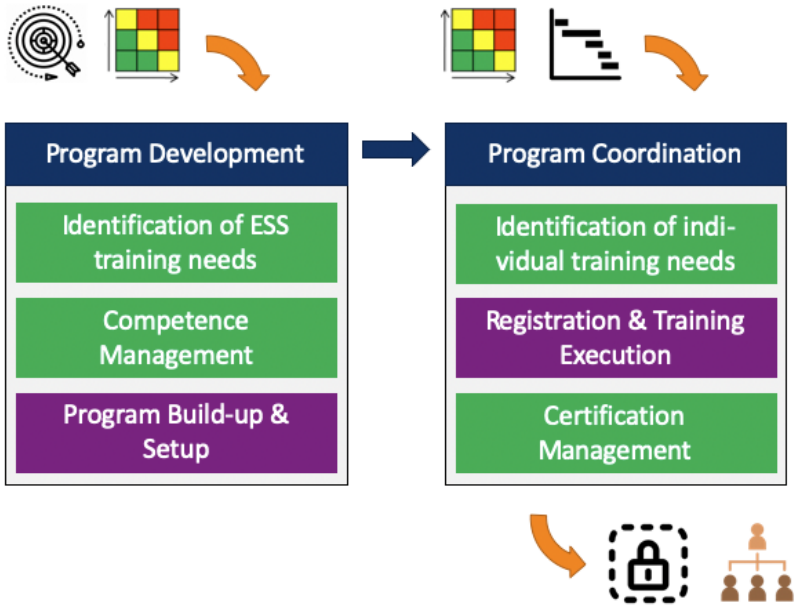
- A novel way to learn: ESS Learning Lounge (LMS)
- Innovations based on RI
- Learning more about Physics



A novel way to learn

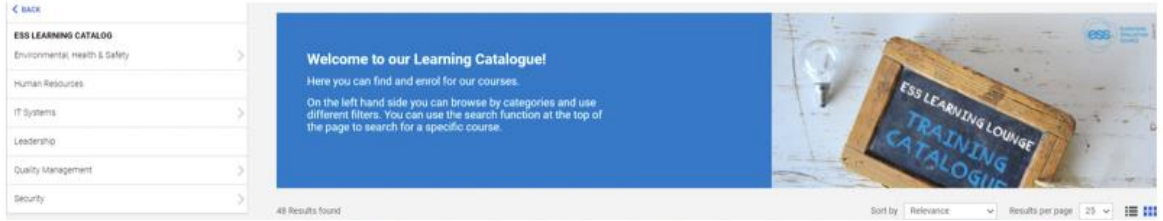
Courtesy Lars Aprin

ESS Learning Lounge



A glimpse into our LMS

Visit us at https://ess.sabacloud.com



SABA

VISMA

Training plans based on roles

Tell me what your role is, and I'll tell you what trainings you need.

Role: Electrical Work at G01

Implementation is being done in LMS (Learner & Supervisor)

Association between "role" and "curriculum" is based on SME knowledge

Location	Curriculum
G01: warm linac	G01 Training
G01: warm linac	RP Awareness
G01: warm linac	RP Controlled Area
…	…

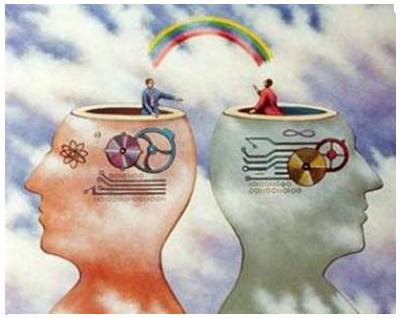
This approach is about to start very soon. First prototypes: Test Stand 2, First Responders, G buildings

Innovations based on RI

Technology and knowledge transfer

State-of-the-art equipment by specifications:

- Research to develop improved materials - radiation hardness, halogen free, cryogenics
- Extreme Sample Environment conditions - high pressure, high temperature
- In-Kind model and Technology Demonstrators
- Directives and their applications - MD, Explosive environment ATEX
- Data - Fastest electronics, DMSC, AI and ML
- Quantity – superconductors, exotic materials
- Novel ways to communicate – WWW, VR, AR



Fractality and entanglement

Networks - LEAPS, LENS, ENRIIC, Big Science Business Forum

The EDUSAFE integrated safety system uses a camera mounted on the helmet to monitor the working area.

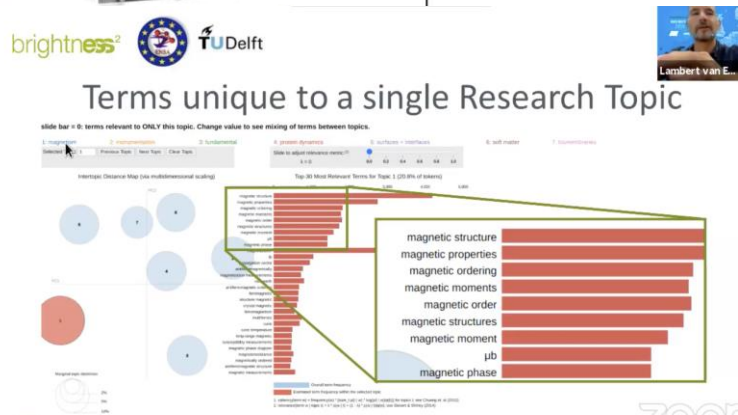
Reasons of being of Research Infrastructures: Discovery Science

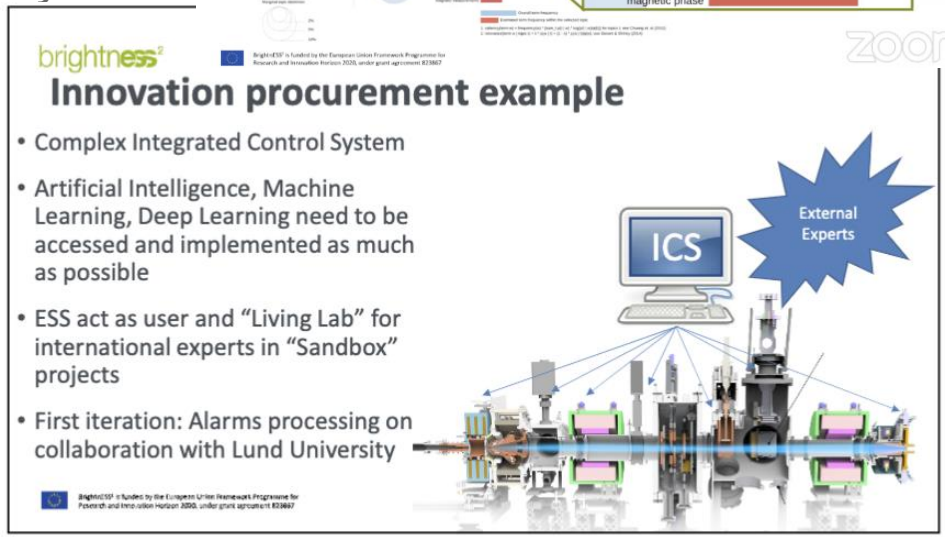
→ See Connecting Industrial R&D Staff to State-of-the-Art Neutron Methods

Tools to guide industries and beyond

Innovative Platforms to learn more and better – The diverse audience / Users

- Industrials to know what relevant equipment to procure
- Industrials to benefit from state-of-the-art researches
- In-Kind - quality, training, legacy
- Academic Users – How to use instrument, training (LSM)
- Public and High school teachers and their learners
- Unified users community: LS and NS
- Politicians and Sponsors - show societal challenges and sustainability
- Universities to train professor and their students
- Tax payer - Return on Investment





More Innovations:

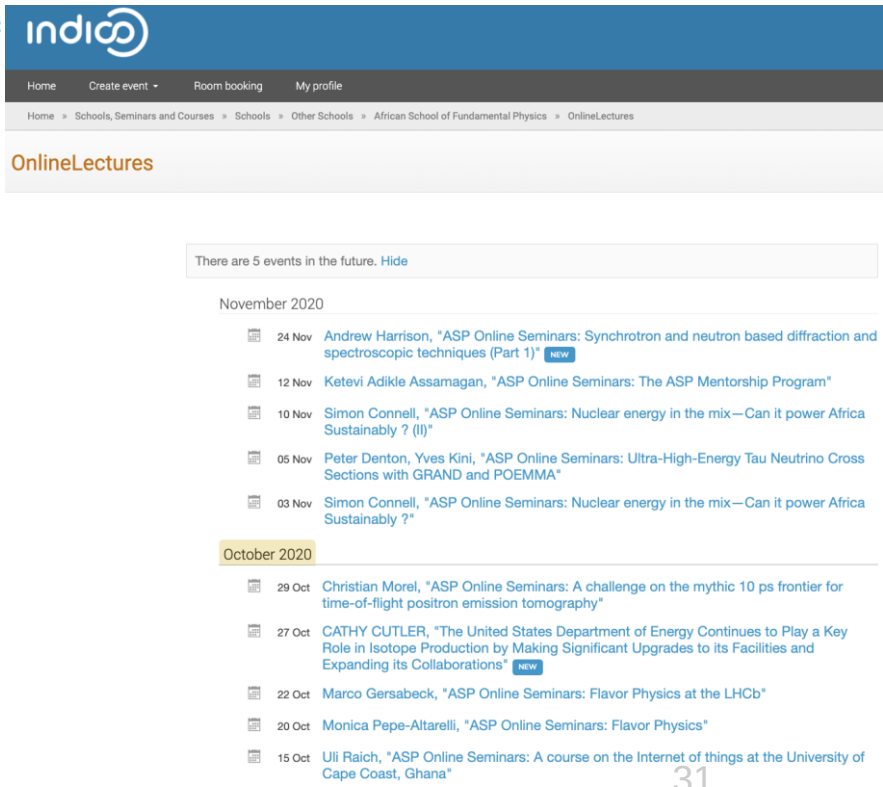
- Communication tools - MOOC, Zoom webinar
- Virtual and Augmented Realities - safer assembly and repair
- Build data-base, On-line courses …

Learning and surviving

The new connected Brave New World …

- ASP - https://www.africanschoolofphysics.org/online-lecture-series/ ; e.g.
  - BNL / Light Sources: "Synchrotron based methods for materials characterization" Part (1)
  - Diamond: "ASP Online Seminars: Synchrotron and neutron based diffraction and spectroscopic techniques (Part 1)"

- Diamond LS – Twitter, Materials science w/ scattering & diffraction #TheLightStuff
- International Association of Physics Students – Facebook
- Nordic Particle Accelerator Project: Massive Open-Online Courses: www.npap.eu



And still the old fashon way… Publications and Journals:

- ESS - What do neutrons tell us:
  - "The instrument suite of the European Spallation Source", NIMS
  - "The European Spallation Source Design", Physica Scripta

Summary

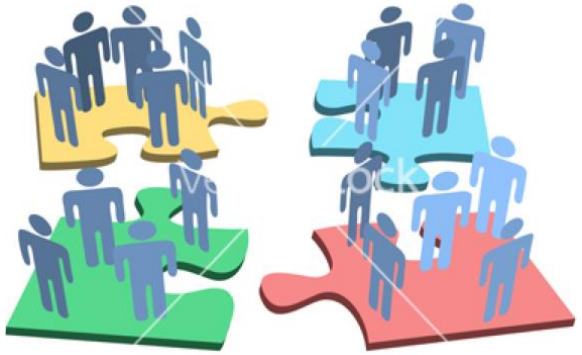
Beyond Safety Radiation.. building capacity

Research Infrastructures are safe and in compliance with European Directives

Transfer of Knowledge & Technology and Return on Investment as a synergy for Industry

RI encourage novel methodologies and tools to support sustainable and SMART projects

Thank you for your attention!



Any Questions? Want to know more?

Website : **http://cdarve.web.cern.ch**

Contact me : **Christine.darve@ess.eu**

Accelerate Webinar Series

Radiation Safety and Quality at Research Infrastructures

Connecting Industrial R&D Staff to State-of-the-Art Neutron Methods

4th November : Nanoscale to Microscale Structural Analysis with Neutrons
Dr. Judith Houston

11th November : Neutron protein crystallography reveals molecular details of inhibitor binding to clinical targets.
Dr. Zöe Fisher

25th November : Non-destructive testing with neutrons: Revealing (micro-) structural properties and providing unique contrast inside large samples and assembled components
Dr. Robin Woracek

Legal dose limits and dose constraints established at ESS

ESS Supervised Area

	Limit Cat A	Limit Cat B	Constraint (set by ESS GSO, ESS-0000004)
Effective dose	20 mSv[1]	6 mSv	**As Low As Reasonable Achievable**, and in any case less than: Individual dose ≤ 2 mSv[2]
Equivalent dose to the lens of eyes	20 mSv[1]	15 mSv	≤ 15 mSv
Equivalent dose to the skin	500 mSv	150 mSv	≤ 50 mSv[2]
Equivalent dose to hands, feet	500 mSv	150 mSv	≤ 50 mSv[2]

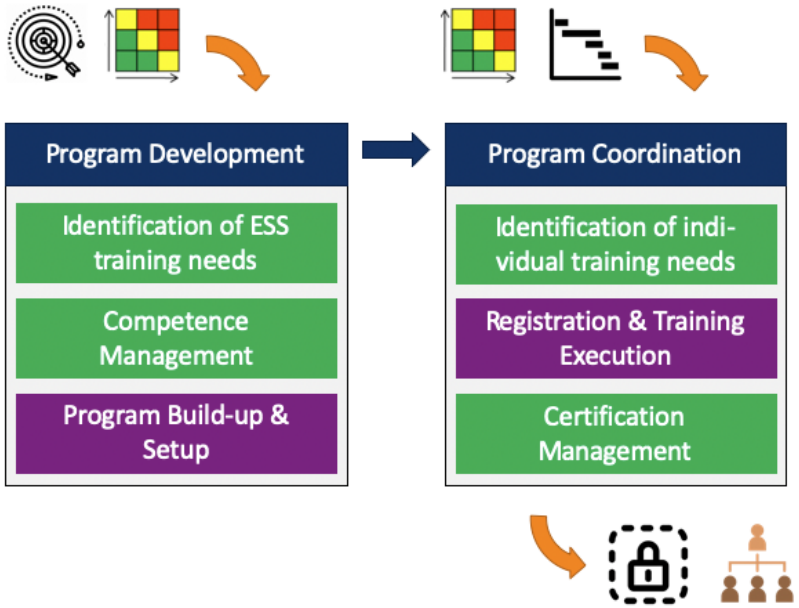
[1] New dose limits in accordance with European directive 2013/59, new Swedish regulations from February 2018.

[2] ESS objective is 10% of dose limit

A novel way to learn

Courtesy Lars Aprin

ESS Learning Lounge



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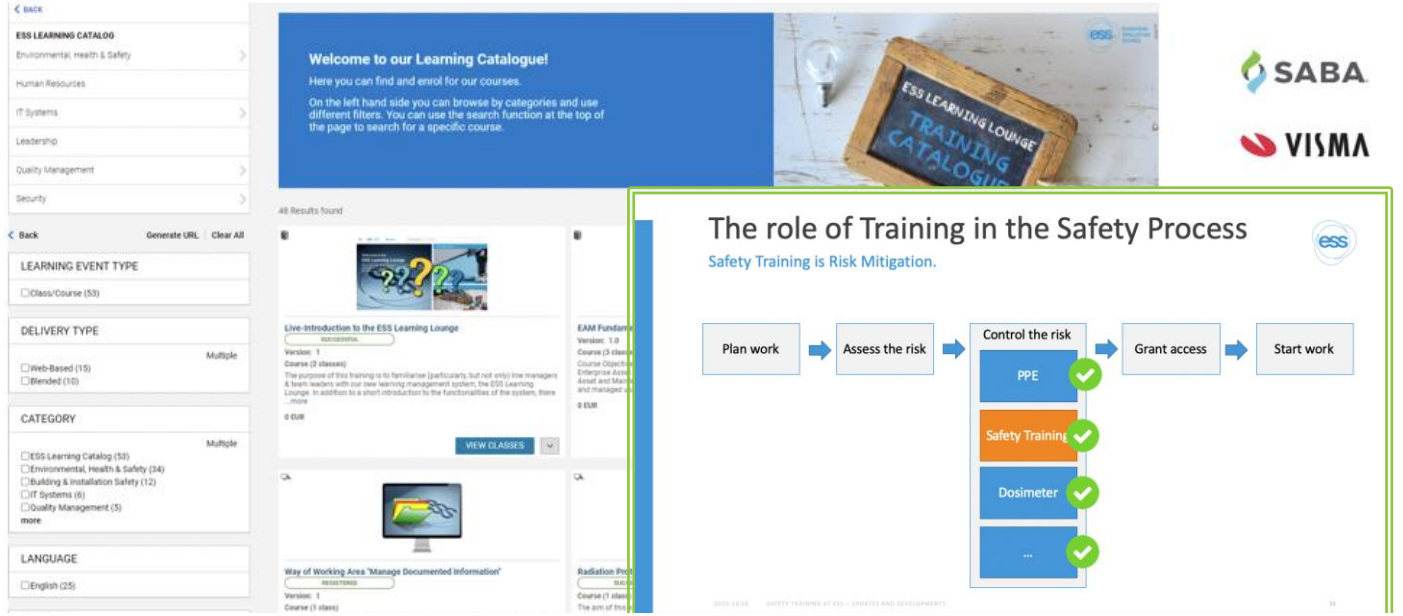

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...	...

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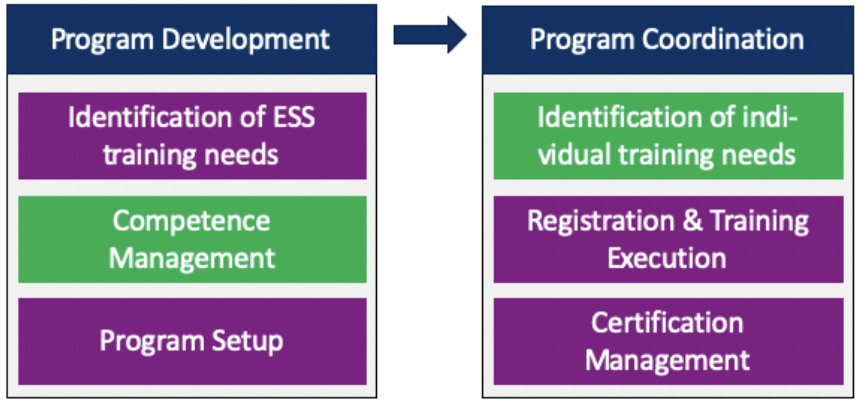
First prototypes: Test Stand 2, First Responders, G buildings

I. Identification of targets groups (roles) per domain
II. Identification of competences per role
III. Identification of curricula per role



I. Assignation of role(s) to the learner
II. Automatic enrolment to curricula linked to role(s)

(See next slide)