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Training for Nuclear Decommissioning

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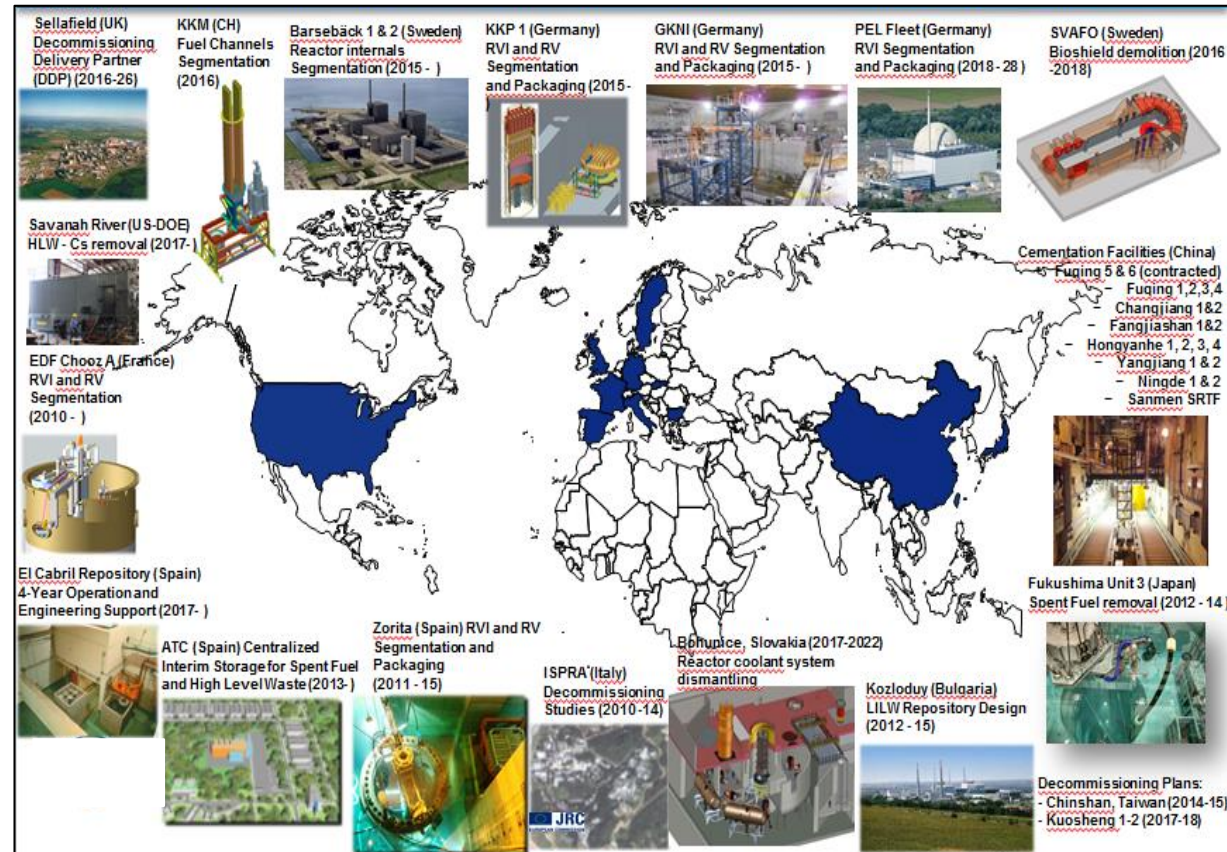
DigiDecom2019, Halden, 19 June 2019

Agenda

- Introduction
- Training Programs
 - Classroom training
 - Hands-on training
 - Site visits
- Examples
- Conclusions
- Q&A

Introduction

- Several nuclear facilities goes into decommissioning in the coming years
- Owners, stakeholders, regulators and the supply chain needs to be properly prepared
- Training in nuclear decommissioning by experienced persons is one way to prepare properly



Training Programs

- Westinghouse has prepared several training programs
 - For different customers
 - For different purposes
- A decommissioning training can comprise
 - Single courses
 - Tailor made programs
 - Basic training
 - Advanced training

Hands-on Segmentation Training

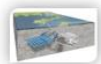
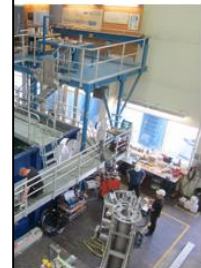


Decommissioning Project Planning Training

Westinghouse Electric Company

Västerås, Sweden

October 29 – November 16



Training Programs

- The training programs contain different types of training to maximize the learning:
 - Classroom
 - Hands-on
 - Site visits
- Classroom training
 - Traditional theoretical training
 - Real examples
 - Lessons learned



By involving lessons learned the trainees get examples of good and bad performance as well as cause

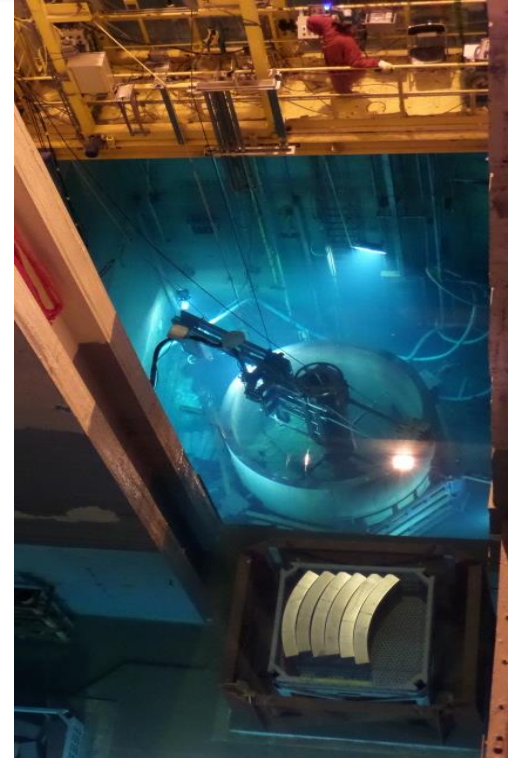
Training Programs

- Hands-on training
 - Starting with theory
 - Equipment setup and operation
 - Mock-up cutting or equivalent
 - Based on previous classroom training
- Site visits
 - Decommissioning activities
 - National systems (disposal facilities, transport systems, interim storages)
 - Combine with learning in classroom



Training Programs

- Some of the most popular training topics are:
 - Introduction to decommissioning
 - Decommissioning planning and cost estimation
 - Characterization
 - Decontamination techniques and applications
 - Segmentation of reactor vessel internals and reactor pressure vessels
 - Major components removal
 - Dismantling and demolition techniques
 - Biological shield demolition
 - Radioactive waste estimation
 - Waste management technologies and equipment



Examples

Introduction to decommissioning

- Trainees: No prior decommissioning knowledge
- Basic or introductory training courses comprising topics:
 - Planning
 - Decommissioning regulation
 - WBS
 - Scheduling
 - Cost estimation
 - Characterization
 - Full system decontamination
 - Segmentation of reactor internals and RPV
 - Radioactive waste estimation
 - Dismantling techniques
 - Demolition techniques
- 3 weeks training including site visits to decommissioning site and final disposal facility

DAY		Estimated time (h)
TUESDAY 18	Welcome, introduction, and general instructions	1
	Regulations IAEA/USA	4
	Decommissioning strategies	3
WEDNESDAY 19	Decommissioning strategies for BWR/PWR	5
	Characterization: Activation analysis (Vandellos I/Zorita cases)	3
THURSDAY 20	Characterization activated zones sampling Vandellos I and Zorita cases	4
	Vandellos I: overview of a SAFSTOR project	2
	Characterization : waste characterization	2
FRIDAY 21	Site preparatory works (site reorganization, general functions and case studies: building modifications for decommissioning (CIEMAT/ZORITA)	8
MONDAY 24	Characterization : General strategy and contaminated zones/equipment	2
	Decontamination (full system decontamination, decontamination workshops, concrete decontamination, case studies CIEMAT/VANDELLOS I)	6
TUESDAY 25	Available dismantling techniques	2
	Dismantling techniques for RPV& its internals and large equipment	2
	Zorita reactor internals and vessel segmentation experience	4
WEDNESDAY 26	Demolition techniques (removal of activated concrete and demolition techniques)	4
	Work breakdown structure	4
THURSDAY 27	Estimation of radioactive and hazardous waste	8
FRIDAY 28	Cost estimation	8

Examples

Advanced decommissioning planning

- Trainees: Basic decommissioning background, no practical experience
- Purpose for trainees to perform D&D tasks after training
- Advanced training courses including:
 - Decommissioning strategies
 - Waste management
 - Waste estimation
 - WBS & Scheduling
 - Cost estimation
 - Internals and RPV segmentation
 - Large components removal
 - Logistics in decommissioning
- 3 weeks training including site visits to decommissioning sites and disposal facilities

DAY	TOPIC	Estimated time (h)	KEY TOPICS
MONDAY	Classroom training 9, WBS Methodology	4	<ul style="list-style-type: none"> • Man-hour estimation (team composition, macro-components, productivity rates, difficulty factors) • Work procedures • WBS and cost analysis for segmentation • WBS for full system decontamination • WBS for large components and bioshield
	Classroom training 10, Scheduling	4	<ul style="list-style-type: none"> • Decommissioning schedule set up • Interdependencies between activities • WBS and schedule dependency • Schedule analysis • Case studies
TUESDAY	Classroom training 11, Safety and Radiation Protection During Decommissioning	4	<ul style="list-style-type: none"> • Risk, safety, precautions and response measures • Exercises and presentation • Classroom discussions
	Classroom training 12, Dismantling & Demolition Techniques	4	<ul style="list-style-type: none"> • Dismantling techniques • Demolition techniques • Removal of activated and contaminated concrete • Case study, biological shield demolition
WEDNESDAY	Visit SKB's Facilities in Forsmark	8	<ul style="list-style-type: none"> • SFR – Final repository for short-lived low and intermediate level waste • Information and guided tour.
THURSDAY	Classroom training 13, Logistics in Decommissioning	4	<ul style="list-style-type: none"> • Introduction • Logistics in decommissioning planning • Case study: Large components removal
	Classroom training 14, Cost Estimation 1	4	<ul style="list-style-type: none"> • Introduction to decommissioning cost estimation • Basis of Estimate • Cost Breakdown Structure • Cost elements
FRIDAY	Classroom training 15, Cost Estimation 2	8	<ul style="list-style-type: none"> • Uncertainties in decommissioning cost estimation • Contingency & risk estimation and calculation • Benchmarking • Exercises in cost estimation

Examples

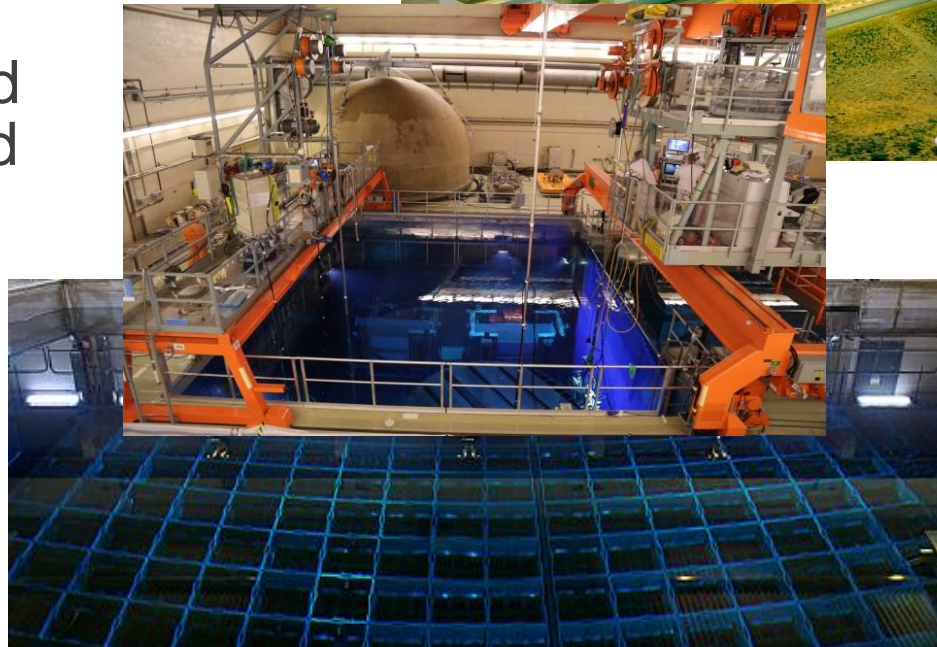
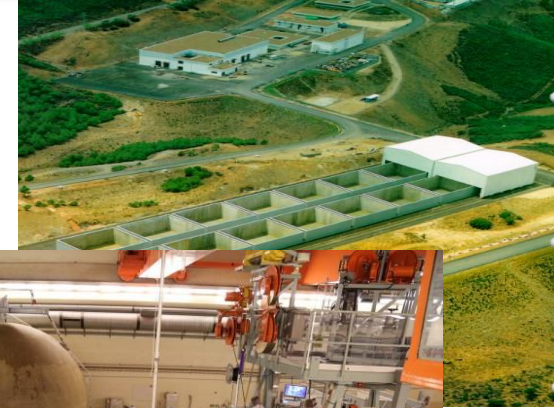
Hands-on segmentation training

- Trainees: Experienced decommissioning people training for decommissioning in practice
- Mix of theoretical and practical courses including:
 - Segmentation classroom and hands-on training in the following areas
 - Advanced segmentation technologies
 - Preparatory work
 - Hydraulic training
 - Working bridge, pole handling and camera training
 - Shearing tool training
 - Disc cutting training
 - Band saw training
 - Packaging training
 - Dismantling planning
 - Full system decontamination
 - Worker dose estimation
 - Waste estimation
 - Bioshield demolition
 - Waste packages
 - WBS methodology
 - Cost estimation
- 3 weeks training including site visits to decommissioning sites and disposal facilities

DAY		Estimated time (h)	KEY TOPICS
MONDAY 20	RPV&I dismantling mock up training 5, Band sawing training.	8	<ul style="list-style-type: none"> • Detailed information on design of band saw tools. • Positioning of band saw tools to mock-up. • Instructions and practical training on mock-up (cutting).
TUESDAY 21	RPV&I dismantling mock up training 6, Packaging training.	4	<ul style="list-style-type: none"> • Information and handling of different systems. • Instructions for optimization of packaging. • Practical training on packaging.
	RPV&I dismantling mock up training 7, Introduction to Repair and Modifications	4	<ul style="list-style-type: none"> • Electrical Discharge Machning (EDM) • Mechanical Clamp Repairs • Laser • Virutal Reality
WEDNESDAY 22	Classroom training 4, Segmentation - RPV & Internal dismantling plan case study.	4	Adapting knowledge from training to Chinshan/Kuosheng (or other examples) dismantling plan case study.
	Classroom training 5, Segmentation - RPV & Internal dismantling plan case study.	4	<ul style="list-style-type: none"> • Identify information for RFQ (work scope). • Applying the preparatory work on the case study.
THURSDAY 23	Classroom training 6, Focused Topics - Full system decontamination.	4	<ul style="list-style-type: none"> • Full system decon vs. sub system decon. • Chemical fundamentals and processes for decontamination. • Real life application of the DfD process.
	Classroom training 7, Focused Topics - Worker dose estimation.	4	<ul style="list-style-type: none"> • Dose exposure during decommissioning. • Historical dose exposures during segmentation projects. • Dose estimations based on historical data.

Conclusions

- Owners, stakeholders, regulators and the supply chain needs to be properly prepared for decommissioning
- A combination of theoretical and practical training is effective and appreciated by trainees
- Show examples from real decommissioning projects
- Include session on lessons learned from actual projects in each training to gain best experience and knowledge transfer



Q&A

Thank you for your attention!

