European ALARA Network

Workshop n°18

(jointly organized with ISOE)

ALARA for decommissioning and site remediation

11, 12 & 13 March 2019

Institut de Chimie Séparative de Marcoule
ICSM UMR 5257 – CEA / CNRS / UM / ENSCM
Marcoule Nuclear Research Centre, Building No. 426
BP 17171, F-30207 Bagnols sur Cèze Cedex, FRANCE

Content

Context and objectives

The European ALARA Network[1] has been funded in 1996 to promote a wider and more uniform implementation of the ALARA principle for the management of worker, public and patient radiation exposures in all situations, as well as provide a focus and a mechanism for the exchange and dissemination of information from practical ALARA experiences. The EAN is co-ordinated by the Nuclear Protection Evaluation Centre (CEPN, France) and Public Health England (PHE).

Among its activities, EAN is regularly organizing workshops on specific topics, to provide a forum for experts and stakeholders to discuss, exchange feedback experience and also identify issues that need further research and guidance. To promote discussion and exchanges appropriate time is made available for work in small working groups (cf. p. 11).

The topic selected for the 18th workshop is **ALARA for Decommissioning and Site Remediation**[2]. The workshop is jointly organized with the ISOE[3] Working Group on Decommissioning (ISOE WG-DECOM).

The objectives of the workshop are:

1. To present the **regulatory background and latest guidance and standards** regarding radiation protection for decommissioning and site remediation; both in the nuclear and the non-nuclear sectors.

2. To **examine the conceptual and the practical aspects of the optimisation (ALARA) principle in these fields** for workers and the public.
   The workshop aims at gathering an array of experience and feedback from work performed in nuclear installations (ex. nuclear power plants, fuel cycle facilities), and also installations outside the nuclear fuel cycle (ex. research facilities) and legacy sites.

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[1] https://www.eu-alara.net

[2] The terms "*decommissioning*" and "*remediation*" can have different meaning for different publication and audience. The International Atomic Energy Agency Safety Glossary (2007) defines

- decommissioning as "*administrative and technical actions taken to allow the removal of some or all of the regulatory control from a facility*"
- and remediation as the "*measures carried out to reduce the radiation exposure from existing contamination of land areas through actions applied to the contamination it-self or the pathways to humans*".

IAEA uses the term clean-up for actions taken to reduce the impact of site that are undergoing decommissioning; so here the generic term of remediation is used to encompass clean-up (among other) during decommissioning.

[3] http://www.isoe-network.net

3. To discuss and investigate selected key themes and overriding issues with regard to ALARA: the **holistic (i.e. integrated) approach** and **waste** have been selected. And finally to identify remaining needs and perspectives.

At the end of the Workshop, the Chairpersons and the working groups representatives will propose to the participants some elements conclusions and recommendations. These conclusions and recommendations are aiming to be advertise and broadcast to relevant stakeholders.

We wish you a pleasant and fruitful workshop!
The Programme Committee

The programme committee

Mr. Sylvain Andresz	Nuclear Protection Evaluation Centre (CEPN), France
Mr. Ignacio Calavia Gimenez	Spanish Nuclear Authority (CSN), ISOE WG-DECOM, Spain
Ms. Petra Hansson	Swedish Radiation Safety Authority (SSM), Sweden
Mr. Marc Lahfid	CEA Marcoule, France
Mr. Paul Livolsi	CEA-INSTN, France
Ms. Julie Gilchrist	Public Health England (PHE), EAN Secretary, United Kingdom
Mr. Bernd Rehs,	Federal Office for the Safety of Nuclear Waste Management (BfE), Germany
Mr. John H. Rowat	IAEA, Decommissioning and Remediation Unit, Austria
Ms. Caroline Schieber	Nuclear Protection Evaluation Centre (CEPN), France, Head of ISOE-European Technical Centre
Mr. Nicolas Stritt,	Federal Office of Public Health (FOPH), EAN Treasurer, Switzerland
Mr. Ludovic Vaillant	Nuclear Protection Evaluation Centre (CEPN), France
Mr. Fernand Vermeersch,	SCK•CEN, EAN Chairman, Belgium

MONDAY 11 MARCH

7:30		BUS SHUTTLE MEETING *Boulevard du Rhône parking lot, Avignon*
8:30	9:00	REGISTRATION

SESSION 1. SETTING THE SCENE

Chairs: Mr. F. Vermeersch & Mr. L. Vaillant

9:00	9:30	Introduction Mr. J-M. Carrere, Direction of CEA-Marcoule Centre, France Presentation of former EAN workshops on the theme and the reasons to organize a new workshop Mr. F. Vermeersch, EAN Chairman, SCK•CEN, Belgium
9:30	9:45	ALARA issues in decommissioning: the point of view of the ISOE WG-DECOM Mr. L. Vaillant, CEPN, France
9:45	10:00	IAEA recommendations and guidance with regard to radiation protection for decommissioning and site remediation Mr. J. Rowat, IAEA, United Kingdom
10:00	10:15	Creation of NEA Committee on Decommissioning and Legacy Management: Mrs. G. Kwong, NEA, France
10:15	10:30	Regulatory Requirements for Radiation Protection in Decommissioning in Germany Dr. B. Rehs, BfE, Germany
10:30	11:00	*COFFEE BREAK*

SESSION 2. ALARA FOR DECOMMISSIONING AND REMEDIATION OF NUCLEAR INSTALLATIONS (1/2)

Chair: Mr. M. Lahfid & Mr. F. Vermeersch

11:00	11:20	Scenarios and strategy for dismantling hot cell M2 at LHMA installation, Mol Mr. Ph. Antoine, SCK•CEN, Belgium
11:20	11:40	Dose estimation and optimisation during the decommissioning of the Low Flux Reactor in Petten, the Netherlands Mr. F. Draaisma, NRG, The Netherlands
11:40	12:00	ALARA Approach – Dismantling PIT7 Decladding Build Mr. F. Petitot, CEA Marcoule, France ; Mr. C. Durain Orano, France
12:00	12:20	Radiological characterization to lay the foundation of ALARA. Experience from Mühleberg NPP Mr. E. Neukäter, BKW Energie, Switzerland
12:20	13:30	*LUNCH*

SESSION 2. ALARA FOR DECOMMISSIONING AND REMEDIATION OF NUCLEAR INSTALLATIONS (2/2)

Chair: Mr. G. Ranchoux & Mr. S. Andresz

13:30	13:50	The decommissioning of research installations at CIEMAT in Madrid Mr. J. C. S. Vergara, CIEMAT, Spain
13:50	14:10	The site remediation of the FBFC fuel cycle facility in Dessel, Belgium Mrs. C. Mommaert, Bel V, Belgium
14:10	14:30	Full system decontamination, under ALARA point of view Dr. M. Knaack, TÜV Nord, Germany
14:30	14:40	Introduction to the Working Groups Mr. S. Andresz, CEPN, France
14:40	15:00	*COFFEE BREAK*
15:00	16:45	**WORKING GROUPS (1/2)**
17:00		BUS SHUTTLE MEETING at ICSM parking *Back to Boulevard du Rhône parking lot, Avignon*

TUESDAY 12 MARCH

8:00		BUS SHUTTLE MEETING *At Boulevard du Rhône parking lot, Avignon*

SESSION 3. ALARA FOR DECOMMISSIONING AND REMEDIATION OF SITE OUTSIDE THE NUCLEAR SECTOR

Chair: Mrs. J. Gilchrist & Mr. L. Vaillant

9:00	9:20	The Radium Action Plan in Switzerland Mrs. M. Palacios, SFOPH, Switzerland
9:20	9:40	Remediation of a former gas mantle factory contaminated with radioactive ^{232}Th Mr. A. Lowe, PHE, United Kingdom
9:40	10:00	Radiation protection in the management of radioactive geological material in private buildings Mr. J. Amoudruz, IRSN, France
10:00	10:20	Remediation and release of the Randstad uranium mining and milling site Mr. H. Efraimsson, SSM, Sweden
10:20	10:50	*COFFEE BREAK*

SESSION 4. TRANSVERSAL AND OVERRIDING ISSUES: HOLISTIC APPROACH AND WASTE (1/2)

Chair: Mr. E. Neukäter & Mr. J. Rowat

10:50	11:10	Radioactivity and Asbestos at EDF/DP2D Mr. G. Ranchoux, EDF/DP2D, France
11:10	11:30	Choosing a strategy for waste: recycling? disposal? experience from an Italian Agency Mrs. M. R. Rosella, ARPA Lombardie, Italie
11:30	12:00	Risk Management at Legacy Sites and Facilities: Implications for Proportionate Risk Management and a Graded Approach to Risk Assessment Mr G. Smith, United Kingdom
12:00	13:00	*LUNCH*

SESSION 4. TRANSVERSAL AND OVERRIDING ISSUES: HOLISTIC APPROACH AND WASTE (2/2)

Chair: Mr. B. Rehs & Mr. L. Vaillant

13:00	13:20	Decommissioning of non-nuclear facilities: insight into the process Mr. A. Bloot, Applus RTD, The Netherland
13:20	13:40	Restricted Clearance - PAHs leading to challenge in dismantling Mrs. S. Fleck, VKTA Rossendorf, Germany
13:40	14:00	The Local Commission of Information of Marcoule: An Example of Public Involvement in the Decommissioning Mrs. Ch. Mouchet, CLI Marcoule, France (*to be confirmed*)
14:00	16:30	**WORKING GROUP (2/2)** including a *COFFEE BREAK served at 15:20*
16:30		BUS SHUTTLE MEETING at ICSM parking **RECREATION VISITS and TASTING of the products of the region** *Sainte-Cécile-les-Vignes • Tulette* *Back to Boulevard du Rhône parking lot, Avignon at 19:45-20:00*

WEDNESDAY 13 MARCH

8:00 — BUS SHUTTLE MEETING
Boulevard du Rhône parking lot, Avignon

Room A1-11a will be made available to participants to store their luggage.

WORKING GROUPS REPORTS

Chair: Mrs. J. Gilchrist & Mr. F. Vermeersch

9:00	9:20	**WG1 - How to apply ALARA for workers in decommissioning and remediation?** WG1's Rapporteur
9:20	9:40	**WG2 - How to apply ALARA for workers in decommissioning and remediation?** WG2's Rapporteur
9:40	10:00	**WG3 - The holistic approach in risk management: how to be ALARA in the context of other risks?** WG3's Rapporteur
10:00	10:20	**WG4 - The challenges raised by waste and how to overcome?** WG4's Rapporteur
10:20	11:00	COFFEE BREAK
11:00	11:45	**Conclusions and recommendations of the workshop** **Discussions** **Farwell and next workshop** EAN Representative(s)
12:00	13:00	LUNCH *Including* *the distribution of the badge at 12:45 (for the technical visit)*

13:00 — For participants not taking part to the technical visit:

BUS SHUTTLE MEETING at ICSM parking
To Avignon TGV, then to Boulevard du Rhône parking lot, Avignon

For participants taking part to the
TECHNICAL VISIT

13:15		BUS SHUTTLES MEETING at ICSM parking
13:15	13:30	**Transfer to Marcoule Centre** (2 buses) **and formalities**
13:40	14:20	As 1 group: **Visit of INFODEM**
14:30	16:25	Visit in 2 groups: **Visit of HERA installations and PHENIX fast-breeder reactor**
16:45	17:00	**Transfer to ICSM parking** (2 buses) **Collecting the luggage stored at ICSM** (Room A1-11a)
17:15		BUS SHUTTLE DEPARTURE *To Avignon TGV and to Boulevard du Rhône parking lot, Avignon*

Working groups, topics and questions

A significant part of the EAN Workshop program is devoted to discussions within working groups:

- Monday (15:00 – 16:45) for introduction and preliminary debate;
- Tuesday (14:00 – 16:30) for final discussion, preparation of recommendations (power point) and brief meeting with the working group facilitators.
- Wednesday (09:00 to 10:20) the working group Representatives (Rapporteur) reports back to the audience.

Questions are provided to *get the working group started* (these are not limited)

Working Group 1a

AUDITORIUM

How to apply ALARA for workers in the decommissioning and remediation?

Radiation protection challenges

- What are the challenges in applying the steps of ALARA?
- How are they different from operation?
- To which extent can the strategy and the end state have an influence on ALARA?
- Are there non-technical factors to take into-account?
- What solutions/approaches to recommend?

Are there remaining issues and needs?

- Technology? Characterisation?
- Specific training?
- …

PARTICIPANTS	
Vladimir	Achmedov
Philippe	Antoine
Andre	Bloot
Björn	Brunefors
Tim	Bursian
Abigail	Chilulu
Tanguy	Dasnoy-Sumell
Fabienne	De Smet
Michael	Knaack
Klaus	Germerdonk
Julie	Gilchrist
Ludovic	Vaillant

Working Group 1b

ROOM A1-8/A1-9

How to apply ALARA for workers in the decommissioning and remediation?

Radiation protection challenges

- What are the challenges in applying the steps of ALARA?
- How are they different from operation?
- To which extent can the strategy and the end state have an influence on ALARA?
- Are there non-technical factors to take into-account?
- What solutions/approaches to recommend?

Are there remaining issues and needs?

- Technology? Characterisation?
- Specific training?
- …

PARTICIPANTS	
Robin	Hanzl
Malgorzata	Kasprzak
Fotso Mayana	Linda
Adam	Lowe
Igor	Lozhnikov
Fabrice	Petitot
Aleksandr	Rakhuba
Gilles	Ranchoux
Tommi	Renvall
Thierry	Schneider
Dirk	Van Laere
Njigab Yefouo	Vanette
Sofie	Verreyt

Working Group 3

ROOM A1-10

The holistic approach: how to be ALARA in the context of other risks?

Examples of multi-risks situations and discussing experiences

- Deconstruction + remediation,
- Radioactivity + chemical, etc.

Challenges

- How to evaluate the risks and put them into balance to identify priorities? (and given the uncertainties)
- Can one risk overwhelm the others? Can the management of one risk be in contradiction with the management of others?
- What are the key points to implement a successful holistic strategy?

PARTICIPANTS	
Sylvain	Andresz
Jérome	Amoudruz
Folkert	Draaisma
Christophe	Durain
Henrik	Efraimsson
Franz	Kabrt
Chantal	Mommaert
Erwin	Neukäter
Stefan	Nijst
Martha	Palacios
John	Rowat
Graham	Smith
Fernand	Vermeersch

Working Group 4

ROOM A1-11b

The challenges raised by wastes and how to overcome?

Deciding a strategy for waste
- Factors that are to be considered

Radiological characterization of waste
- What is known, what is uncertain?
- Finding the optimum strategy?

Specificities
- How to manage mixed wastes: radiological + chemical
- Discussing environmental implications

PARTICIPANTS	
Alexandre	Dorsival
Sabine	Fleck
Fabio	Gueli
Gloria	Kwong
Marc	Lahfid
Bernd	Rehs
Rosella	Rusconi
José Carlos	Sáez
Benjamin	Schummer
Caroline	Simonucci
Joachim	Vollaire

ABSTRACTS

REGULATORY REQUIREMENTS FOR RADIATION PROTECTION IN DECOMMISSIONING IN GERMANY

Dr. Bernd REHS

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As a consequence of the nuclear accident at the NPP Fukushima Daiichi, on 11 March 2011 in Japan, the German legislator decided to phase out the use of nuclear power for the commercial generation of electricity on a step-by-step basis by the end of the year 2022 at the latest. Radiation protection in decommissioning needs careful previous planning within the licensing procedure for decommissioning as well as during implementation of dismantling measures within the supervisory procedure.

The legal regulatory framework for radiation protection in Germany was amended recently. On the one hand the new Radiation Protection Act [1] transposes the Council Directive 2013/59/EURATOM into national legislation. On the other hand the associated Radiation Protection Ordinance [2] came into force on 31. December 2018. Both are legally binding and rule the radiation protection principles, the dose limits for workers and public, the technical and operational measures for protection against damage from ionizing radiation and the clearance for operation as well as for decommissioning of nuclear facilities.

Below the level of laws and ordinances exist guiding documents, recommendations and rules with relevance for radiation protection in decommissioning, which are binding by specifications in the license or by the supervisory measure in the individual case. To these belongs the “Decommissioning Guide” [3], the recommendation of the Nuclear Waste Management Commission “Guidelines for the Decommissioning of Nuclear Facilities” [4] and the “Guideline for the protection against radiation of personnel during the execution of maintenance work, modification, disposal and the dismantling in nuclear installations and facilities Part II (IWRS II)” [5]. The latter describes radiation protection measures to be taken during the operation or decommissioning of an installation or facility, including procedures for optimization of radiation protection.

Decommissioning of a nuclear facility requires an adaption of the radiation protection measures to the requirements and changed framework conditions of dismantling. As a consequence, the definition of decontamination and dismantling techniques needs to reflect aspects of radiation protection as well as other aspects, leading to the question how to optimise the radiation protection measures in practice. Furthermore, the Radiation Protection Act stipulates to reduce exposures or contamination below the dose limits as low as possible.

[1] Radiation Protection Act (*Strahlenschutzgesetz*) of 27 June 2017, published in the Federal Law Gazette on 3 July 2017

[2] Radiation Protection Ordninance (*Strahlenschutzverordnung*), published in the Federal Law Gazette on 5 December 2018, in force coming 31 December 2018

[3] Guide to the decommissioning, the safe enclosure and the dismantling of facilities or parts thereof as defined in § 7 of the Atomic Energy Act“ as of 23 June 2016. (Banz AT 19.07.2016 B7)

[4] Recommendation of the Nuclear Waste Management Commission (ESK) of 16.03.2015: “Guidelines for the Decommissioning of Nuclear Facilities”

[5] Guideline for the protection against radiation of personnel during the execution of maintenance work, modification, disposal and the dismantling in nuclear installations and facilities Part II (IWRS II) of 17 January 2005

RADIOLOGICAL CHARACTERIZATION TO LAY THE FOUNDATION OF ALARA EXPERIENCE FROM MÜHLEBERG NPP

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The characterization of a plant or nuclear installation is one of the mayor issues of the dismantling. Describing the

- physical parameters of components and buildings,
- connected industrial safety hazards and
- radiological parameters

enables the planning of the dismantling process, starting with the preparation to apply for a dismantling license, planning the execution of the work and last but not least the measures to prove, that hazards left to the environment are acceptable within the legal framework.

The radiological characterization is a part of the whole characterization process describing the relevant conditions from the radiation protection point of view. This presentation focusses on only a small, but concerning dose to staff a very important, part of the former. The procedures of defining the specific radioactivity of components inside and outside of the reactor pressure vessel caused by activation are described. This is a prerequisite for the optimized cutting and packaging of the radioactive waste into containers to be stored in an interim storage later.

THE DECOMMISSIONING OF RESEARCH FACILITIES AT CIEMAT IN MADRID

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INTRODUCTION

The CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas) is a public research body, focusing on energy and environment and the technologies related to them. It has offices in several different regions of Spain, and its activity is structured around projects which form a bridge between R&D&I and social interest goals.

The CIEMAT took over from the old Junta de Energía Nuclear (JEN), which since 1951 had led research in nuclear fission energy production and control in Spain. In the decade of the eighties, it opened to new energy alternatives and to applied study of the environmental impact of energy. At present, the main lines of action are the study, development, promotion and optimisation of various sources as: renewable energies, nuclear fusion, nuclear fission and fossil fuels; the study of their impact on the environment, development of new technologies; not forgetting areas of basic research such as high-energy physics and molecular and cellular biology.

For the regulatory aspects, CIEMAT remains as an UNIQUE Nuclear Facility grouping Nuclear Facilities as a research reactor (JEN-I), U processing plants, hot cells, …, (all dismantled nowadays) and about 20 radioactive facilities in operation.

INTEGRATED PLAN FOR CIEMAT FACILITY IMPROVEMENT

The Integrated Plan for Facilities Refurbishment (PIMIC, acronym from Spanish Plan Integrado para la Mejora de las Instalaciones del CIEMAT)) was started up in 2000 for decommissioning old radioactive and nuclear facilities that were shut down for a long time, remediation of zones and grounds with residual contamination, modernizing buildings and facilities, and improving the general infrastructures of the site.

The Nuclear Safety Council (Consejo de Seguridad Nuclear, CSN) is the body in charge of supervising and inspecting PIMIC actions, including documents (manual, functional regulations, procedures, records, etc.), operation and dosimetry for workers and public.

The PIMIC is divided into two projects led by the CIEMAT Subdirectorate General of Safety and Facilities Refurbishment: The general Rehabilitation Project is being implemented by Ciemat as nuclear operator, while the Dismantling Plan and restoration of contaminated areas was entrusted to Enresa and has being carried out between 2006 and 2018.

Since its beginning, the most significant remediation and cleaning PIMIC operations already performed in facilities and spaces have been the following:

- JEN-1 experimental reactor (IN-01), under refurbishement in order to become a relevant facility for fusion research (double-triple ion beam for material characterization).
- Radioactive liquid waste storage plant (IN-07), currently a temporary VLLW storage facility.

- Radioactive liquid waste conditioning plant (IR-16), currently at final stage for re-use as a conventional building.
- Solidification of radioactive aqueous waste in concrete drums
- Research reactor fuel element development plant (IN-03), currently the CIEMAT neutron Metrology laboratory.
- Hot Metallurgical Cells (IN-04), currently at final stage for re-use as conventional building.
- M-1 irradiated fuel reprocessing pilot plant (IR-18), pending of final decision on the remaining buried contamination.
- Radionuclide Alpha metrology laboratory (IR-13A), cleaned and remediated.
- Cleaning and Rehabilitation of buildings where activities related to the first part of the nuclear fuel cycle were carried out.
- Remediation on the Uranium tailings contaminated soil in 'Montecillo' area, currently waiting for final restoration.
- Remediation on the accidental contaminated soil (^{137}Cs and ^{90}Sr) in 'Lenteja' area, currently a temporary VLLW storage facility.

The activities of PIMIC are being performed living together with the normal operation of CIEMAT. While PIMIC-Dismantling is protected with a fenced area and specific security access points, PIMIC-Rehabilitation is performed in buildings near by conventional workplaces than require to inform about PIMIC progress. Obviously, all the conventional risks and hazards like dust production and noise reduction have been considered.

The Radiation Protection program consist of: education and training of exposed workers, classification of working areas, definition of local rules, procedures in controlled areas, administrative record (radiation Work Permit), workplace monitoring and individual external radiation monitoring (official TLD, operational DED) and internal dosimetry (Whole Body Counting and BioAssay).

ALARA approach has been applied in order to optimize the received doses based on an annual collective dose objective and keeping the individual doses well below the dose limits for workers.

In the period 2006-2018 the number of radiation workers per year in PIMIC ranged from 20 to 100 people and the mean annual dose ranged from 0 to 1.4 mSv/a. The maximum annual individual dose ranged from 0.1 to 4.7 mSv/a. The annual collective dose ranged from 0.1 to 38.1 mSv/a. The collective dose for the whole project at the moment is 86 mSv·p.

An important task concerning D&D projects is the waste management. Each PIMIC project have developed Clearance Plans that have been approved by the CSN, allowing the free release of about 50% of the PIMIC-Dismantling waste (total about 12,000 t) and 80% of the PIMIC-Rehabilitation waste (total about 2,000 t). No HLW was produced in PIMIC because fuel bars and some activated parts were previously extracted in the 1990s.

The total budget for the PIMIC project during the last 18 years is about 60 M€, from which approximately 80% corresponds to PIMIC-Dismantling and the remaining 20% correspond to PIMIC-Rehabilitation which is still in progress.

ACKNOWLEDGEMENTS

Authors want to express their gratitude to Dr. Javier Quiñones (previous PIMIC Director) and Esther Garcia (ENRESA manager for PIMIC-Dismantling project) for the information provided to write this paper.

FULL SYSTEM DECONTAMINATION UNDER ALARA POINT OF VIEW

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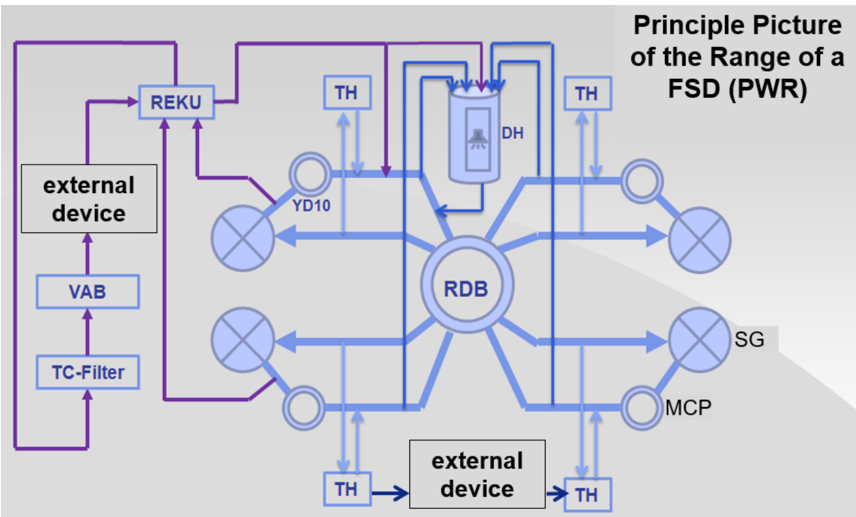
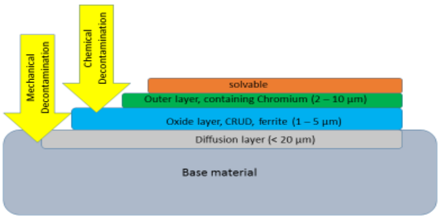
Keywords: ALARA, decontamination, decommissioning, characterization.

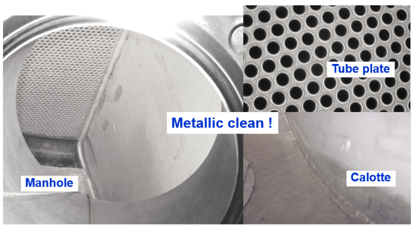
In the life cycle of nuclear power plants, oxide layers on the inner surface grow up and are a main source of radiation field in the facility. To avoid this radiation decontamination was performed to protect the staff during maintenance work.
There are different kinds of decontamination methods like mechanical and chemical processes [1,2]. It is common for all these processes, that the contamination is removed from the surface. The structure of the contamination has substantial influence on the success of the decontamination. Slight adhered nuclides can be removed more effective than strongly sticking nuclides. Chemical decontamination in bathes up to Full System Decontaminations (FSD) can remove oxide layers. Electrochemical and mechanical processes like milling remove not only contamination but also a part of the surface. After the treatment only deeply penetrated nuclides are still measurable.
Parts and components are decontaminated in bathes where the chemicals could solve the oxide layers. This is done e.g. for the decontamination of main coolant pumps for maintenance. With external equipment like pumps and filters, a next step is the decontamination of single loops or components. A FSD decontaminate all loops, pumps, steam generators (in case of pressurized water reactors (PWR)) and auxiliary systems. All power plant installations are used with some external devices. The effect is a powerful reduction of the radioactive field in which dismantling works has to be carry out.



The chemistry break up and solve the oxide layers on the inner surface.



Filtering systems and ion-exchangers remove particles and solved ions from the decontamination medium. Different kinds of used chemistry leads to many different procedures of the FSD. In the presentation a short overview will be given, major procedures will be discussed; results like the pictures below will be shown and the advantages and the pitfalls for the different processes in the ALARA view will be discussed.



[3]

before: 200 Bq/cm² ± 50%

after: 20 Bq/cm² ± 50%

[3]

[4]

DF = 14 (MP 181)
Before FSD: 34 mSv/h
After FSD: 2,4 mSv/h

DF = 22 (MP 160)
Before FSD: 11 mSv/h
After FSD: 0,5 mSv/h

DF > 100 (MP 165)
Before FSD: 15 mSv/h

References

[1] EC-CND Coordination Network on Decommissioning; Dismantling Techniques,Decontamination Techniques, Dissemination of Best Practice, Experience and Know-How; Final Report, 2009

[2] J. Kaulard, B.Brendebach, E. Strub; Strahlenschutzaspekte gängiger Abbau- und Dekontaminationstechniken, GRS, Dezember 2010, GRS-270, ISBN 978-3-939355-46-5

[3] Quelle: Preussen Elektra KKU

[4] Quelle : Preussen Elektra KKI

THE RADIUM ACTION PLAN IN SWITZERLAND

Martha PALACIOS, Gennaro DI TOMMASO, Sybille ESTIER, Thomas FLURY, Claudio STALDER, Daniel STORCH, Sébastien BAECHLER

Federal Office of Public Health (FOPH)
CH-3003 Berne, Switzerland

The objective of the Radium Action Plan 2015-2019 is to control the situation of radiological legacies related to the application of Radium-226 luminescent paint by the watch industry until the 1960s.

In the beginning of the action plan, it was assumed that the number of potentially contaminated properties was 500. However, historical research conducted in the meantime indicates that the number of potential properties nearly doubled to 1000. For this reason, an extension of the action plan until the end of 2022 is necessary to complete the work. The Swiss Federal Council will decide on an adaptation of the allocated resources in the near future.

The Federal Office of Public Health (FOPH) has already measured 540 properties with more than 3000 dwellings. Of these, 100 properties require remediation, 70 dwellings and 64 gardens. Nearly 90% of the properties to be remediated are for residential use. In the case of Radium-226 contaminations in indoor premises, the FOPH evaluates the effective dose received by residents based on measurements and exposure scenarios. The FOPH considers a dwelling to require a remediation, if the result of this assessment shows that the effective dose exceeds 1 mSv per year. The majority of indoor premises in need of remediation exhibit doses calculated between 1 and 10 mSv per year. However, in five dwellings, the doses are between 10 and 17 mSv per year. Outdoor remediation involves removing soil or materials with a specific Radium-226 activity exceeding 1000 Bq/kg. The average of the measured specific activities in the samples is 29’000 Bq/kg with a maximum local value of up to 670’000 Bq/kg.

To date, the FOPH has remediated 44 dwellings and 50 gardens in collaboration with specialized companies. The remediation of indoor premises consists mainly in removing and replacing contaminated building materials guaranteeing at least the same standard as before and guaranteeing that the dose is below 1 mSv per year. Nevertheless, even after remediation, some residual traces of Radium-226 remain in three quarters of the premises but the exposure for the residents is well below 1 mSv per year. The remediation costs average to 30’000 euros for decontamination and 12’000 euros for rehabilitation. Most of the indoor waste volume (80%) is combustible. According to the Swiss Radiological Protection Ordinance (RPO), slightly contaminated combustible waste can be eliminated in incineration plants as long as the weekly activity does not exceed 2 MBq for Radium-226. The waste with a higher activity level (about 4%) must be stored at the Federal interim storage facility.

With regard to outdoor spaces, the average volume of soil removed is about 30 m3 and the average surface area cleaned is 50 m2. The average remediation cost for contaminated gardens amounts to 20’000 euros, more or less equally divided between decontamination and rehabilitation costs. According to the RPO, landfill of slightly contaminated inert waste is allowed under certain conditions, if the specific Radium-226 activity does not exceed 10’000 Bq/kg.

The FOPH has already identified eight former industrial sites involving mixed outdoor pollutions (chemical and radiological), for which specific solutions must be found in collaboration with the Federal Office for the Environment (FOEN) and the cantons.

The FOPH and the FOEN are currently developing a strategy for identifying former landfills that operated between 1920 and 1970 and that could contain Radium-226 contaminated waste. This selection is based in particular on the number of properties potentially contaminated with Radium-226 in the municipality where the landfill is located, as well as on the presence of large consumers or producers of Radium-226 paint around a former landfill.
In the long term, the FOPH plans to take measures whenever landfills are processed in order to avoid dissemination of contaminated waste in the environment and assure the radiation protection of the workers.

REMEDIATION OF A FORMER GAS MANTLE FACTORY CONTAMINATED WITH RADIOACTIVE THORIUM-232

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This presentation describes the practical radiation protection and waste management issues arising during the remediation of a former gas mantle factory contaminated with thorium-232. It discusses the radiological objectives established at the start of the project and the practical radiation protection procedures used to deliver these objectives. It considers the optimisation (ALARA) principle for both workers and members of the public and contrasts these with the general health and safety risks of operating on a demolition site.

RADIATION PROTECTION IN THE MANAGEMENT OF RADIOACTIVE GEOLOGICAL MATERIAL IN PRIVATE BUILDINGS

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The Department of Radiological Intervention and Environmental Monitoring (SIRSE) of the Institute for Radiological Protection and Nuclear Safety (IRSN) is brought within the scope of its activities to carry out interventions in case of radiological emergency, upon public authorities requests. The carried out measurements may take place in non-controlled environments, especially when there is a doubt to be lifted regarding the presence of radioactive materials and/or contamination. In this context, the optimization of the radiation protection of intervention workers is based on two key aspects: preparation prior to the intervention and adaptation of intervention modes on the field.

At the preparatory stage, a risk analysis is carried out on the basis of available information, which is often incomplete or erroneous. This analysis takes into account radiological hazards, conventional hazards, the other technological risks and where appropriate the societal and mediatic impact. At the end of the risk analysis, a protocol is eventually prepared to set out the actions and the provisions of protection for the different envisaged scenarios. The methods used in the protocol are based on the feedback of past interventions of similar typology.
During the intervention, catch points are organized consistently with the aforementioned protocol in order to adjust the actions and protections to be implemented in the light of new information gathered in situ. These adjustments are seen as necessary in the light of optimization of radiation protection, based on the best practices.

This approach of optimization and risk management can be illustrated through the example of an intervention, requested in 2017, by the division ASN of Orleans, following the discovery of vast amounts of radioactive minerals in three dwellings. A part of these minerals was stored in an apartment, located in a building in the center of the city of Orleans. The SIRSE intervention team aimed at ensuring that radioactive minerals were stored in a safe manner before their collection and at measuring the exposure in the surroundings (neighbours, common spaces…), in order to estimate the risk associated with the presence of these minerals.
However, the information gathered prior to the intervention did not allow an exhaustive risk analysis. In fact, the type of minerals involved was not clearly identified and their estimated quantity and distribution in the different rooms not very precise. Moreover, primary data about the levels of irradiation could lead to suspect values around ten micro sievert per hour, but many there was some uncertainty about the type of equipment used and the conditions of measurement.
The protocol therefore had to take account of these numerous uncertainties and consequently opt for a graded approach enabling at each step of the way to reassess the risk and to adapt protection measures and actions to be taken both for safety of the intervention team and the completion of the mission.
On top op that, the SIRSE sought the support of the mobile radiological response (CMIR) of the local fire and rescue team (SDIS 45). This collaboration led to a better understanding of the

respective approaches of this type of intervention: the experience gained proved complementary with regards to the optimization of the radiation protection, on the provisions of prevention and protection and the methodology for intervention as well.

REMEDIATION AND RELEASE OF THE RANSTAD URANIUM MINING AND MILLING SITE

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The Ranstad uranium mining and milling site in Sweden was established in the 1960-es in order to exploit the uranium content of the alum shales in the area. From an open shaft mine about 1.5 million tonnes of shales were brought to a nearby milling facility where about 200 tonnes of uranium was produced. The mill tailings were deposited in the vicinity of the facility.

The operations ended 1980. In the beginning of the 1990-ies, the tailings were covered with a sealing cap and new arrangements were made to treat the leaching water. The open shaft mine was partly backfilled with rejected alum shales and restored into a lake. Some parts of the milling facility were demolished and removed.

From the beginning of the 1980-ies until 2009 some installations and buildings were used for extraction of uranium from contaminated materials from light water reactor fuel production. Thus, some parts of the facility were contaminated by enriched uranium (maximum 5 % enrichment). Other parts of the facility were used for other purposes, such as minor industry activities and storage of goods and hazardous waste.

In 2007-2009, some measures were taken to reduce the environmental hazard of the site. This included removal and disposal of hazardous waste, removal of scrapped components from open-air storage and coverage of areas that had been contaminated due to storage of alum shales and mill tailings.
In 2008, it was decided to decommission the remaining parts of the milling facility. This included the sorting facility, the leaching and extraction facility and some other larger buildings and constructions. The decommissioning project involved several contractors and provided several challenges, for example concerning historical site assessment, radiological characterization, development and authorization of new disposal routes (clearance for disposal or for incineration), handling of remains of sulfuric acid, dismantling of buildings with parallel removal of contaminated materials, final status survey and site release. Today (March 2019), most of the activities for cleanup and restoration have been completed and an application for site release is under review by the Swedish Radiation Safety Authority.

The presentation at the workshop will describe the current radiological status of the facility and explain the procedures and judgements that has resulted in that some contaminated materials have been removed from the site while other contaminated materials have been left in the ground. Principal issues concerning the application of the ALARA principle in decommissioning and remediation of nuclear facilities will be discussed, based on experience of judgement and regulation of radiological issues in the context of other hazards, other regulations, the need for long term controls, cost and time. Some examples of challenges:

- Nuclear activities vs. NORM activities.
- Planned exposure situations vs. Existing exposure situations.
- Doses to workers vs. Doses to members of the public, now and in the future.
- Optimisation of radioactive waste management.

MIXED ALPHA/ASBESTOS RISK MANAGEMENT AT EDF-DP2D

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Especially in its facilities in decommissioning, EDF has to manage work sites in which workers can be exposed to a combined radioactive aerosols (alpha particles) and asbestos fibers contaminated atmosphere.

Risk analysis for this kind of very specific work sites have to take into account two different regulations imposing workers protection rules that can be incompatible or inadequate one another.

For instance, the use of water is currently used as an efficient protection mean to mitigate asbestos risks but could be hardly usable in alpha contaminated areas due, in particular, to contamination spreading risks and effluent and waste production (that can lead to an additional risk of exposure), issues related to workers alpha non-contamination checking after required asbestos decontamination showers when leaving work sites, …

This presentation will deal with:

- a general overview of the mixed asbestos / alpha contamination work sites issue;
- the strategy currently put in place to face this issue at EDF/DP2D in its facilities in decommissioning with a focus on the Bugey 1 work site “sleeves extraction in HK301”;
- some perspectives including the collaborative work in progress between French operators of facilities in decommissioning to propose innovative solutions (colored surfactant use in replacement of decontamination shower) as a part of experimental work sites for assessment by regulator.

CHOSING A STRATEGY FOR WASTE: RECYCLING? DISPOSAL? EXPERIENCE FROM AN ITALIAN AGENCY

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The first accidental melting of a radioactive source occurred in Italy in 1989 in an aluminum foundry. A Cs-137 radioactive source of several tens of GBq of activity was melted; contamination was spread in 6 different companies; liquid wastes contaminated river waters up to 100 km downstream of the factories; direct source melting and the following decontamination work produced about 100,000 ton of solid wastes, most of them salt slags.
After that event European and National authorities put in force legislation meant to prevent the accidental melting of orphan sources. Specific guidance on monitoring for radioactive scrap metal was given by international (e.g. UNECE 2006, Recommendations on Monitoring and Response Procedures for Radioactive Scrap Metal; European Commission 2013, Best Available Techniques (BAT) Reference Document for Iron and Steel Production) and national bodies (e.g. UNI 10897 (2016), Loads of scrap metal – Radionuclide detection by X and gamma measurements).

Northern Italy is one of the first regions, at European scale, for ferrous and nonferrous metal production.
Despite the effort put by companies and authorities to prevent the accidental melting of radioactive sources, incidents remain to some extent unavoidable even if after the put in force of the legislation on radiometric control the activity of melted (unfound) sources decreased from 1000 GBq to less than 1 GBq.
Since 1989 13 companies (out of 140) melted radioactive sources; a new incident occurs almost every 3 years; the mass of contaminated material produced is roughly of hundreds (thousands) tons; the chemical composition differs according to the metal factory involved; the most frequent radionuclide is Cs-137.
The industrial plant decontamination follows the usual rules for nuclear site decommissioning, duly reduced depending on the source activity and the spread of contamination.
The true challenge concerns waste characterization and management.
The volume of contaminated material is usually high, while the activity concentration is low.
Waste disposal to a radioactive waste repository is not necessarily the best option; furthermore, in most cases it is not feasible due to restrictions related to chemical composition of waste.
Alternative solutions are needed.
In one case wastes were treated on site and volumes highly reduced, thus being suitable for disposal to a radioactive waste repository.
In other cases, the application of clearance levels was prevented by difficult proper waste characterization.
Public concern with respect to matters related to radioactive wastes usually raises further problems and barrier to the adoption of the best "ALARA" option.
The presentation will focus on the experience of ARPA Lombardia (Environment Protection Agency of Lombardia), a public Agency in charge of radiation protection in Northern Italy, with special regards to the investigation of feasible solutions for waste characterization and clearance.

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BUS SHUTTLE PICK UP POINT AT AVIGNON CITY