Working Group on Radiological Aspects of Decommissioning Activities at Nuclear Power Plants (WGDECOM)

Chair: Mike Hale (USA)

Vice-Chair: Ignacio Calavla (Spain)

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WGDECOM Background

- Decommissioning of nuclear power plants is a subject of growing importance for NEA member countries and will represent significant budgets and industrial activities in the future.
- Through various joint projects of the NEA, much experience has been gained in the technical aspects of decommissioning and dismantling, including providing for the safety of workers, the public and the environment.
- However, a number of challenges and uncertainties remain, particularly in field of occupational radiation protection (ORP) during the decommissioning of nuclear power plants.

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Main Objective of WGDECOM

- Provide a forum for experts to develop a process within the Information System on Occupational Exposure (ISOE) program to better share operational RP data and experience for NPPs in some stage of decommissioning or in preparation for decommissioning.

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WGDECOM Terms of Reference

The Group will identify:

- The areas of operational RP for NPPs planning decommissioning or in the process of decommissioning that are most relevant for effective management of occupational exposure;
- The operational data that can be collected through the ISOE databases in order to suggest trends and aspects that can be studied and used for benchmarking as a starting point for more in-depth analyses;

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WGDECOM Terms of Reference

- A network of operational RP experts at NPPs who are planning decommissioning or who are in the process of decommissioning for the ISOE Management Board to see how they can be integrated into the ISOE program to effectively exchange occupational exposure management experience;
- Factors and aspects that play key roles in achieving good practices in decommissioning (knowledge and institutional memory, experience, technology, regulatory requirements and guidance, worker involvement, information exchange and networking, radioactive low and medium level waste management, etc.), and analyzing and quantifying their possible impact on occupational doses.

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WGDECOM Member Countries

Belgium
Brazil
Canada
France
Germany
Italy
Korea (Republic of)
Romina
Russian Federation
Spain
Sweden
Switzerland
United States of America

24 Members from 13 Countries supported by 7 Corresponding Members

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Additions, Replacements, Change of Status

Additions:

CANADA

Jean –Yves Gagnon	Gentilly	Team Member

Germany

Joerg Kaulard	TŰV Rheinland ISTec GmbH	Corresponding Member

Spain

Jose Campos	enresa	Team Member

USA

Willie Harris	Exelon	Team Member
Chris Messier	BHI	Corresponding Member
Nick Williams	Zion Solutions	Corresponding Member

Replacements:

Brazil

Albuquerque Vieira, Flavia	Eletrobras Eletronuclear	Team Member
Estanqueira Pinho, Bruno	Eletrobras Eletronuclear	Team member

Change of Status:

Korea (Republic of)

Kim, Byeong-Soo	Korea Institute of Nuclear Safety	Corresponding Member

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Program of Work (2016-2017)

- Identify a network of RP experts associated with decommissioning
- Issue Site Benchmarking Template / Plan
- Create a FAQ List on RP in decommissioning
- Review the ISOE D trial Data Collection Template
- Review the dose data breakdown from José Cabrera NPP decommissioning project

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Actions to date

- 1st station visit on April 2016 in USA. (Complete)
- 2nd station visit on October 2016 in Sweden. (Complete)
- 3rd station visit in April 2017 in Spain. (Scheduled)
- 4th station visit in October 2017 in Switzerland. (Scheduled)

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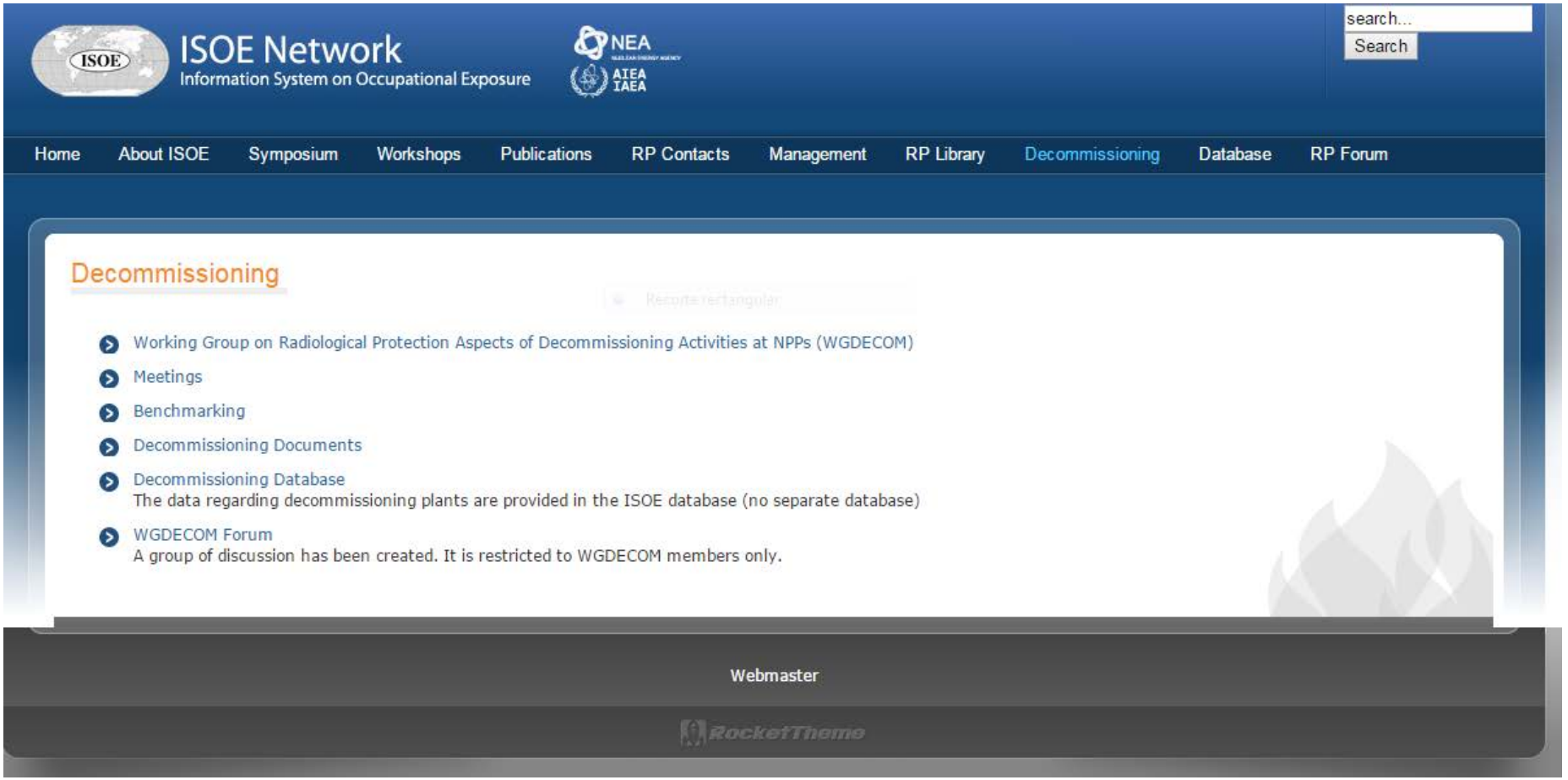
Modification to Decommissioning Website

- Changes to Decommissioning Tab



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Actions to date (cont)

- Items posted on the ISOE website under “Decommissioning Tab”
  - Current membership list
  - Benchmarking reports
    - Zion
    - La Crosse
    - USA
    - Sweden
- Numerous PowerPoint presentations and reports on ORP in decommissioning
  - Position Papers on decommissioning 40
  - Technical presentations on decommissioning 37
  - Decommissioning reports 3

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Highlights of USA and Sweden Benchmarking

- USA visit
  - Participation
    - RPM's from Crystal River 3, San Onfere Nuclear Generating Station, Humboldt Bay, Zion, USNRC, Braidwood, Exelon Corporate, Energy Solutions VP Radiological Zion, BHI VP Engineering
    - Opened meeting in Chicago with USNRC, traveled to Zion, traveled to Kewaunee
    - Site walk downs; CTMT at Kewaunee, Temp storage of radioactive material at Zion, presentations
    - All phases of decommissioning; Transition, SAFSTOR, Preps for dismantlement, Active dismantlement, Historical dismantlement were represented at the meeting.

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USA visit (cont)

Most interesting OE was from Zion

On their “Rainbow Event”

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Water Chemistry During Zion Reactor Internals Segmentation

- Primary issue with water chemistry during segmentation process was with anticipation and prevention of biological growth in a stagnant pool open to the environment.
- Algae bloomed and the water turned green approximately 2 weeks after filling refueling pool with demineralized water, resulting in low visibility.
- Hydrogen peroxide was added to kill bacteria which turned water brown with still low visibility.
- Water was cleaned up with underwater demineralizer/activated charcoal skid.
- Approximately 5 ppm [H2O2] was target to maintain however not well maintained over several months during segmentation and subsequent bio blooms resulted causing additional cleanup and delays.
- Underwater trinuclear filters and resin/charcoal depleted quickly due to high D/P and not due to high dose rate.

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Water Chemistry During Zion Reactor Internals Segmentation

- Due to a lack of understanding by contractor, a large shock treatment was performed which resulted in a pH of 3 and high [H2O2] in pool.
- The shock of peroxide caused a small crud burst in the reactor vessel driving water activity up by 3 orders of magnitude.
- The green water again turned brown as the algae died then started to corrode the carbon steel cutting equipment turning the water red.
- The water was neutralized with sodium hydroxide and manhole covers were suspended in the pool as sacrificial anodes.
- ZionSolutions assumed all chemistry control of pool from contractor and maintained a constant [H2O2] of 10-15 ppm which was effective.
- Dead biological growth was at this time present on all surfaces of pool, segmented reactor internals, waste liners and GTCC Transportable Storage Containers (TSCs).
- GTCC TSCs once fully loaded were moved to Fuel Handling Building Dry Cask Pit. Each GTCC TSC was flushed with high pH NaOH solution to kill and remove any remaining biological growth.

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Water Chemistry During Zion Reactor Internals Segmentation

Lessons Learned

- Mismanagement of contractor and subcontractor lead to poor chemistry control of refueling cavities. Similar issues were experienced in both refueling activities as reactor internals segmentation was occurring in parallel in each Containment.
- A flocculent could not be used to settle out dead bio due to metallurgical concerns with GTCC TSCs and water purification media.
- The effect of biological material in a GTCC TSC was not understood and led to additional dose, time and cost to recover from issues experienced.

Why is this interesting?

- As the rainbow event was presented, 4 people in the room raised their hands and said same thing happened to us !
- **Historical OE was unknown to Zion**

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Highlights of USA and Sweden Trips

- Sweden visit
  - Studsvik Research Reactor
    - Containment enclosure built around Rx containment
    - Use of iron in concrete (shielding)
    - Counting facility for release of debris
- Barseback 1 & 2 NPP
    - Temporary building for interim storage of reactor internals
    - Transfer system to move segmented reactor internals
      - Wet Hood, Cassettes, Steel container, Transport Box
      - Presentation in decommissioning folder tab “WGDECOM Technical Presentations”

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Draft format and Information on Technical Experts

Lead – Petra Hansson

- **Task -** Develop a template for network of experts

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Information on Technical Experts - Draft Format (Excel ?)

Country	Type	Unit	Company Positions	email	Current Status	Area(s) of expertise
USA		1	PG&E HBPP Site Closure Manager	WHB6@pge.com	Dismantling	All areas of decommissioning
USA	PWR	1	Duke RPM CR3	Leon.AkinsJr@duke-energy.com	Transition to SAFSTOR	RP management/Radwaste
USA	PWR	2	Zion VP RP & Environmental	dewilliams1@energysolutions.com	Dismantling	All areas of decommissioning
USA			BHI VP of Engineering	Chris.Messier@BHIEnergy.com		All areas of decommissioning
Sweden	Research	R2-0, R2	Svafo RPM at NPP	christoffer.ellmark@svafo.se	Dismantling	
Sweden	PWR	R4	Ringhals			Steam Generators
Sweden	BWR	B2	Barsebäck RPM at NPP	lars.hakansson@bkab.uniper.energy	Care & Maintenance	Segmentation RX internals
USA			RSCS Executive Director	jptarzia@radsafety.com		All areas of decommissioning

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Benchmarking Tool

Lead – Jean-Yves Gagnon
Lead - Ludovic Vaillant

Task- Develop a template/approach for benchmarking

Rev number	Comment	Date	Author
Rev.0	Initial Proposal	June 2016	JYG
Rev.1	Modifications from Ludovic's Comments	June 2016	JYG
Rev.2	Numbering of topics added in first column	October 2016	JYG

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Sample of Benchmarking Sheet

Station Description			Station Description	
Country's name	Canada		United States of America	
Reactor Type (PWR, PHWR, BWR, RBMK, others…)	PHWR		PWR two loop, Westinghouse	
Station's Name	Gentilly-2		Kewaunee Power Station	
Owners/Company's Name	Hydro-Québec		Dominion	
Unit Number	2		Unit 1	
Multi Unit Station	Yes		no	
Single Unit Station	N/A		Yes	
Multi Owner on Same Site (Nuclear and Coal/Gas)	N/A		No	
Multi Owner on Same Site (Nuclear and Nuclear)	Hydro-Québec (U2) and Canadian Nuclear Laboratory (U1)		No	

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Sample of Benchmarking Sheet

Station Status			Station Status	
Running on Operating License			Began commercial operations on June 16, 1974 Operating license extended February 2011 for operating license to 2033	
Shutdown with fuel in core			Permanently Shut down in May 2013	
Shutdown with both Spent Fuel in core and Fuel Bay			x	
Shutdown fuel in Spent Fuel Bay			x	
Safe Storage (Fuel in Dry Storage)				

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Sample of Benchmarking Sheet

	Site Characterization			Site Characterization	
	To be done before SafeStor	NYD (Not yet determined)		Phase I completed (fuel out of core)	
	To be done before Dismantling	NYD (Not yet determined)		Not determined	
	Using Normal (at power) Procedures			No, Fleet RP procedures not applicable	
	Using Special Procedures			Yes, prepared Kewaunee decommissioning specific RP procedures	x
	Protocol applied (Marsimm / Marsame others…)			No	
	Have you developped your Own Methodology	Pilot Project approved for zone change approval		No, survey of all materials to be released	
	If yes was it authorized by Regulator?				
	Alpha over Beta/Gamma Ratios			No alpha detected. Will continue carefully monitor alpha, etc	
				Historical Site Assessment (HSA) completed in 2014	
				includes zone 1,2,3 areas designation & CFR 50.75.g file)	

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Proposed additions

- Radiological characterization protocol used?
- Radiological Activity Measured? And surprises ?
- Percentage of waste get free release after verification?
- Environmental Surveillance Program Changes through different phases of D&D?
- Do you have radioactive liquid waste to deal with?
- Do you have gas effluent to deal with?
- Regulatory control request for free release?
- Do you have very high level contaminated liquids to deal with?

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Proposed additions

- Have you experienced radiolysis problems when storing waste
- What surveillance is requested for waste and spent fuel?
- Waste characterization levels? VLLW, LLW, ILW, HLW etc…
- To what extent do you characterize your waste? (dose rate, spectrum, activity, etc…)
- Could you predict the final state for you installation after dismantling and closing your license?
- Are you making volume reduction for already stored waste on site?
- Did you experience specific problem for wasted soils and underground water?
- Have you experienced unexpected surprise during D&D? Examples?

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FAQ for Decommissioning

Lead - Boris Brendebach

- **Task -** Develop a template/approach to posting FAQ's

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FAQ - Example

Which type of radiological information should be preserved for later decommissioning when entering a period of safe enclosure?

"A radiological characterization of a plant, which is performed before entering the period of safe enclosure, may serve as a starting point for later dismantling activities, especially if there is the threat of losing easy to measure nuclides (like Co-60) due to decay.
But these data can just be interpreted if additional information is provided like type of measuring device (including measuring principle, physical properties), measuring procedures followed etc.
In addition, a program to transfer the data to new storage media should be set up to keep it readable over long time spans."

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FAQ - Example

Which role does RP play in the selection of decontamination and dismantling techniques?

"The selection process for decontamination and dismantling techniques is a multi-step process, where in a first step the list of all available techniques is narrowed done following general more strategic decisions, which are influenced by general requirements (such as technical, regulatory or radiological aspects) and principle decision (such as use of mechanical cutting techniques only or to perform a decontamination of the system).

A further reduction of the list of techniques is done during planning of the decontamination or dismantling task, performing and evaluating on the basis of qualitative and/or quantitative analysis. This leads to a "tool-box" of techniques, which allows enough flexibility during the detailed work planning for optimization in relation to aspects of e.g. radiation protection, radioactive waste generation, and costs."

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FAQ - Example

Generic selection process

Project strategies

More strategic factors ↑ *and consideration*

Potential decision factors, e.g.

- Decommissioning strategy
- Radiological / conventional worker protection
- Radiological conditions at the working place
- Regulatory requirements
- Know-how on the nuclear facility
- Own experiences on the use of the technique
- Requirements by the work to be done
- Applicability / type of the technique, incl.
  - Dismantling capacity
  - Safety aspects
  - Infrastructure and space needed
  - Installation / de-installation time
- Aspects of costs
- Rad. waste generation and disposal roots
  - Aspects of clearance

Available techniques

↓

Pre-selection

↓

Pre-selected techniques

↓

Assessment and comparison of techniques

↓

Set of techniques to be considered during detailed work planning

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Present Decommissioning Landscape

- A change of mindset is required by station staff.
  - **Purpose of Decommissioning is to terminate the license**
  - **Refurbishment is not dismantlement**

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Present Decommissioning Landscape

- There are many parts to decommissioning
- These parts have various names in different countries but can be placed into three general categories
- Transition- plant is made ready for Dormancy or immediate Dismantlement
- Dormancy (SAFSTOR)- long term storage waiting for Dismantlement
- Dismantlement- is the final process to return land to “green field” or the condition it was in prior to building and operating a nuclear power plant.

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Present Decommissioning Landscape

Transition Phase

- Reactor defueled
- Systems are drained and vented
- Liquids and Gases are processed and released
- Fuel is placed in wet or dry storage
- Modifications may be required to support long term storage or immediate dismantlement
- Staffing reductions

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Present Decommissioning Landscape

Transition

- **Refueling outage shutdown vs. Shutdown for decommissioning**
  - Tasks are the same but methods are different resulting in different total dose
  - Dry Storage total dose
    - Same general tasks
    - Driven by type and manufacturer of storage containers resulting in different total dose
    - May be performed by utility personnel or contractor or a combination of both
  - Venting and draining systems for maintenance vs. venting and draining for decommissioning
    - Same general tasks but different drain points in different radiation fields

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Present Decommissioning Landscape

Transition

- Transition dose can be affected by the next two options
- Dormancy
  - Full system decontamination vs. Decay
- Dismantlement dose can be affected by many factors
  - Length of time in dormancy or time since shutdown
  - Source term
  - Technology

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Present Decommissioning Landscape

- The ISOE questionnaire for Decommissioning
  - Will have to address the few examples presented plus numerous other factors
  - Smaller staffs to input data
  - Non Utility personnel/contractors not a ISOE member inputting data
  - Motivation for the new licensee to input data
  - Sharing of data could been seen as proprietary

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Spain Decommissioning Landscape

Information provided by Jose' Campos

- In Spain, by law, enresa is the company in charge of decommissioning all NPP's.
- The Electric company operating the plant is the licensee during operation phase.
- Once finished with operation, a transfer of the license from the former licensee to enresa.
- enresa is the licensee for decommissioning.
  - They have their own RP organization and they contract specialist companies to perform work.
  - In some cases we ask those contractors to have 1 RP technician to be the link (in RP) with our RP organization.
  - More detailed dose information is in ALARA plan. But some is on summary sheets for each activity.
- After completion of the decommissioning enresa will return the site to the electric company for future potential industrial use of the "land"

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Spain Decommissioning Landscape

Information provided by Jose' Campos

- On site there are approximately 15 people from enresa, Heads of departments and Site managers.
- Almost every other person is contracted.
- We have two different groups of workers:
- Those directly contracted by enresa for the decommissioning (we call them "collaborators"): RP, Fire Fighting, Surveying, Safety, Security, Operation
- Those companies contracted to perform specific decommissioning work (we call them "contractors"): Westinghouse for Reactor vessel head, vessel, internals; or ENSA for Steam generator, pressurizer, Reactor cooling pump.
- For "contractors", and depending on the work they are contracted to perform, we ask them to have their own PR technician, to prepare their ALARA plans, and to be the interface with our RP organization

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Typical Decommissioning Landscape in USA

Information provided by Cheryl Olson

Dairyland Power Company (DPC) La Crosse Nuclear Plant

- Who “owns” the property is a little convoluted
  - In the contract the DPC remains owner of the fuel.
  - As licensee, Energy Solutions has control over the operations at both the plant and ISFSI
  - Energy Solutions subcontracted the ISFSI ops back to DPC.
    - The plant side – they “own” the plant and real estate surrounding the plant that they need to conduct their D&D.
    - Energy Solutions cannot allow a lien to be placed against the property and must transfer it without cost back to DPC once they are done.

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Typical Decommissioning Landscape in USA

Information provided by Cheryl Olson

- DPC treats Solutions as the "owner" for the plant property in that we have to ask permission to do things on the property.
  - The license, which includes the coal plant, a public boat launch and property across Hwy 35, belongs to Solutions.
  - DPC is also on the license since we maintain ownership of the fuel
  - When the NRC shows up – Solutions is the lead
  - When ANI shows up – DPC is the lead.

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Information on ISOE3

Lead - Ignacio Calavia

Task - Review the ISOE D trial Data Collection Template and make recommendations

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Previous decom database proposal

Tried to extend the ISOE data base to decommissioning by establishing a format with jobs and tasks. It was later extremely simplified, but even then didn't get response from decommissioning projects.

Analyzing the previous proposal, WGDECOM finds that possible issues are:

- End user involvement: The 'client' is no longer an ISOE member. This aspect needs to be addressed by the Management Board, because all attempts will fail without 'corresponding members' involvement.
- Before building the current ISOE database, years of experience helped by showing trends and common practices to most plants. Decommissioning isn't quite there yet, since operations are still scarce and diverse.
- Time frames such as "year" and "outage" are no longer valid. Reporting to the ISOE should also reflect this.

Previous proposal also introduces two new ideas into the data collection specific for decommissioning that can be used:

- RP related reporting on completed decommissioning Works
- Influencing parameters

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New proposal for "Searchable Tool"

- The "Searchable Tool" intends to be the foundation for a future database, aimed to gather information from decom projects before it gets lost. The basic container for the information from a plant could be a "folder". It could contain:

- WGEDCOM Benchmarking Template collection of factual data from the plant. The purpose of this document is to provide context for the dose data.

- RP reporting on completed decom Works (Modified form of the ISOE-3d),These will provide information on decommissioning works in the same way as a traditional ALARA report (it should be easy to use).

- The keywords in this bid provide the searchability in "Searchable Tool". Related documents: The user could also include related documents linked to completed decommissioning works, that would also be stored in the folder.

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Examples of what information is available

Cod.		**mSv-p** *comments*
5	Reactor vessel	
5.1	Preparatory activities	**47.45** *completed*
5.2	Control rod drive dismantling	**7.98** *completed*
5.3	Reactor incore instrumentation removal	**2.7** *completed*
5.4	Reactor instrumentation (neutron monitoring system)	**3.84** *completed*
5.5	Reactor vessel head insulation	**0** *completed*
5.6	Reactor vessel head removal	**4.72** *completed*
5.7	Reactor vessel head segmentation	**25.62** *completed*
5.8	Neutron shielding removal	**8.33** *completed*
5.9	Cutting of Cooling pipes	**8.31** *completed*
5.10	Reactor vessel removal	**9.51** *completed*
5.11	Reactor vessel insulation	**26.54** *completed*
5.12	Reactor vessel segmentation	**30.81** *completed*

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Next Meeting José Cabrera NPP

Location: Madrid

Dates: April 24 -28

Sponsored by: enresa

Agenda (in progress)

Tentative Schedule:

- Mon 24th Fly to Madrid airport
- Tue 25th Meeting at CSN- Spanish Regulatory body
- Wed 26th Meeting at enresa.
- Thu 27th Travel to José Cabrera NPP, Meeting and visit the plant
- Fri 28th Meeting and visit the plant, travel back to Madrid

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QUESTIONS

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