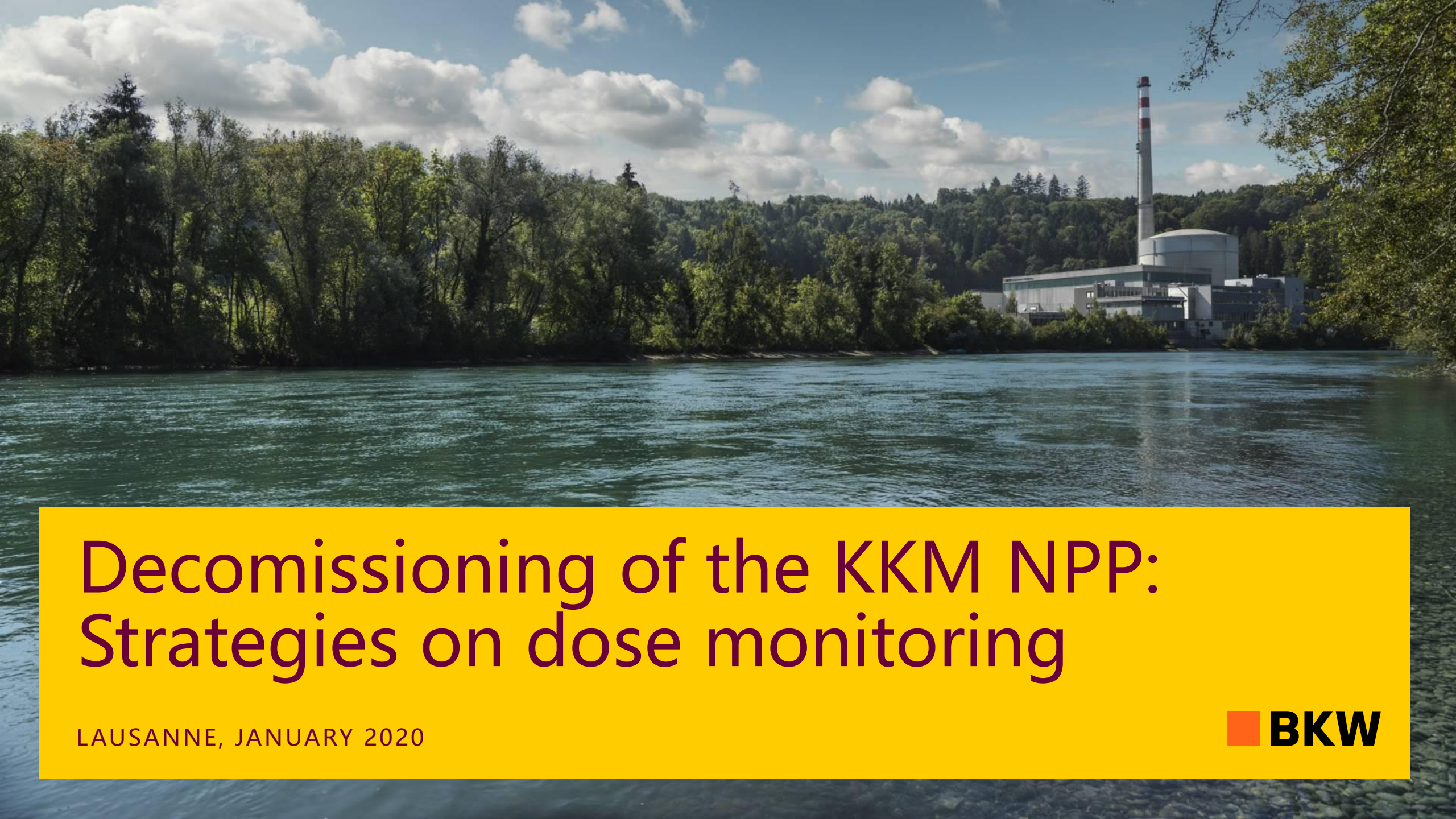


Decomissioning of the KKM NPP: Strategies on dose monitoring

LAUSANNE, JANUARY 2020

BKW

Outline

Dose Monitoring
- Dose Monitoring Requirements – Legal and Operational
- Dose Monitoring in the NPP KKM – 3 Systems

Job Dosimetry
- Some fundamental aspects
- Comparision of Requirements

Application
- The KKM Dosimetry System Capabilities
- The KKM Jobdosimetry Approach in View of Decomissioning
- Examples

Requirements – Legal and Operational

Applicable Legal Requirements for the Nuclear Industry / Surveillance of ENSI:

RP Ordinance

- general requirement for dose monitoring

Dosimetry Ordinance

- technical requirements for the dosimetry service / dose quantities to be assessed / **Job dosimetry** (Art. 14)

ENSI-B09: Dosimetry of radiation exposed people

- Classification of professionally exposed personnel
- Requirement for 2 independent dosimetry systems:
  - Recognized Dose meter
  - Additional Dose meter
- Details on reporting (Individual- and Collective exposure)

Requirements – Legal and Operational

Applicable **Operational** Requirements for the Nuclear Industry

General:

- Confirmation of legal compliance regarding radiation exposure

Operational:

- Monitoring of collective dose to compare against annual plant objectives
- Monitoring of Job doses to prove effectiveness of RP measures
- Monitoring of individual doses to ensure legal compliance

All this information is needed in due time, i.e. almost immediately!

Dose Monitoring in the NPP KKM – 3 Systems

Recognized Dose Meter

Whole Body exposure (monthly evaluated)
- Standard TLD
- 4 Pellets: 1 Hp(10), 3 Hp(10) + Hp(0.07)
- Neutrons: Fission tracks (supplied by PSI)

Extremity exposure
- Standard Ring dose meters (TLD) (supplied by PSI)

Internal exposure
- Triage measurements by Quick counter (Co-60; Cs-137)
- Whole Body Counter (Co-60, Cs-137, I-131)

Additional Dose Meter

Electronic Personal Dose Meter capable of:
- Hp (10)
- dHp (10)/dt
- Can be associated to an individual
- Programmable Dose Rate / Dose Alarms (partially clearable)

Dose Management System

- Transaction based dose management (audit trail)
- Allows in time generation of Reports regarding individual dose, collective dose, job doses, groups of job doses etc.
- Is currently in replacement

KKM: Acknowledged Dosimetry Service

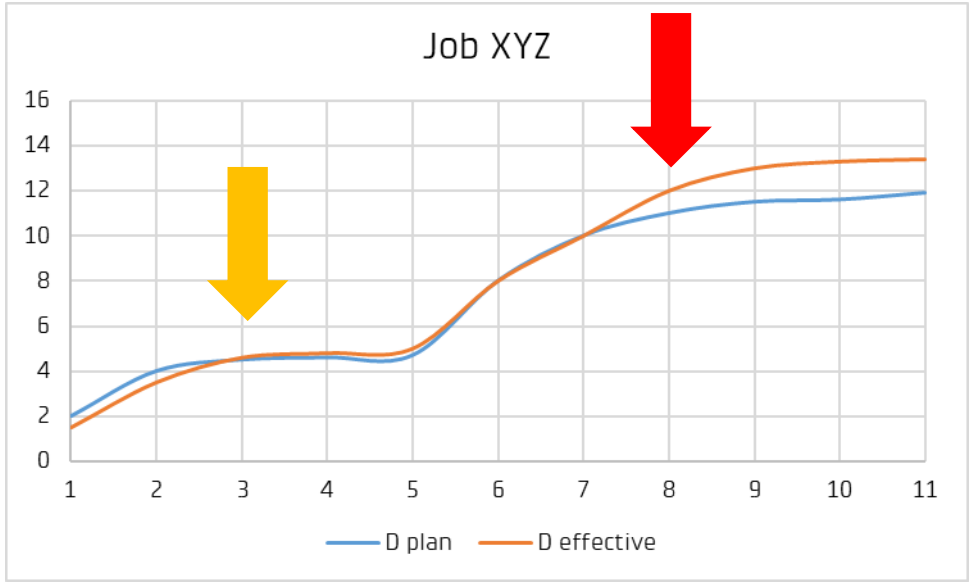
Job Dosimetry – Some fundamental considerations

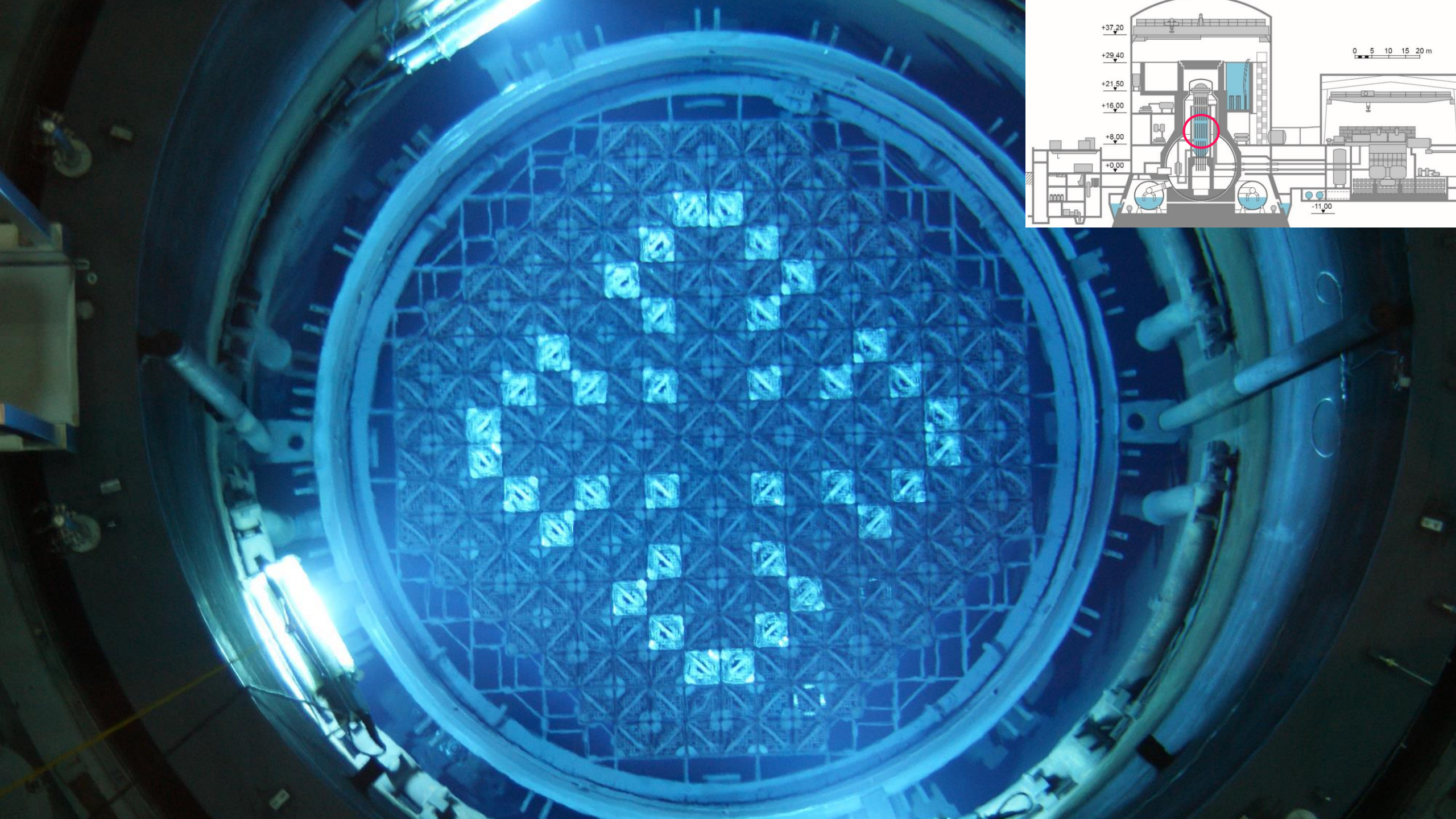
Desired outcome:

- (Real Time) assessment of **effective** exposure against **planned/expected** exposure
  - For activities, thus providing means to **identify** those activities which
  - Of individuals or professional groups (eg. RP officers, mechanics, …) which

  require **RP attention** and **corrective measures.**

- Easily produced reports

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Removal of equipment for power generation

2015 Einreichung Gesuch

2019 Einstellung Leistungsbetrieb

2020 Anlage bereit für die Stilllegung

2024 Brennelemente entfernt

2031 Radioaktivität entfernt

Removal Shrapnell protection
Number: 165 pcs
Mass: 1'250 Mg
Duration: Jan.-March 2020

Removal of larger components
(Turbines, Generators, Pre-heaters)
Mass: ca. 1'000 Mg
Duration: Jan.-Okt. 2020

Nuclear Decomissioning: Dismantling of core internals

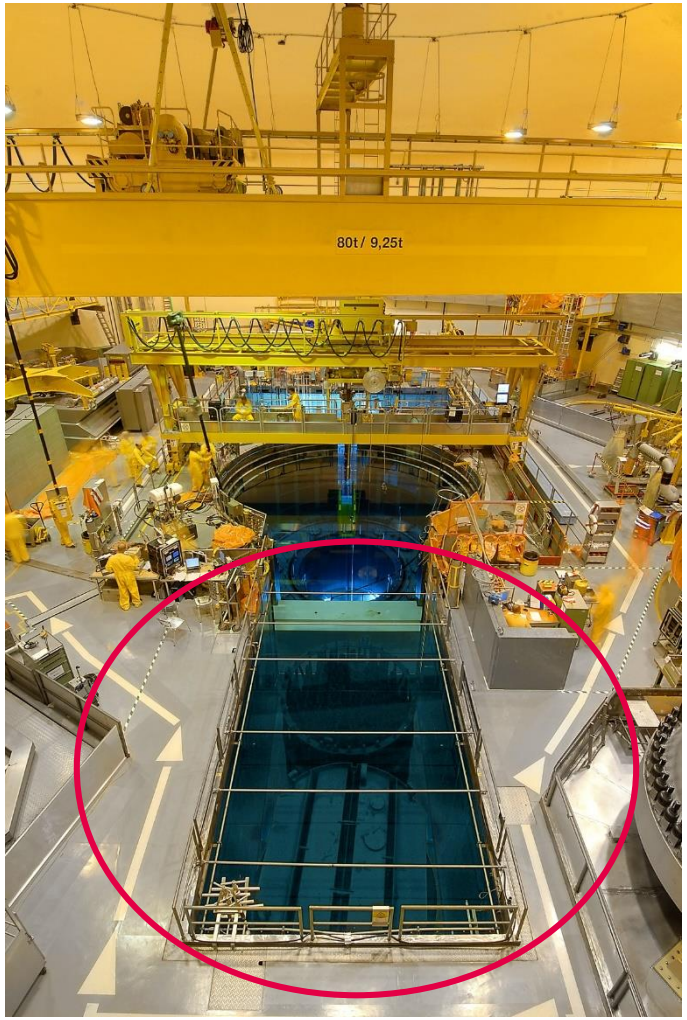
2015 Einreichung Gesuch

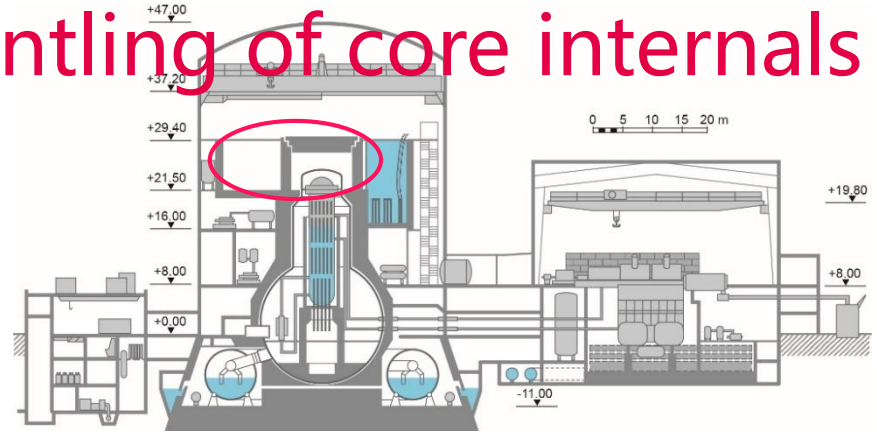
2019 Einstellung Leistungsbetrieb

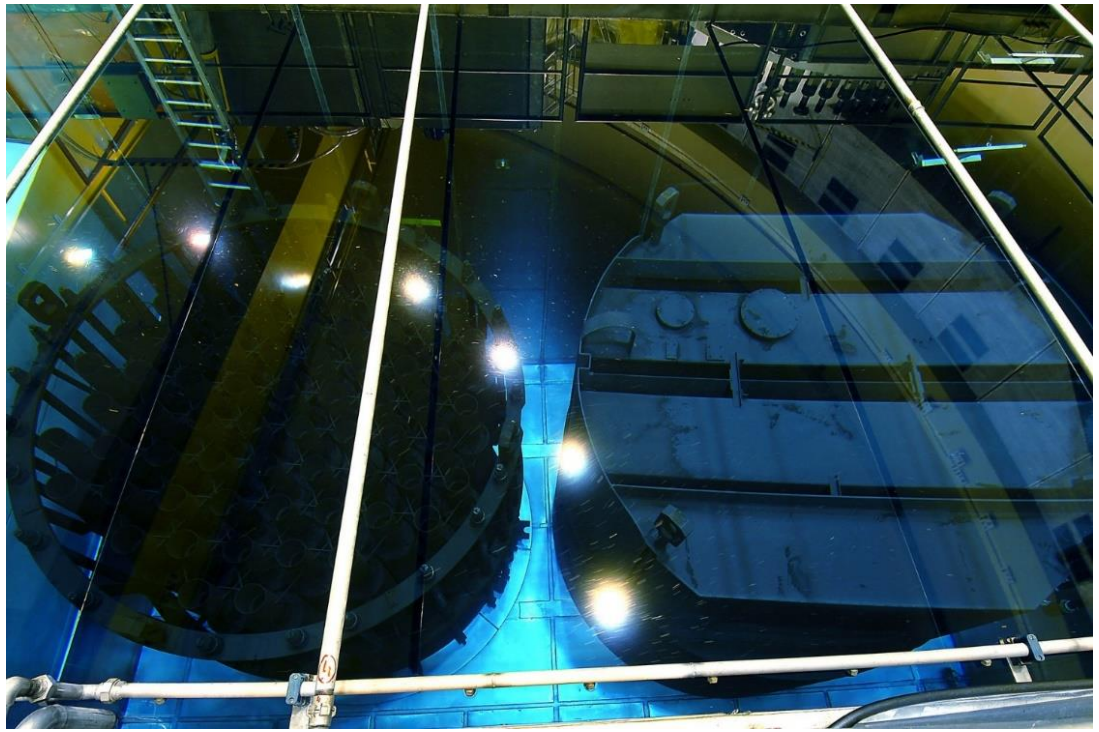
2020 Anlage bereit für die Stilllegung

2024 Brennelemente entfernt

2031 Radioaktivität entfernt







Removal of spent fuel

- **2015** Einreichung Gesuch
- **2019** Einstellung Leistungsbetrieb
- **2020** Anlage bereit für die Stilllegung
- **2024** **Brennelemente entfernt**
- **2031** Radioaktivität entfernt

Workflow of Decomissioning activities

2015 Einreichung Gesuch

2019 Einstellung Leistungsbetrieb

2020 Anlage bereit für die Stilllegung

2024 **Brennelemente entfernt**

2031 **Radioaktivität entfernt**

Permanent Shutdown

Dismantling

Disassembling

Decontamination

conventional

Recycling

Clearance

radioactiv

Intermediate Storage

Waste Treatment

Quellen: KKW Philippsburg, KKW Grundremmingen, KKW Würgassen, KKW Greifswald, GNS mbH, Zwischenlager Würenlingen AG, , EWN GmbH

Job Dosimetry – Comparison of Requirements

KKM Operation

- Dose mostly during shutdown (3 weeks)
- Jobs have a short duration

- RP optimisation of activities on a yearly basis
- Mostly well known an defined activities
- High number of personnel in the Controlled Zone

- General: High exposures in short time

- High number of jobs and sub-jobs, based on historic developments

KKM Decommissioning

- Dose during whole year (12 months)
- Jobs have a longer duration (up to several months)
- RP optimisation of activities "on the fly"
- New and unknown activities
- Limited number of personnel in the Controlled Zone
- General: moderate exposures in long time

- Limited number of jobs with only few sub-jobs

Design Requirements

Limited Number of Job categories for dismantling activities:

- Dismantling
- Supporting activities (insulation, scaffolding, workplace decontamination, RP services)
- Allocated to building parts or larger task groups

Limited Number of Job categories for special, large activities:

- Stage 1 of special, large activity
- Stage 2 of special, large activity etc.
- For each stage a main activity and a supporting activities

Limited Number of general activities:

- Decontamination
- Material Treatment
- Logistics
- Clearance Measurement
- RP surveillance
- RA Waste Treatment

Application: The KKM Dosimetry System Capabilities

Job dosimetric workflow:
On entry into the Controlled Zone:
- Automatic pre-registration on a "General Job"
- Setting of specific alarm levels

When changing buildings:
- Automatic registration of the building

When changing activities:
- Manual registration on a "Specific Job"
- Adjusting alarm levels to job requirements

Job Ticket design - hierarchical:
- Task1
  - Sub-Task 1.Dismantling
  - Sub-Task 1.Decontamination
  - Sub-Task 1.Support
- Task 2
  - Sub-Task 2.Dismantling
  - Sub-Task 2.Support

Reporting:
- Individual complete history of all transactions in the dose management system
- Report generation for
  - Collective Dose for each sub job, over a given time period
  - **Aggregated Collective Doses for each job**
  - Collective Doses for organisational units
  - Collective Doses for professional units
  - …
  - Individual Doses over a time period
  - …

Management of individuals:
- Medical checks
- Access restrictions
- …

Application: Examples

Turbine Building Crane – Replacement of control electronic (Jan 2019)

- One-Time-Activity!
- Continuously elevated dose rate levels
- Long duration – large collective dose estimated: approx. 40 man-mSv
- On the fly optimisation:
  - improved temporary shielding of workplace (reduction factor 2 - 3)
  - Pre-assembly of large pieces of equipment in low-radiation areas
- 7 man-mSv accumulated

Removal and Disassembling of control rod drives (58 units)

- Well known activity – 6 units each year
- High individual and collective exposure – dose sharing
- 2 main jobs: removal and disassembling
- *Collective Dose Monitoring against units removed*
- 1 supporting job
- Estimated job dose: 95 man-mSv

Conclusion

The KKM strategy for Job dosimetry during dismantling is:

- Usage of a highly flexible dose monitoring system – many freedoms in job creation & reporting
- Task – specific Job tickets, tailored to ensure **monitoring of the critical aspects** of the activities

Questions?

Many Thanks for your attention

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