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Title	**Shutdown Mühleberg NPP – Expectations and Intentions of the Operator**
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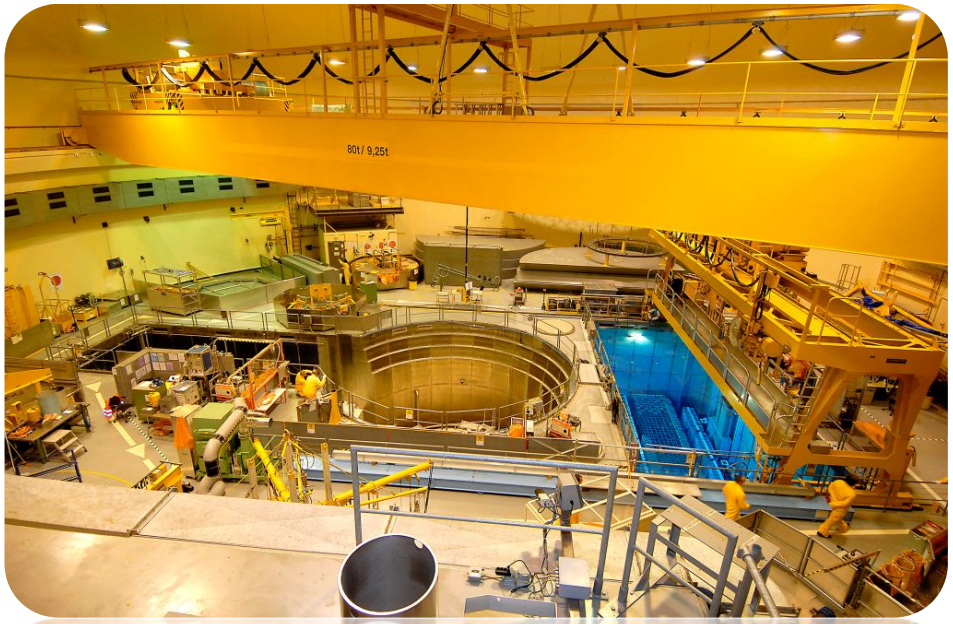
Abstract English	The decision to shut down the nuclear power plant Mühleberg leads to the first decommissioning project of a commercially operated nuclear power plant in Switzerland. A short description of the operator`s objectives regarding the decommissioning is followed by a brief insight into the Swiss regulatory conditions and approval situation. Eventually, ways to optimize the decommissioning are described, which comprises technical and organizational as well as regulatory characteristics. Moreover, the “decommissioning project” – the document for submission to the Swiss authorities for directing the decommissioning – and the different phases of decommissioning will be introduced. This covers technical as well as regulatory characteristics of project development and -execution. A first insight into the KKM decommissioning project and it`s optimization is given. This includes, besides the project organization, also the parallelization of tasks. Preconditions are discussed, which ensure immediate dismantling once the decommissioning is directed, independent of nuclear fuel possibly still present at the plant at this point. In addition, the considerations for an appropriate preparation years before the final shut down are exploited. In conclusion, the operator’s expectations towards the project and the authorities are given.

Decommissioning Mühleberg NPP
Expectations and Intentions of the Operator



BKW Energie AG, Switzerland

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Brussels, October 14, 2014

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1. The operator's aims
The key points

The operator's responsibility towards the community and the supervisory bodies still remains after the final shutdown

The operator's key aims

- **Safety**: Guarantee of safety at all times with sufficient safety margin, taking into account all requirements, reducing hazard potential as dismantling work progresses.
- **Economy**: Economical use of funds contributed, thus enabling commercially sound use of unused funds in keeping with Swiss federal government's energy strategy, etc.
- **Flexibility**: Flexibility in operational and regulatory requirements, thus making it possible to adapt to realities as the dismantling work progresses.
- **Planning**: Timely planning enables the early release (draw-down) of funds and avoids an overly restrictive interpretation of laws and ordinances.

2. Statutory regulations

License situation during post-operation and dismantling

The decommissioning is directed…

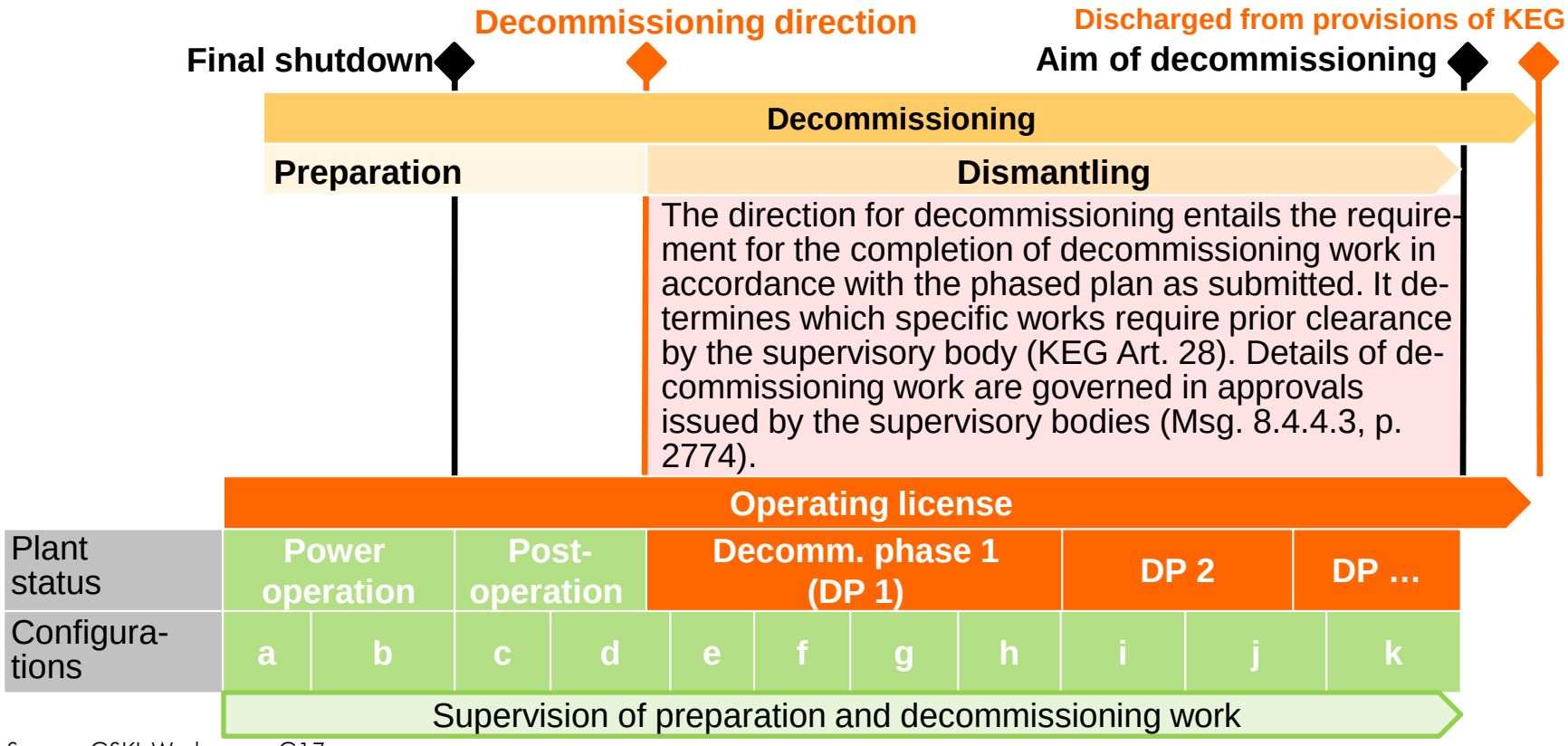
- Final plant shutdown automatically entails requirement for decommissioning.
- Final plant shutdown entails requirement for the operator to submit the decommissioning project plan to the supervisory bodies.
- This forms the basis for decommissioning directed by Uvek[1)]. Uvek also decides which work requires prior approval by the supervisory body.
- The existing license remains valid and only becomes less important when decommissioning is directed.
- Post-operation ends when decommissioning direction becomes effective.

1) Federal Department of the Environment, Transport, Energy and Communications

2. Statutory regulations

License situation during post-operation and dismantling

… and until then the operating license provisions remain valid



Source: GSKL Work group G17

Decommissioning is concluded when decommissioning work has been properly completed and Uvek has decided that the plant no longer presents a radiological hazard and is no longer bound by KEG provisions.

Uvek competence Ensi competence

3. Optimizing post-operation and dismantling

Ways of optimizing the legal process

The reliability of due process

- Coordination with supervisory body in drawing up decommissioning project plans.
- Efficient process management by BFE[1)] in the decommissioning project procedure.
- Determination of approval process for minor changes.
- Moving specific work to a different decommissioning phase should be possible as a minor change in the approval process.
- Conclusion of bilateral agreements for conditioning in other countries.

1) Swiss Federal Office of Energy

3. Optimizing post-operation and dismantling

Technical and organizational optimization

Minimizing the effects of cost drivers

- Early planning of disassembly work and determining the waste disposal concept during power operation. Sound planning gives room for flexibility to make modifications during dismantling.
- Early submission of decommissioning project plans.
- Carrying out preparation work prior to decommissioning, even before the decommissioning is directed during post-operation.
- Performance of decommissioning work, even if nuclear fuel is still present onsite.
- Development of an optimized radiological process for the approval, further use and recycling of material.
- Ensuring organization meets the needs of final shutdown.
- Creation of future job perspectives for personnel.
- Support from the owner company and cooperation with other sector players.

3. Optimizing post-operation and dismantling

Absence of nuclear fuel

Minimizing the effects of cost drivers

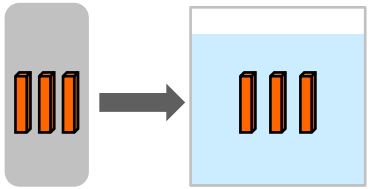
- For as long as fuel elements are stored in the spent fuel pool, cooling systems must remain operational – and these involve costs.
- According to the current definition, post-operation ends with absence of all fuel elements.
- Under current decommissioning plans, absence of all fuel elements can be expected within 3.5 to 6 years following final shutdown.
- A key criterion is the availability of fuel element transport and storage containers capable of handling last-core fuel elements after just 3.5 years of radiation reduction.

3. Optimizing post-operation and dismantling

Absence of nuclear fuel

The path from RPV to intermediate storage

1 Decay storage in spent fuel pool

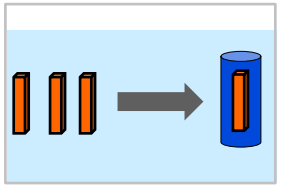


RPV | Spent fuel pool

Step 1

Spent fuel elements are placed in the spent fuel pool, where they are left to decay (thermal and radiological decay) over many years before they are suitable for transport.

2 Packing in spent fuel pool

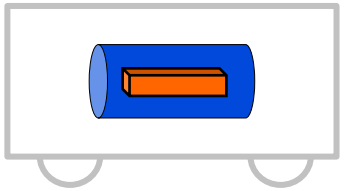


Spent fuel pool

Step 2

Following thermal and radiological decay, the spent fuel elements are packed into transport casks under water. Transport is possible when container has dried out.

3 Transport

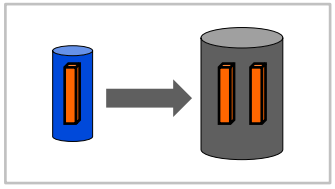


Transporter

Step 3

Fuel elements are then placed in further intermediate storage or in external wet storage – e.g. Zwilag intermediate storage site.

4 Intermediate storage



Re-packing

Step 4

Fuel elements are packed in intermediate storage containers in Zwilag hot cell and stored until a deep geological repository becomes available.

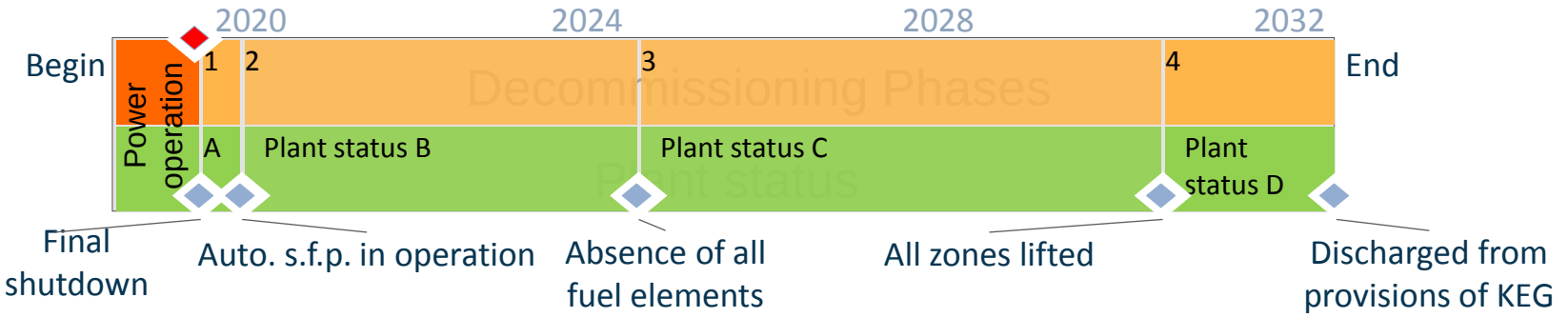
Following intermediate storage, the fuel elements must be re-packed in a container approved for storage in a deep geographical repository.

4. The decommissioning project

Performance in decommissioning phases

Decommissioning Phases

Decommissioning direction becomes effective



A Operating modes 4 and 5

- Conditioning of RPV internals (reactor waste)
- System decontamination
- Creating autonomous spent fuel pool operation
- Setting up center for materials logistics and decontamination
- Installing (conventional) replacement systems

B Autonomous operation of spent fuel pool

- Dismantling of all systems no longer required
- Once autonomous spent fuel pool operation has been established:
  - dismantling RPV
  - dismantling biological protective shield
- Removal of fuel elements, followed by lifting of security measures

C Operation without fuel elements

- Dismantling of all water-carrying systems
- Dismantling of all remaining systems and connection to replacement systems
- Controlled zone given clearance
- Lifting of zones
- Removal of security guard

D Lifting of plant zones

- Conventional dismantling work provided for in the decommissioning project
  - demolition of turbine building
  - demolition of reactor building
- Discharge from provisions enshrined in the nuclear energy laws

4. The decommissioning project
Safety requirements

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Significance of decommissioning phases: Decreasing safety requirements

Final shutdown

Components with varying radiological potential	Power operation	Post-operation	Decommissioning phases 1	2	3	4
Fuel elements in the reactor	X					
Fuel elements in the spent fuel pool	X	X	X			
Activated components: reactor, internals, connecting parts	X	X	X	X		
Radioactive waste from operation	X	X	X			
Contamin. components: Primary circuit, cooling and auxil. systems	X	X	X	X	X	
Activated building parts	X	X	X	X	X	
Contaminated building parts	X	X	X	X	X	X
Phase end (physical):	Reactor no longer pressurized, opened and flooded	No physical definition	Plant is free of nuclear fuel	Activated components including activated building parts (unless they are load-bearing parts) are removed	Contaminated components are removed	Buildings are given clearance
	Operating license		Decommissioning direction			

decreasing

Radiological potential

Source: GSKL Work group G17

5. Optimizing decommissioning of Mühleberg NPP
Parallelization of time-critical paths

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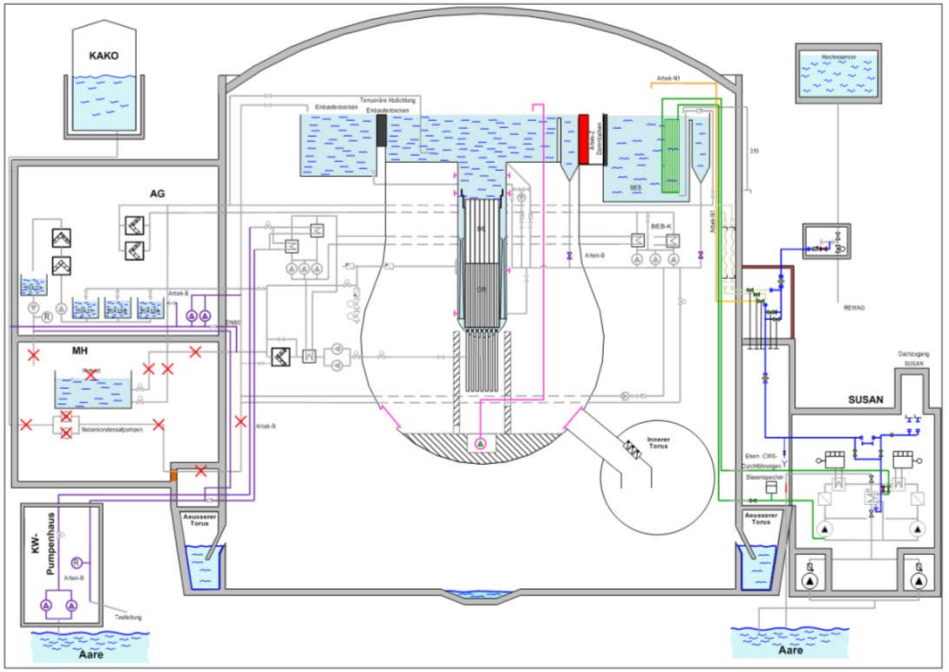
Parallel performance of work with a view to optimizing the work process…

- Creating autonomous spent fuel pool operation, consisting of constructional protection and installations to ensure comprehensive fulfilment of safety objectives.
- Absence of and protection against repercussions is ensured.



… greatly shortens the total amount of time needed for decommissioning

- Dividing-up the time-critical path, e.g. dismantling the reactor pressure vessel before removing fuel elements from the site.

5. Optimizing decommissioning of Mühleberg NPP
Turbine building as logistics center

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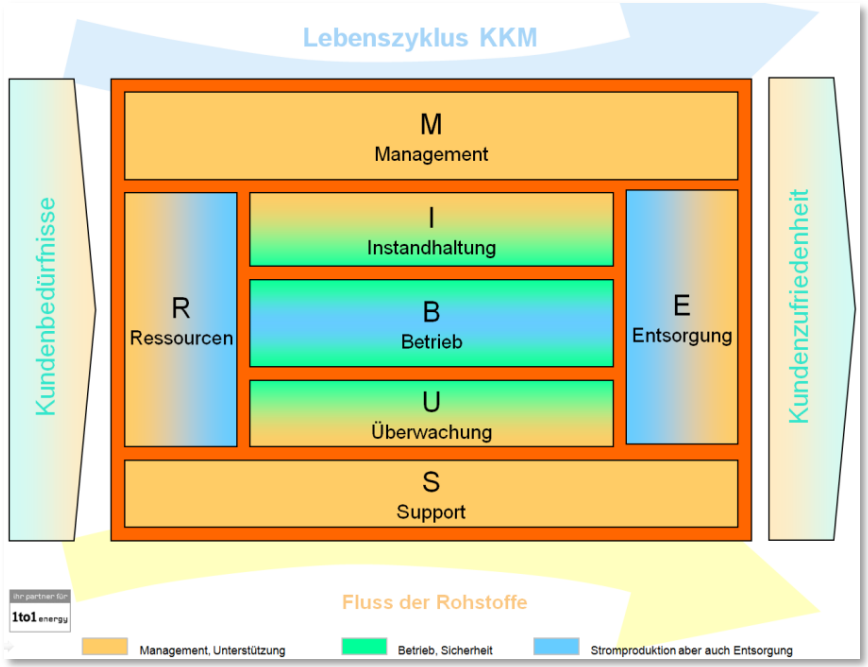
Parallel performance of work with a view to optimizing the work process

- Decommissioning and shutdown of systems: First in the turbine building, then in the reactor building.
- Use of turbine building as material and waste processing center.
- Coordination of work in the turbine building: Construction work for processing unit and dismantling work.
- "Dry" dismantling and decontamination process.
- Disposal paths are assumed to be in place.

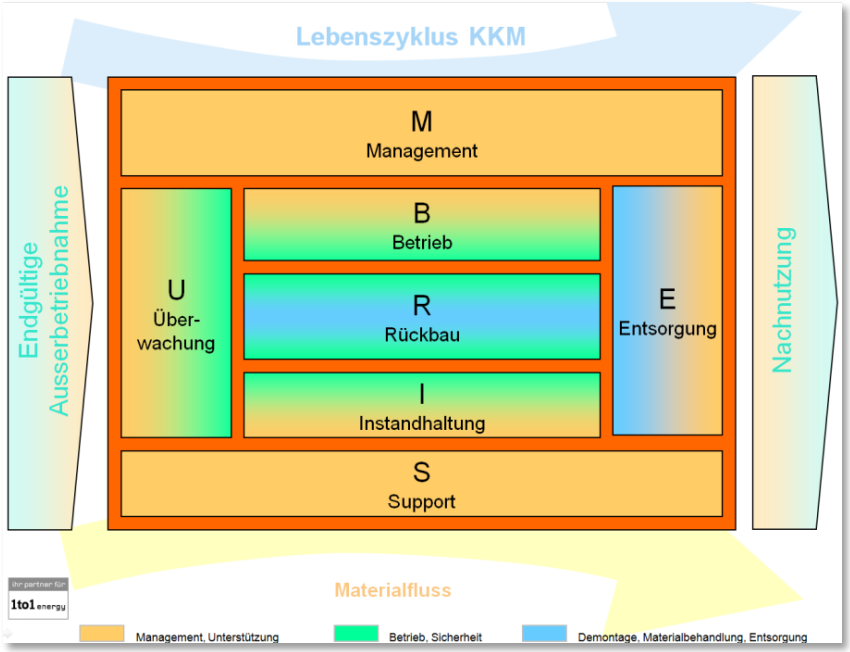
5. Optimizing decommissioning of Mühleberg NPP

Modifying the management system



Mühleberg NPP process groups during power operation

Operation produces electricity, hence customer satisfaction



Mühleberg NPP process groups during post-operation and dismantling

Dismantling removes material and ultimately enables re-use

5. Optimizing decommissioning of Mühleberg NPP

Optimizing organization

Development of organization for decommissioning

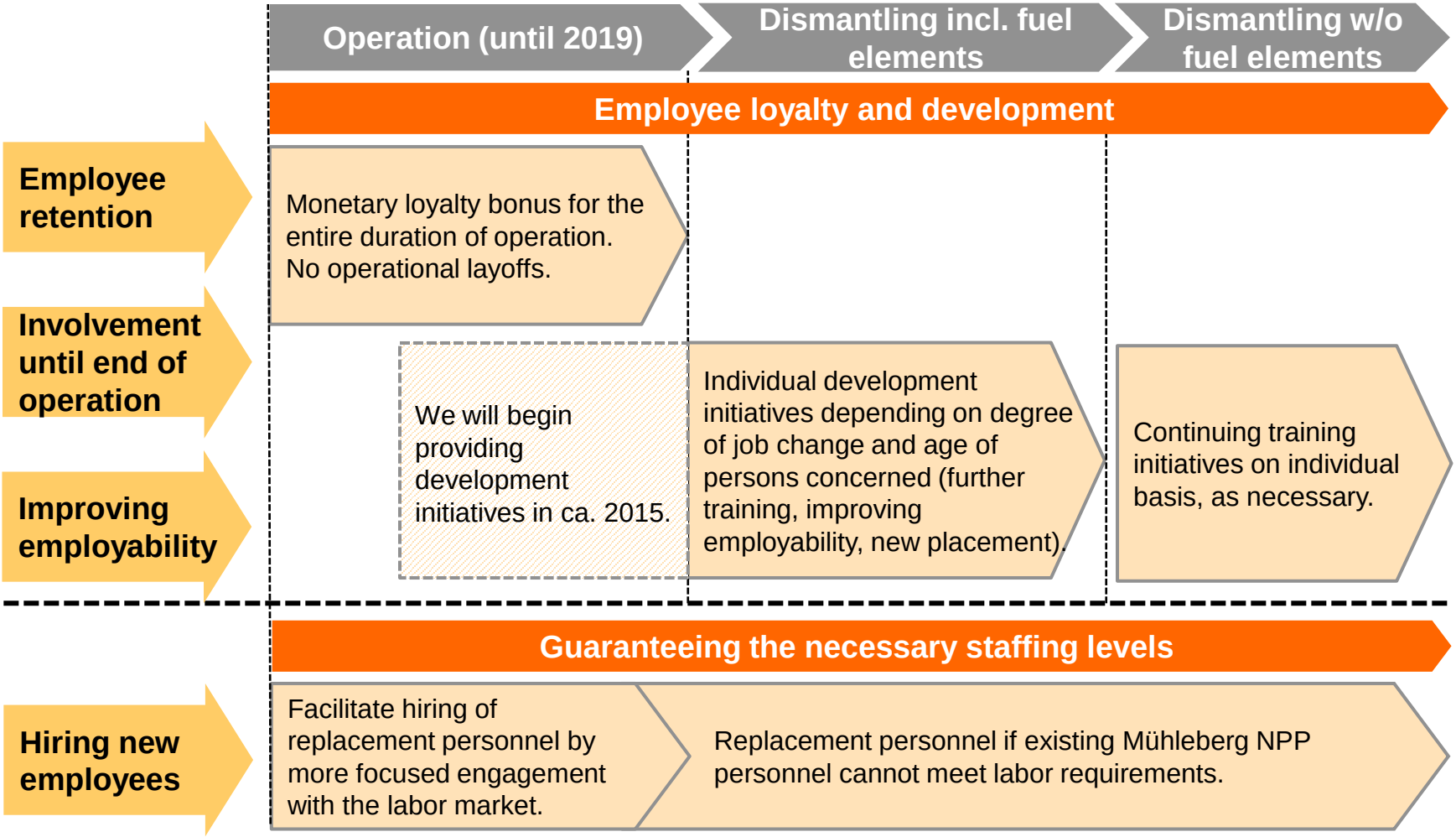
- Management system and operation-related processes must be adapted to the new organizational structure.
- Organization must transfer from operations' organization to dismantling organization.
- The methods adopted and work done in the post-operation and dismantling phases must be capable of planning and control.
- HR concept for personnel future job perspectives must be drawn up and communicated in a timely manner.

Quelle: thesmarttrainer.com

Future perspectives for personnel are currently an important topic at Mühleberg NPP.

6. Measures in place at Mühleberg NPP today

Draft HR concept



6. Measures in place at Mühleberg NPP today
Need for clarification

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Points for clarification

- The regulation of post-operation and dismantling is still under discussion. In our opinion, the provisions enshrined in nuclear law and ordinance allow **post-operation** under the provisions of the existing operating license. System changes continue to remain subject to regulatory notification and approval obligations. Procedures remain unchanged; however, when assessing the importance of changes, the decommissioning obligation must be taken into account. Hence, the removal of components used solely for power production cannot be considered to be a major change.
- Several **committees** have been installed addressing challenges regarding decommissioning aspects with sub-committees taking care of procedural, technical and communication aspects.
- **Guideline G17** sets out the decommissioning requirements and regulates the application documents.
- Nevertheless, are we currently addressing the **decommissioning project** and the planning of post-operation.

6. Measures in place at Mühleberg NPP today
The most urgent needs

Emphasis on three key points

- **PePe** – Personnel future perspectives
  We need our personnel until 2019 and beyond. We want safety-conscious, motivated and satisfied employees.
- **Technical plan** – "An integral aspect of decommissioning"
  Based on the decommissioning procedure already drawn up, the most important activities are summarized in a report. This forms the foundation for the overall approach after the final shutdown.
- **"Arbek"** – Plan for autonomous spent fuel pool operation
  Dismantling should be prepared as soon as possible after shutdown. Post-operation should be simplified and components which are no longer required should be removed. To this end, autonomous spent fuel pool operation is required. We are currently working on the plan for this and will be submitting it for representation in due course.

7. Expectations for optimal project implementation

Expectations made of procedural principles

Post-operation contains preparation of dismantling

- **Until the decommissioning direction becomes effective**, preparation or dismantling work can be carried out which is covered by the notification obligation or which is construed as **plant changes requiring specific approval under Art. 40 KEV**.
- After power production has stopped, the **significance** of plant changes under Art. 65 KEG is to be **assessed differently** to during power operation.
- Assuming that it does not compromise safety and that future dismantling work will not be significantly impeded, the **dismantling of components which are no longer required** should be performed during post-operation.
- Other **measures preparatory to dismantling**, such as the modification of the existing infrastructure, the construction of facilities needed for dismantling, and the installation of service, storage and staging areas, should be possible **during post-operation**.

7. Expectations for optimal project implementation

The key to success

Considering all factors involved leads to three overarching expectations

- **Proportionality**: The decommissioning procedure must closely pursue the safety objectives. The cost of nuclear safety reflects the potential for radiological hazard.
- **Flexibility in the approval process**: The operator (or the project) must be able to react flexibly to changing boundary conditions during the project.
- **Short decommissioning duration**: Extensive preparation work for decommissioning can be carried out during post-operation following an approval process in accordance with Ensi guideline A04.

This is a picture of Mühleberg nuclear power plant.

Take a good look at it – soon it will be gone.

Any questions?