Licensing Procedure and Inspection Fields in Decommissioning of Swiss NPP

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Definitions

**Decommissioning** (Message to the Nuclear Energy Act)

The decommissioning of a nuclear installation includes:

• all activities that are required in order to reuse the site for other purposes.

The site will no longer be:

• a radiological hazard
• a subject to nuclear energy legislation.

**Dismantling** (Nuclear Energy Order & Guideline ENSI-G17)

• Includes: disassembling, decontamination and demolition
• Dismantling starts when the decommissioning order becomes legally effective and ends when the nuclear installation is no longer subject to nuclear energy legislation.
Decommissioning process (NEA)

Owner: **Obligation for Decommissioning (after final shutdown)** and Initiation of a Decommissioning project

- Includes a phase concept specified by the owner
- Describes the dismantling strategy by concept

**ENSI: Expert report**

**Federal Department of the Environment, Transport, Energy and Communication (DETEC):** **Decommissioning license (order)**

- Replaces the operating license
- Regulates ENSI’s requirements (Expert report)
- Regulates ENSI’s approvals (phases and working steps)

**DETEC: Release from NEA**
Content of the decommissioning project (NEO)

The decommissioning project has to contain:

- Phase concept
- Dismantling concept
- Safety concept
- Security concept
- Radiation protection concept
- Waste separation and disposal concept
- Emergency concept
- Personnel and organisation concept
- Quality management concept
- Environmental concept
Definition of approvals (NEO)

The decommissioning licence has to define an approval especially for the following activities:

- Procedure for the **clearance measurement** of resulting materials
- Conditioning of radioactive waste
- Demolition of buildings after their decontamination and clearance measurement
- Non-nuclear use of installations after completion of the decommissioning process
- Repeal of security measures
- **Disassembly of the reactor vessel and its surrounding building elements**
Guideline ENSI-G17
"Decommissioning of nuclear installations"

Requirements for decommissioning:
• Specifies the requirements from NEO

Requirements for the application documents:
• Decommissioning project
• Post-shutdown period
• Decommissioning phases
• Final report
Mühleberg NPP

BWR, 373 MWe
GE SWR 4 / Mark 1
Nov. 1972
Final cease of power operation: December 20th, 2019
# Timetable of the preparation process

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tr>
<td>10/2013</td>
<td>BKW takes the corporate decision to decommission NPP Mühleberg</td>
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<tr>
<td>12/2015</td>
<td>BKW submits the decommissioning project to the SFOE</td>
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| 01/2016 - 08/2017 | Authorities SFOE/ENSI/FOEN check the completeness  
                        ▪ BKW reviews the project  
                        ▪ Public hearing leads to 9 objections  
                        ▪ Cantons and federal authorities gives their statement to the project  
                        ▪ Safety assessment and expert report by ENSI (Statement of NSC)  
                        ▪ ENSI-Report including 6 safety criteria and 35 obligations |
| 12/2017    | Exchange of involved federal and cantonal authorities                 |
| 06/2018    | Decommissioning license from DETEC (no complaints & litigations!)     |
| 01/2018 - 12/2019 | ENSI examines and approves the applications:  
                        ▪ Establishment of technical post-operation  
                        ▪ Preparatory measures  
                        ▪ Decommissioning phase 1 |
| Dec 20th, 2019 | BKW ceases the operation of NPP Mühleberg                              |
| 12/2019 - 10/2020 | Establishment of technical post-operation  
                        ▪ Preparatory measures |
| ca. 10/2020 | Formal Establishment of final shutdown status                         |
| 10/2020 - 2031 | Nuclear dismantling expected 10/2020 - 2031                           |
Decommissioning phases

1) preparatory measures
2) establishment of technical post-operation
3) maintenance of technical post-operation
4) measures under decommissioning order

- final cease of nuclear power operation: 12/2019
- final shutdown: ~9/2020
- free of nuclear fuel: 2024
- clearance measurement / repeal controlled zones: 2030

- step by step implementation according to the requirements of the decommissioning order
- validity of decommissioning order

AS: status
1) based on supervisory process with ENSI
2) final assessment report ENSI

source: BKW
Establishment of technical post-operation & Preparatory measures

A: Unload the reactor pressure vessel (transfer of spent fuel to the spent fuel pool)
B: Installation of the safety grade spent fuel pool cooling system
C: Removal of mobile equipment in the reactor building at +29m

Necessary to comply with the nuclear safety objectives

Preparatory measures (under decommissioning licence)
- Removal of components in the turbine hall
- Installation of material treatment facilities (cutting, decontamination and packaging)
Establishment of technical post-operation

BKW submitted applications

Installation of an independent, redundant spent fuel cooling system

- Arbek-S (new safety system for spent fuel cooling)
- Arbek-Z (additional fixing of plugs between spent fuel pool and reactor cavity)
- Arbek-B (modifications of operating system)

ENSIs approval on March 20th, 2019
«Concept establishment of technical post-operation»

Installation of equipment for dismantling the core internals
Preparatory measures

BKW submitted application for approval of Preparatory measures on December 18th, 2018

Approval by ENSI scheduled for November 2019

• Removal of equipment in the Turbine Hall
  ➢ disassembly
  ➢ decontamination
  ➢ Packaging and shipping of large individual components

• Logistics & retroactivity protection measures

• Construction of Material treatment equipment

• New lock at turbine hall (clearance measurements)

• Conversion of TA building
Requirements for final shut down status

- All necessary technical and organisational measures for the establishment of the technical post-operation have to be applied and approved under the existing operating license.

- Spent fuel has to be transferred from the RPV into the spent fuel pool.

- All necessary measures have to be implemented.

- The necessary approvals by ENSI have to be available, especially for the technical specifications and reglements.
Approval process for Decommissioning phase 1

- Disassembly Core internals
- Disassembly of systems in Reactor Building
- Removal/Shipping of Fuel
Separate ENSI approvals for Decommissioning phase 1 (SP1)

- Technical Specification
- Civil measures for retroactivity protection
- Disassembly of Core internals
- General facility regulations
- Training and further education concept
- Concept for radiation protection and incorporation protection
- Emergency regulations
- Procedure for the release measurements
- Procedure for decision measurements for decay storage
- Conditioning procedures in connection with AGT
Dismantling strategy phase 2

A Disassembly of spent fuel pool cooling systems
B Disassembly of pool internals
C Disassembly of reactor pressure vessel (RPV)
D Removal of personnel and material airlocks
E Disassembly of drywell components
F Disassembly of steam pipes and feed water pipes
G Disassembly of upper part of the biological shield
H Disassembly of drywell steel liner
I Disassembly of steam dryer and moisture separator storage pool liner and RPV cavity
J Disassembly of all remaining systems, e.g. reactor water clean up system
K Decontamination of facilities and buildings
L Operation of material treatment equipment
M Disassembly of systems in the SUSAN-building

Source: BKW
Final state after nuclear dismantling

1  SUSAN-building
3  Reactor building (Secondary containment)
17  Spent fuel pool
19  Steam dryer and moisture separator storage pool
21  Turbine hall

Source: BKW
Inspection fields in decommissioning

Expert report - overriding and phase aspects - decommissioning license requirements
Nuclear safety

- Compliance of protection goals
- Safety related systems & equipment
- Classification, Tech. Spec., maintenance
- Fire protection- & emergency exit concept
- Safety analysis
- Emergency management
Nuclear security

- Nuclear Security Concept
- Classification of security relevant Informations
- Personnel requirement und organisation of the security guard
- Personell security check
Dismantling

• New Processes «taking out of service» and «dismantling»
• Complex actions (dismantling Reactor Pressure Vessel etc.)
• Retroactive effects of changes, taking out of service and dismantling
• Material treatment equipment (dismantling & decontamination)
• Conversion of buildings
Radiation protection

- Radiation and incorporation protection, monitoring concept
- Monitoring of immissions of radioactive substances and of direct radiation
- Dose estimation of personnel
- Discharge of radioactive substances into the environment and limits
- Radiation exposure
- Radiation measuring technique
Waste management

• Masses and flow of material
• Separation and assignment of radioactive waste
• Internal and external transport logistic
• Clearance measurement of materials and areas
Staff and organisation

- Organisation and responsibilities
- Personnel resources & qualification
- Safety culture
- Quality management
- Documentation
Thank you for your attention.