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Stress test Follow-Up Actions

Issue Paper for Switzerland

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Table of Contents

1. Introduction

The EU post Fukushima Stress tests provided important insights into the robustness but also the vulnerabilities of individual NPP sites and units. Even during the performance of the Stress tests, having identified safety weaknesses, many plants embarked on modifications and safety improvements, in particular by adding mobile equipment. Following the completion of the Stress tests, all EU countries operating nuclear power plants prepared National Action Plans defining safety improvement measures and their implementation schedule. The National Action Plans addressed specific vulnerabilities found during the stress tests but also other elements, like safety improvements identified by other analyses or peer reviews.

Achieving and maintaining a high level of safety of NPPs in the neighbouring countries is of high interest to Austria. An important part of this is the understanding of and information concerning the implementation of the safety improvements, which are designed to rectify the vulnerabilities identified during the Stress tests, as well as other safety improvements. In order to identify the issues and safety improvements that are of highest relevance to Austria, the Federal Ministry for Agriculture, Forestry, Environment and Water Management engaged a group of Consultants (Project team) to undertake an in depth analysis of the Stress test reports, (including operators' and regulators'), the Extraordinary CNS reports, the National action Plans but also some other sources like bilateral meetings and other previous discussions. The results of the analysis for Switzerland are provided in the attached report.

Using the sources as described above, a set of safety issues and improvement measures of high interest for each of the neighbouring countries have been identified. Those issues and measures, following the same structure as used during the Stress test, are grouped into three categories:

- Topic #1: Initiating Events (Earthquake, flooding and extreme weather)
- Topic #2: Loss of Safety Systems
- Topic #3: Severe Accident Management

In each category relevant safety issues are listed. For each issue, the safety relevance and background information are provided. The information is, in general, taken from available reports and sources, and extended by the analyses of the Project team. The Project team provided its own estimates of the safety importance, as well as the expected schedule for the implementation. The latter (generally) reflects the schedules as provided by each country in the National Action Plan, though in some cases modified on the basis of perceived safety importance. Finally, the analysis of each of the safety improvements contains an entry called "To be discussed". In this entry, the specific details are summarized which are relevant for each specific safety issue and are considered to be of particular interest by the Project team, and that are proposed to be discussed during bilateral meetings.

With the selection of safety issues and improvement measures, it is intended to open the discussion during the regular annual bilateral meetings with each of the neighbouring countries. It is expected that each of the safety issues and improvement measures will be followed up upon to their final implementation or resolution.

In order to assure that the safety improvements are discussed commensurate to their actual safety relevance, a categorisation of the issues has been proposed. With the analysis as described above, all the issues are grouped in 3 categories. The categorisation reflects the perceived safety importance of each issue or measure, but also reflecting the amount (and clarity) of information currently available. The three categories, in the increasing level of complexities are:

- Check list
- Dedicated presentation
- Dedicated workshop

The “**check list**” is assigned to the safety issues/improvement measures that are in general understood and specifics of those are either known or obvious. Considering this, it is expected that a short presentation is made describing the status and announcing the schedule for the completion of the issue/improvement measure.

The “**dedicated presentation**” is the next higher category. For issues/safety improvements in that category, it is expected that the countries will provide a dedicated presentation, where the relevant specifics of the issue or improvement measure will be highlighted in more details. This is expected to include e.g. the design concept, the specifics of the construction/implementation/analysis or the planned operation of a modification. The list in the “to be discussed” entry indicates the main (though not necessarily all) the elements that are of interest.

For the issues of greatest safety significance but also for those of high complexity, or for the issues where the design solution is not known or many alternatives exist, the Project team recommends that a “**dedicated workshop**” is organized. In this, the country would present all related details on the issue to enable the Austrian side to ask clarifying questions, to assure full understanding of the concept, details of installation/operation or any other element that is relevant for the issue/improvement measure. To increase the efficiency, some of the workshops are meant to address several related subjects in as one set.

It is generally expected that each safety issue or improvement measure will remain on the agenda of bilateral meetings until the final completion and clarification. This does not mean that for each of the issues/improvements, a specific action (e.g. a workshop) would to be made in each of the bilateral meetings. Rather, it is expected that in the course of the next several meetings all the issues will be addressed in accordance with a mutually agreed work plan.

2. Glossary

AC	Alternate Current
AFW	Auxiliary Feedwater
AHRS	Additional Heat Removal System
AM	Accident Mitigation
AMP	Ageing Management Program
ANSYS	Analysis System (finite element software)
ASME	American Society of Mechanical Engineers
ASTEC	Accident Source Term Evaluation Code
BD	Czech for Control Room (Bloková Dozorna)
BDB	Beyond Design Basis
BDBA	Beyond Design Basis Accident
BHB	German acronym for Operating Manual
BSVP	Czech for Spent Fuel Storage Pool (Bazén Skladováni Vyhořelého Paliva)
BMU	German Federal Ministry for the Environment
BWR	Boiling Water Reactor
CCW	Component Cooling Water
CW	Cooling Water
CDF	Core Damage Frequency
CERES	Cooling Effectiveness on Reactor External Surface
CEZ (ČEZ)	České Energetické Závody, Czech Electrical Utility
CH	Switzerland
CISRK	Czech for Central Radiation Monitoring System (Centrální Informačni Systém Radiačni Kontroly)
CNS	Convention on Nuclear Safety
CNS EOM	CNS Extraordinary Meeting
CRP	Copper-rich Precipitates
CS	Containment Spray
ČSN	Česká Norma
CST	Condensate Storage Tank
CVCS	Chemical & Volume Control System
CZ	Czech Republic
ČEPS	Czech Transition Grid (Česká Elektrická Přenosová Oustava)
DACAAM	Data Collection and Analysis for Ageing Management
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DE	Germany
DEC	Design Extension Conditions
DC	Direct Current
DG	Diesel Generator

E.ON	German Electrical Utility
EBO	Bohunice Nuclear Power Plant, Slovakia
EC	European Commission
ECC	emergency control centre
ECCS	Emergency Core Cooling System
ECR	Emergency Control Room
EDA	Power Plant Dalešice, Czech Republic
EDG	Emergency Diesel Generator
EDU	Dukovany Nuclear Power Plant, Czech Republic
EFW	Emergency Feedwater
EFWS	Emergency Feed Water System
EMO	Mochovce Nuclear Power Plant, Slovakia
EMS	European Macroseismic Scale
EnBW	Energie Baden-Württemberg AG, German Electrical Utility
ENSI	Swiss Federal Nuclear Safety Inspectorate (Eidgenössisches Nuklearsicherheitsinspektorat)
ENSREG	European Nuclear Safety Regulators Group
EOP	Emergency Operating Instructions
EPG	Emergency Power Generators
ERMSAR	European Review Meeting on Severe Accident Research
ES	Engineered Safeguards
ESCW	Essential Services Chilled Water
ESR	Electron Spin Resonance Dating
ESW	Essential Service Water
ETE	Temelín Nuclear Power Plant, Czech Republic
FWT	Feedwater Tank
GKN I	Neckarwestheim I Nuclear Power Plant, Germany
GKN II	Neckarwestheim II Nuclear Power Plant, Germany
GRS	Gesellschaft für Anlagen- und Reaktorsicherheit, Germany
GPP	Gas Power Plant
HA	Hydro Accumulator
HAEA	Hungarian Atomic Energy Authority
HCLPF	High Confidence of Low Probability of Failure
HP	High Pressure
HŘS	Czech for Emergency Control Centre (Havarijní Řídící Středisko)
HU	Hungary
HVAC	Heating, Ventilation and Air Conditioning
HZSp	Czech for Fire Brigade of the NPP (Hasičský Záchranný Sbor Podniku)
IAEA	International Atomic Energy Agency
ICTS	Information and Communication Technology Services
IRS	Incident Reporting System
ISI	In-service Inspection
IZS	Czech for Integrated Rescue System (Integrovaný Záchranný System)

I&C	Instrumentation & Control
KBR	Brokdorf Nuclear Power Plant, Germany
KKB	Beznau Nuclear Power Plant, Switzerland
KKC	Czech for Emergency Coordination Centre (Krizové Koordinační Centrum)
KKE	Emsland Nuclear Power Plant, Germany
KKG	Grafenrheinfeld Nuclear Power Plant, Germany
	Gösgen Nuclear Power Plant, Switzerland
KKI-1	Isar I Nuclear Power Plant, Germany
KKI-2	Isar II Nuclear Power Plant, Germany
KKK	Krümmel Nuclear Power Plant, Germany
KKL	Nuclear Power Plant Leibstadt, Switzerland
KKM	Mühleberg Nuclear Power Plant, Switzerland
KKP I	Philippsburg I Nuclear Power Plant, Germany
KKP II	Philippsburg II Nuclear Power Plant, Germany
KKU	Nuclear Power Plant Unterweser, Germany
KRB B	Gundremmingen Nuclear Power Plant Unit B, Germany
KRB C	Gundremmingen Nuclear Power Plant Unit C, Germany
kV	Kilovolt
kW	Kilowatt
KWB A	Biblis Nuclear Power Plant Unit A, Germany
KWB B	Biblis Nuclear Power Plant Unit B, Germany
KWG	Grohnde Nuclear Power Plant, Germany
LFRS	Lead-Cooled Fast Reactors
LOCA	Loss of Coolant Accident
LOOP	Loss of Off-site Power
LP ECCS	Low Pressure Safety Injection (within Emergency Core Cooling System)
LRF	Large Release Frequency
M	Magnitude
MCCI	Molten Corium Concrete Interaction
MCR	Main Control Room
MPa	Megapascal
MPLS WAN	Multiprotocol Label Switching Wide Area Network
MSK	Modified Mercalli Scale
NAcP	National Action Plan
ND	Czech for Emergency Control Room (Nouzová Dozorna)
NPP	Nuclear Power Plant
NRC	(US) Nuclear Regulatory Commission
OECD	Organisation for Economic Co-operation and Development
OECD/NEA	Nuclear Energy Agency of OECD
OSL	Optically Stimulated Luminescence Age dating
PAMS	Post-Accident Monitoring System
PAR	Passive Autocatalytic Recombiners

PC	Primary Circuit
PGA	Peak Ground Acceleration
PGAH	Peak Horizontal Ground Acceleration
PGAV	Peak Vertical Ground Acceleration
PSA	Probabilistic Safety Analysis
PSHA	Probabilistic Seismic Hazard Assessment
PSR	Periodic Safety Review
PTS	Pressurized Thermal Shock
PU	Power Uprate
PWR	Pressurized Water Reactor
RA	Radioactive
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RELAP	Reactor Excursion and Leak Analysis Program (simulation tool)
RHR	Residual Heat Removal
RPV	Reactor Pressure Vessel
RSK	Reactor Safety Commission (Advisory Body to German Federal Ministry for the Environment)
RWE	German Electrical Utility
RWST	Reactor Water Storage Tank
SA	Severe Accident
SAM	Severe Accident Management
SAMG	Severe Accident Management Guidelines
SBLOCA	Small Break LOCA
SBO	Station Blackout
SCW	Service Circulating Water
SDSA	Steam Dump Station to Atmosphere
SFP	Spent Fuel Pool/pit
SFSP	Spent Fuel Storage Pool
SG	Steam Generator
SHA	Seismic Hazard Assessment
SiAnf	German Safety Requirements for Nuclear Power Plants
SK	Slovakia
SLO	Slovenia
SPSS	Secure power supply systems
SSCs	Structures, Systems and Components
StMUG	(Bavarian) State Ministry for the Environment
SÚJB	State Office for Nuclear Safety, Czech Republic
SUP	Safety Upgrade Program
SUSAN	Special Emergency System (Spezielles unabhängiges System zur Abfuhr der Nachzerfallwärme)
SW	Service Water
SWR69	German type of BWR

SWR72	German type of BWR
SZN	Czech for Safety Ensuring System (Systém Zajištění Bezpečnosti)
T_k	Ductile to Brittle Transition Temperature
TSC	Technical Support Centre
TVD	Czech for Essential Service Water (Technická Voda Důležitá)
UHS	Ultimate Heat Sink
UPS	Czech for Uninterruptible Power Supply (Nepřerušitelný Zdroj Elektrického Napájení)
V	Volt
VE	Czech for Hydroelectric Power Station (Vodní Elektrárna)
VVER	Water-Water-Energy-Reactor (reactor type of Soviet provenience)
WANO	World Association of Nuclear Operators
ZUNA	German acronym for AHRS

3. Summary of the findings

SUMMARY TABLE Stresstest Follow-Up Action: Issues for Monitoring, Switzerland				
Issue	Title	Safety importance	Follow-up	
			Action	Schedule
TOPIC 1: Initiating Events				
CH 1.1	Results of the PEGASOS Refinement Project (PRP)	High	Dedicated workshop together with CH 1.2 and CH 1.3	2Q /2015
CH 1.2	Seismic upgrades following the PEGASOS Project (all plants)	High	Dedicated workshop together with CH 1.1 and CH 1.3	2Q /2015
CH 1.3	Seismic safety margins (all plants)	High	Dedicated workshop together with CH 1.1 and CH 1.2	2Q /2015
CH 1.4	Status of microseismic monitoring and identification of active faults	High	Dedicated presentation	2Q /2014
CH 1.5	KKG and KKL: Seismic robustness and qualification of containment venting	High	Check list	2Q /2016
CH 1.6	KKM: Seismic margin and seismic safety of upstream dams	High	Dedicated presentation	2Q /2015
CH 1.7	KKG: Seismic upgrade of the main control room	Medium	Check list	2Q /2016
CH 1.8	Adequacy of the design basis with respect to extreme weather (all plants)	High	Dedicated presentation	2Q /2016
TOPIC 2: Loss of Safety Systems				
CH 2.1	KKM: Development of independent alternative heat sink	High	Dedicated presentation	2Q /2015
CH 2.2	Enhancement of SFP cooling (all NPPs)	Medium	Dedicated presentation	2Q /2018
CH 2.3	KKG: Ensuring availability of on-site special emergency power supply	High	Check list	2Q /2016
CH 2.4	KKB: The enhancement of the AC power supply	High	Dedicated presentation	2Q /2017
CH 2.5	KKB: Enhancement of the primary pump seals system	High	Dedicated presentation	2Q /2014
TOPIC 3: Severe Accident Management				
CH 3.1	Containment hydrogen management	High	Dedicated workshop	2Q /2016
CH 3.2	Safety improvements for spent fuel pools	High	Dedicated presentation	2Q /2014
CH 3.3	Safety improvements planned for Swiss NPPs – strategy for deployment of mobile equipment	High	Dedicated presentation	2Q /2014
CH 3.4	Power supply of instrumentation necessary for AM measures (KKM, possibly also other NPPs)	High	Dedicated presentation	2Q /2015
CH 3.5	Systematic assessment of the operability/availability of Accident Management measures at KKM	High	Dedicated presentation	2Q /2015
CH 3.6	Operability of pneumatic valves under accident conditions (especially RPV depressurization for NPP Mühleberg (KKM))	High	Dedicated presentation	2Q /2015
CH 3.7	Safety improvements planned for Swiss NPPs – cliff-edge effect in shutdown phases	Medium	Dedicated presentation	2Q /2016

3.1 Topic 1: Initiating Events (Earthquake, flooding and extreme weather)

Switzerland	
Topic 1: Initiating events	
Issue No	**CH 1.1**
Title	Results of the PEGASOS Refinement Project (PRP)
Content	The assessments of seismic hazard levels for the Swiss nuclear power plant sites were established in the 1970s. These hazard levels are referred to as H1 ("*hazard which the plant was originally designed to withstand"*) and H2 (*"hazard for which the plant was requalified (may be identical with H1)":* ENSI, 2011). The methodological approaches for the assessments of H1 and H2 were outdated by the advance of science and technology since the 1970s. At the end of the 1990s ENSI and NAGRA therefore launched a long-lasting process of hazard re-assessment in the framework of the PEGASOS project, which was completed in 2004, and the subsequent Pegasos Refinement Project. The re-assessment should define the updated site-specific seismic hazard levels H3 *"which is to be taken as the basis for the new deterministic proof regarding the 10,000 year earthquake"* as stipulated by ENSI (2011). During the Stress Tests ENSI announced that the final results of the Pegasos Refinement Project and the results of the latest seismic hazard update (H3) could be expected 2012. This schedule was apparently not met. According to the Swiss National Action Plan (NAcP; Actionsplan Fukushima, ENSI 2013) the Pegasos Refinement Project was to be completed in the 2nd quarter of 2013. Subsequently, ENSI was to examine the results and to define new hazard (4th quarter of 2013).
Safety relevance	The site-specific hazard levels H3, which are determined by the Pegasos Refinement Project, shall be taken as the basis for the new deterministic proof regarding the design basis earthquake.
Background	Seismic hazard assessment of the Swiss nuclear installations has been updated by an extensive PSHA study (PEGASOS) based on probabilistic seismic hazard analysis (Senior Seismic Hazard Analysis Committee SSHAC Level 4 study as defined in NUREG/CR-6372) from 2001-2004 (NAGRA, 2004; HSK, 2007). The study was scheduled to update the hazard levels H1 and H2, which were established in the 1970s with methods not longer considered state of the art. The new hazard level derived from the PEGASOS Project and the associated site-specific ground motion values exceed the earlier hazard estimates H1 and H2 significantly (HSK, 2007). The PEGASOS study has been completed in 2004 revealing updates of the site-specific seismic hazards for all Swiss NPPs. In 2008 the follow-up Pegasos Refinement Project was launched in order to reduce the uncertainties associated with the hazard levels obtained from PEGASOS (e.g., Renault et al., 2010). This should be achieved by the acquisition of new site-specific data. The final results of that project are referred to as hazard level H3 (ENSI, 2011). In the Stress Tests documents H3 (i.e., the hazard level in accordance with the

	latest seismic studies in the Pegasos Refinement Project derived for an exceedence probability of 10^{-4} per year) was announced as the basis for the new deterministic proof by 31 March 2012 (ENSI, 2012). The Swiss NAcP later announced the results of the Pegasos Refinement Project for the 2nd quarter of 2013 (ENSI, 2012). ENSI further announced that: *"Bis im 4. Quartal 2013 wird das methodische und terminliche Vorgehen für die Erdbebennachweise der schweizerischen Kernkraftwerke detailiert neu festgelegt. Daran anschliessend sind die Nachweise durch die Bewilligungsinhaber der Kernkraftwerke zu überarbeiten bzw. neu zu erbringen"* (ENSI, 2013, PP1). References: ENSI (2011). EU Stress Test Swiss National Report. ENSI Review of the Operators' Reports. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf ENSI (Swiss Federal Nuclear Safety Inspectorate) (2012). EU Stress Test: Swiss National Action Plan. Follow up of the Peer Review. 2012 Year-End Status Report. http://www.ensreg.eu/node/697 ENSI (Swiss Federal Nuclear Safety Inspectorate) (2013). Aktionsplan Fukushima 2013. http://static.ensi.ch/1362073505/20130228_ aktionsplanfuksuhima2013.pdf ENSI (Swiss Federal Nuclear Safety Inspectorate) (2012). Swiss National Report Topic 1. EU stress test – Topical Review Switzerland. Presentation at Luxembourg, 9-10 February 2012, EU_ST-Topical_Review_CH-Topic1.pdf ENSREG (2012). Switzerland. Peer review country report. Stress tests performed on European nuclear power plants. http://www.ensreg.eu/node/392 HSK (2007). Neubestimmung der Erdbebengefährdung an den Kernkraftwerkstandorten in der Schweiz (Projekt PEGASOS). Hauptabteilung für die Sicherheit der Kernanlagen (HSK), Villingen. NAGRA (2004). Probabilistic Seismic Hazard Asnalysis for Swiss Nuclear Power Plant Sites (PEGASOS Project). Final Report, Volumes 1 to 6. http://www.swissnuclear.ch/upload/cms/user/PEGASOSProjectReport Volume1.pdf Renault, P., Heuberger, S. & Abrahamson, N.A. (2010). PEGASOS Refinement Project: An improved PSHA for Swiss nuclear power plants. 14th European Conference on Earthquake Engineering (ECEE), Ohrid, 30.08.-03.09.2010
To be discussed	The Project team asks information about the results of PRP. Information should address the following questions: ➢ What are the updated site-specific hazard levels (H3) in terms of ground motion parameters for the Swiss nuclear sites? ➢ What kinds of novel site-specific data have been acquired in framework of the Pegasos Refinement Project? ➢ What are the major advances of the Pegasos Refinement Project when compared with PEGASOS? ➢ What are the differences between the results of the Pegasos Refinement Project and PEGASOS in terms of site-specific hazards

	(ground motion parameters) and the related uncertainties? ➢ Which methods have been selected to demonstrate seismic safety with respect to the hazard level H3? ➢ What is the time schedule for demonstrating seismic safety?
Safety importance	High
Expected schedule	Medium term
Follow-up	Dedicated workshop (together with CH 1.2 and CH 1.3)

Switzerland	
Topic 1: Initiating events	
Issue No	**CH 1.2**
Title	Seismic upgrades following the PEGASOS Project (all plants)
Content	Seismic hazard estimates obtained from the PEGASOS Project in 2004 exceeded both, the hazards for which the plants were originally designed to withstand (H1), and the hazards for which the plants were re-qualified (H2). The plant-specific design bases are therefore lower than the seismic loads, which are expected from design basis events with recurrence probabilities of 10^{-4}/year according to the PEGASOS study. The new hazard obtained from PEGASOS was incorporated into plant-specific Probabilistic Safety Analyses (PSA) with a PSA process, which allowed for a 20% reduction of the PEGASOS ground acceleration values. According to ENSI, these PSAs led to some targeted seismic upgrades. These upgrades, however, are not specified in the Stress Tests documents (ENSI, 2011). Also, the Stress Tests documents do not clarify whether a systematic retrofitting of classified SSCs has been scheduled, or not.
Safety relevance	Consistency of the seismic robustness of classified SSCs with the loads of the design basis event is a primary safety requirement.
Background	See CH 1.1. References: ENSI (2011). EU Stress Test Swiss National Report. ENSI Review of the Operators' Reports. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf
To be discussed	The following information is requested for the four Swiss nuclear power plants: ➢ What are the results of the plant-specific PSAs? ➢ Which measures have been decided upon the results of the PSAs? ➢ Which retrofitting measures have been completed to upgrade classified SSCs to the reduced PEGASOS ground acceleration values? ➢ Have these upgrades been completed, or are parts of the measures still pending?
Safety importance	High
Expected schedule	Medium term
Follow-up	Dedicated workshop (together with CH 1.1 and CH 1.3)

Switzerland	
Topic 1: Initiating events	
Issue No	**CH 1.3**
Title	Seismic safety margins (all plants)
Content	The Stress Tests documents include information on seismic margins, which were derived from the comparison of the seismic robustness of classified SSCs (determined by HCLPF) to the hazard levels H1 and H2. Some of the determined margins appear very low (e.g., 1st safety train for core cooling, KKG and KKM; 1st safety train for spent fuel pool cooling, KKG and KKM). According to the Swiss National Report submitted to the Stress Tests, ENSI scheduled to review the HCLPF values provided by the licensees on a sampling basis, as part of its review on the proof of safety in case of the 10,000-year earthquake, which was to be submitted on 31 March 2012. At the regular bilateral meeting Switzerland – Austria in 2012, the Swiss side stated that the above-mentioned safety cases had been submitted in due time by the licensees. The review by ENSI was still on-going at the time of the bilateral meeting 2013 (Bilateral Meeting CH-A, 2012; 2013; ENSI, 2013, OP2-3).
Safety relevance	During the Stress Tests it was not clarified whether the new site-specific hazard values (H3) derived from the PEGASOS and Pegasos Refinement Projects are enveloped by safety margins, or not.
Background	In their National Report ENSI (2011) distinguished three seismic hazard levels referred to as H1 (hazard which the plant was original designed to withstand by a deterministic approach), H2 (hazard for which the plant was requalified or, for the newer Swiss plants, already used as original design basis; established by a probabilistic approach) and H3 (hazard in accordance with the latest seismic studies in the Pegasos Refinement Project with an exceedence frequency of 10^{-4} per year, basis for the new deterministic proof by 31 March 2012). It is notable that ENSI stipulated for the purpose of the EU Stress Tests not to refer to hazard level H3, which was not quantified in the Stress Tests Documents (ENSI, 2011), but to compare the seismic robustness of the Swiss plants and the robustness of classified SSCs to the outdated hazard levels H1 and H2. For some plants and some SSCs this comparison revealed only small safety margins. This approach to use H1 and H2 as benchmarks for the safety margins was accepted by ENSREG (2012) as a stringent definition of term "seismic safety margin" has not been given during the Stress Tests process. It remained open whether the hazard level H3, which is apparently significantly higher than H1/H2, is enveloped by some margin, or not. References: Bilateral Meeting CH-A (2012). Information provided by the Swiss side at the 12. Swiss-Austrian Bilateral Meeting, Wabern near Bern, May 07, 2012. Bilateral Meeting CH-A (2013). Information provided by the Swiss side at the 13. Swiss-Austrian Bilateral Meeting, Vienna, April 29, 2013.

	ENSI (2011). EU Stress Test Swiss National Report. ENSI Review of the Operators' Reports. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf ENSI (Swiss Federal Nuclear Safety Inspectorate) (2012). Swiss National Report Topic 1. EU stress test – Topical Review Switzerland. Presentation at Luxembourg, 9-10 February 2012, EU_ST-Topical_Review_CH-Topic1.pdf ENSI (Swiss Federal Nuclear Safety Inspectorate) (2013). Aktionsplan Fukushima 2013. http://static.ensi.ch/1362073505/20130228_ aktionsplanfuksuhima2013.pdf ENSREG (2012). Switzerland. Peer review country report. Stress tests performed on European nuclear power plants. http://www.ensreg.eu/node/392
To be discussed	The Project team asks for the following information on a plant-by-plant basis: ➢ Detailed information on the safety margins determined as the difference between the robustness of classified SSCs and the hazard value H3. ➢ Identification of the weakest system, structure or component in each success path for safe shutdown in order to quantify the seismic margin of each plant by the difference between the ground motion value that leads to failure of the weakest component in the most robust success path and the seismic level H3. ➢ In the case that H3 is not enveloped by existing margins: information about the measures foreseen to increase the seismic robustness and the time schedule for the implementation of such measures is requested.
Safety importance	High
Expected schedule	Medium term
Follow-up	Dedicated workshop (together with CH 1.1 and CH 1.2)

Switzerland	
Topic 1: Initiating events	
Issue No	**CH 1.4**
Title	Status of microseismic monitoring and identification of active faults
Content	During the Stress Tests information was obtained about the existence of a joint program of the Swiss NPP operators and the Swiss Seismological Survey to extend the seismological observation network in NW Switzerland and the Swiss Mittelland. The extended coverage and increased accuracy of seismological records should help to identify active fault zones.
Safety relevance	Seismic monitoring networks should be used for identifying active faults in the site vicinity and near region of nuclear installations.
Background	Seismic hazard assessments in areas of low to moderate seismicity suffer from the limitations of historical and instrumental earthquake records. In many cases earthquake catalogues are not long and precise enough to identify all active faults in the area, particularly in cases of slow moving faults, which produce earthquakes at large time intervals. Such faults, however, may contribute significantly to seismic hazard. The observation of micro-seismicity and precise locations of earthquakes by a dense network of seismic stations may be used to allocate seismicity to individual tectonic faults thereby providing evidence for their activity.
To be discussed	The Project team asks for information on the status and results of the seismic monitoring programme. ➢ Have microseismic data previously been used to identify active faults in the near region of the Swiss NPPs? ➢ What is the status of the program to extend the seismic monitoring network?
Safety importance	High
Expected schedule	Short term
Follow-up	Dedicated presentation

Switzerland	
Topic 1: Initiating events	
Issue No	**CH 1.5**
Title	KKG and KKL: Seismic robustness and qualification of containment venting
Content	According to the Swiss National Report for the ENSREG Stress Tests measures are planned to improve the seismic stability of the containment venting systems for the NPPs Gösgen (KKG) and Leibstadt (KKL).
Safety relevance	Containment venting shall be qualified to withstand a design basis event. The venting system is important for long-term overpressure protection of the containment and it shall also be available after a seismic event.
Background	The Swiss National Action Plan (NAcP) states that work is ongoing to improve the seismic capacity of the venting systems of KKG and KKL (ENSI, 2012; ENSI, 2013, OP2-3). The topic appears particularly important for KKG where the safety margins for containment integrity were assessed by HCLPF methods. The assessment revealed a safety margin for the containment venting system, which is equal to a peak ground acceleration value of PGA_{HCLPF}=0.23g (ENSI, 2011). This value is lower than the acceleration value associated with the hazard level H2, which is given by 0.28g for the ground surface reference level. For KKG, this raises the question whether venting is qualified for the seismic hazard level H2, or not. References: ENSI (2011). EU Stress Test Swiss National Report. ENSI Review of the Operators' Reports. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf ENSI (Swiss Federal Nuclear Safety Inspectorate) (2012). EU Stress Test: Swiss National Action Plan. Follow up of the Peer Review. 2012 Year-End Status Report. http://www.ensreg.eu/node/697 ENSI (Swiss Federal Nuclear Safety Inspectorate) (2013). Aktionsplan Fukushima 2013. http://static.ensi.ch/1362073505/20130228_ aktionsplanfuksuhima2013.pdf
To be discussed	The requested presentation should address the following topics: ➢ What is the status and progress of the seismic upgrade of the containment venting systems at KKG and KKL? ➢ What is the target value (in terms of ground motion parameters) for the ongoing upgrade? ➢ What is the time schedule for finalizing the upgrade?
Safety importance	High
Expected schedule	Medium term
Follow-up	Check list

Switzerland	
Topic 1: Initiating events	
Issue No	**CH 1.6**
Title	KKM: Seismic margin and seismic safety of upstream dams
Content	For the NPP Mühleberg (KKM) it is impossible to exclude flooding of the power plant site, with a hazard posed to the safety equipment of all the safety trains by dam wall breaches caused by a severe earthquake. Hazards derive from possible breaches of the upstream dams Wohlensee, Schiffenen and Rossens.
Safety relevance	The seismic margin of the 2nd safety train for core cooling of KKM is limited by the seismic robustness of the Wohlensee dam wall upstream of the plant because, in case of a seismically induced failure of the dam wall, the cooling water supply would be endangered due to blockage of the intake structure.
Background	The seismic robustness of the safety trains for core cooling of KKM have been determined by a HCLPF (High Confidence of Low Probability of Failure) methodology with PGA_{HCLPF}=0.17g for the 1st safety train and PGA_{HCLPF}=0.31g for the 2nd safety train. The robustness of the 2nd safety train is limited by the seismic robustness of the Wohlensee dam wall upstream of the plant because the cooling water intake of the special emergency system is endangered in case of a seismically induced failure of the dam wall (ENSI, 2011). Flooding due to dam breach is said to be included in the design basis flood level (ENSREG, 2011). The seismic fragility of the dam was established by a nonlinear analysis revealing a HCLPF capacity of 0.30g (Ghanaat et al., 2011). In its assessment ENSI compares the robustness of the 2nd safety train (PGA_{HCLPF}=0.31g) with the (outdated) hazard level H2 (PGA=0.15g) concluding that a significant safety margin exists for this function as the robustness of the dam exceeds the hazard level of H2 by a factor of 2.1 (ENSI, 2011). The level H2 is outdated by the PEGASOS Project (see Issue CH 1.1), which revealed significantly higher ground motion values between 0.20-0.28g for bedrock surface, and even higher mean hazard values for soil (PGA_H>0.30g) for the occurrence probability of 10^{-4} per year (NAGRA, 2004; HSK, 2007). Although a confirmation of these values by the Pegasos Refinement Project is pending, it appears that only a small safety margin is available for the 2nd safety train when comparing its robustness to the PEAGASOS hazard values. The PEGASOS results further suggest that higher hazard levels also apply to the sites of the upstream dams. It is unclear whether the robustness of the upstream dams is high enough to withstand the ground motion of a seismic event with the occurrence probability of 10^{-4}/year as determined by the Pegasos Refinement Project. At the times of the Stress Tests both the earthquake resistance of the Wohlensee dam wall and of the dam walls at Schiffenen and Rossens were being re-examined by KKM, taking account of hazard level H3. ENSI further have requested an alternate heat sink diverse to the water intake of the river Aare, so that a breach of the Wohlensee dam will not be limiting the seismic safety of KKM in future (ENSI, 2012; 2013, issue PP3, scheduled for 2015).

	References: ENSI (2011). EU Stress Test Swiss National Report. ENSI Review of the Operators' Reports. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf ENSI (Swiss Federal Nuclear Safety Inspectorate) (2012). EU Stress Test: Swiss National Action Plan. Follow up of the Peer Review. 2012 Year-End Status Report. http://www.ensreg.eu/node/697 ENSI (Swiss Federal Nuclear Safety Inspectorate) (2013). Aktionsplan Fukushima 2013. http://static.ensi.ch/1362073505/20130228_ aktionsplanfuksuhima2013.pdf Ghanat, Y., Hashimoto, P.S., Zuchuat, O. & Kennedy, R.P. (2011). Seismic fragility of Mühleberg dam using nonlinear analysis with latin hypercube simulation. U.S. Society on Dams, 31st Annual USSD Conference, San Diego, California, April 11-15, 2011, p 1197-1212. HSK (2007). Neubestimmung der Erdbebengefährdung an den Kernkraftwerkstandorten in der Schweiz (Projekt PEGASOS). Hauptabteilung für die Sicherheit der Kernanlagen (HSK), Villingen. NAGRA (2004). Probabilistic Seismic Hazard Asnalysis for Swiss Nuclear Power Plant Sites (PEGASOS Project). Final Report, Volumes 1 to 6. http://www.swissnuclear.ch/upload/cms/user/PEGASOSProjectReport Volume1.pdf
To be discussed	The requested presentation should include the following information: ➢ What ground motion hazards (10^{-4} per year occurrence probability) are expected for the dam sites upstream of KKM according to PEGASOS and Pegasos Refinement Project? ➢ Are these ground motion values enveloped by the seismic robustness of the dams? ➢ What is the current status of establishing an alternate heat sink for KKM?
Safety importance	High
Expected schedule	Medium term
Follow-up	Dedicated presentation

Switzerland	
Topic 1: Initiating events	
Issue No	**CH 1.7**
Title	KKG: Seismic upgrade of the main control room
Content	Seismic upgrade of certain structures in the main control room
Safety relevance	Integrity of the main control room in case of a seismic event is highly safety relevant.
Background	It is mentioned in the Peer Review Country Report (ENSREG, 2011) that the Gösgen NPP (KKG) found in its stress test analysis that the supporting structures for cables and the control stations in the main control room should be seismically upgraded. It is further indicated that potential improvements to the seismic robustness of the emergency diesel generators (EGs) and to the fixtures of auxiliary equipment are being examined (Kernkraftwerk Gösgen, 2011). These activities are apparently not included in the Swiss National Action Plan (ENSI, 2012, 2013). References: ENSI (Swiss Federal Nuclear Safety Inspectorate) (2012). EU Stress Test: Swiss National Action Plan. Follow up of the Peer Review. 2012 Year-End Status Report. http://www.ensreg.eu/node/697 ENSI (Swiss Federal Nuclear Safety Inspectorate) (2013). Aktionsplan Fukushima 2013. http://static.ensi.ch/1362073505/20130228_ aktionsplanfuksuhima2013.pdf ENSREG (2012). Switzerland. Peer review country report. Stress tests performed on European nuclear power plants. http://www.ensreg.eu/node/392 Kernkraftwerk Gösgen (2011). EU Stresstest: Beurteilung der Sicherheitsmargen des KKG, Bericht des Genehmigungsinhabers. BER-D-54731. http://static.ensi.ch/1326186551/stresstest-kkg_geschw.pdf
To be discussed	The Project team asks for the following information: ➢ What kinds of measures are foreseen to increase seismic robustness of the main control room, and what is the time scheduler for these measures? ➢ What are the results of the examination of the seismic robustness of the EDGs and auxiliary equipment?
Safety importance	Medium
Expected schedule	Medium term
Follow-up	Check list

Switzerland	
Topic 1: Initiating events	
Issue No	**CH 1.8**
Title	Adequacy of the design basis with respect to extreme weather (all plants)
Content	Assessment of hazards with respect to extreme weather and analyses of the protection against extreme weather conditions
Safety relevance	To proof adequate protection against extreme meteorological conditions, account must be taken of events with occurrence probabilities of 10^{-4} per year or less.
Background	The loads resulting from extreme weather conditions were determined in the 1960s and 1970s, using methods based on the standards of the Swiss Association of Architects and Engineers (SIA). For extreme temperatures, the Swiss civil engineering design standard has been applied during the initial construction of the Swiss NPPs (ENSREG, 2011). With respect to extreme weather conditions ENSREG's Stress Tests Country Report states that *"There is no complete and comprehensible proof of the precise determination of the hazards and their impact on the plants at this stage"* further noting that *"ENSI has requested the proofs of protection against extreme weather conditions, including combinations of extreme conditions".* According to the Stress Tests documents there is particularly no demonstration of the adequacy of the design basis for the following cases: (1) For Beznau (KKB) and Leibstadt (KKL) tornado occurrence frequencies have apparently not been established. Additional analyses have been requested by ENSI (ENSREG, 2011). (2) The adequacy of the design basis extreme temperatures with the regulatory requirement (exceedence probability less than 10^{-4}/year) has not been demonstrated. ENSI has requested additional analysis to the Licensees (ENSREG, 2011). These issues are covered by the Swiss National Action Plan(ENSI, 2013, issue PP1). ENSI has defined specifications for analyses on the protection against extreme weather conditions and their combinations, to be performed by the licensees. Operator's reports have to be delivered in 2013 (ENSI, 2012). References: ENSI (Swiss Federal Nuclear Safety Inspectorate) (2012). EU Stress Test: Swiss National Action Plan. Follow up of the Peer Review. 2012 Year-End Status Report. http://www.ensreg.eu/node/697 ENSI (Swiss Federal Nuclear Safety Inspectorate) (2013). Aktionsplan Fukushima 2013. http://static.ensi.ch/1362073505/20130228_ aktionsplanfuksuhima2013.pdf ENSREG (2012). Switzerland. Peer review country report. Stress tests performed on European nuclear power plants. http://www.ensreg.eu/node/392

To be discussed	The following information is requested form a dedicated presentation: ➢ What are the results of hazard analyses with respect to extreme weather conditions? ➢ Which data and methods have been used for the hazard assessment? ➢ Are the loads by extreme weather conditions and combinations of extreme conditions enveloped by the designs of the plants?
Safety importance	High
Expected schedule	Medium term
Follow-up	Dedicated presentation

3.2 Topic 2: Loss of Safety Systems

Switzerland	
Topic 2: Loss of safety systems	
Issue No	**CH 2.1**
Title	KKM: Development of independent alternative heat sink
Content	Installation of a new seismically qualified water source as an alternative UHS to the river for safety train 2.
Safety relevance	In the Mühleberg NPP (KKM) river water is used as the primary UHS. River water is used to cool safety trains 1 and 2. As its primary ultimate heat sink, safety train 1 uses river water from the main cooling water intake structure. The cooling water supply for safety train 2 is provided by the special emergency intake structure (located at the main cooling water outlet), pumping water from the same river. Loss of the primary UHS assumes loss of both intakes. According to present knowledge, a flood-induced blockage of both intake structures cannot be excluded. As a consequence of such event the water supply for safety trains 1 and 2 will be lost threatening the core cooling and the fuel integrity.
Background	According to the **EU Stress Test Swiss National Report** (ENSI, 2011), KKM has only one primary ultimate heat sink. The cooling water supplies for safety trains 1 and 2 are physically separated, and the second intake structure has extended protection against flooding as compared to the first structure. However, clogging of both intake structures by water-carried debris and sediment cannot be excluded in case of extreme flooding. Because of the lack of sufficient ground water on site, an alternate or diversified ultimate heat sink does not yet exist at the Mühleberg NPP. Both cooling water intake structures take water from the Aare river. In order to assure core cooling and residual heat removal in case of loss of the ultimate heat sink, ENSI ordered the Mühleberg NPP to implement a diversified heat sink that is independent from the Aare river by the end of 2017 (project DIWANAS). The **Swiss National Action Plan** states that Mühleberg NPP will follow this order by providing alternate cooling water to the special emergency system SUSAN from a protected well that is fed by the Saane River which is also located in the vicinity of the Mühleberg NPP. As a bridging measure, KKM has ensured an additional cooling water supply by means of mobile pumps. References: ENSI (2011). EU Stress Test Swiss National Report. ENSI Review of the Operators' Reports. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf EU Stress Test: Swiss National Action Plan Follow up of the Peer Review 2012 Year-End Status Report. http://www.ensreg.eu/node/697

To be discussed	The presentation should describe in more detail the safety concept and design of the proposed measure and answer the following questions: ➢ What studies have been/are/will be made regarding the availability and capacity of the new source of water in extreme conditions (earthquake, flood, drought, etc.) and what are the results (if already available)? ➢ What will be the external events resistance of the new well and associated equipment? ➢ Special emergency system SUSAN safety functions description. ➢ Planned consumers in addition to special emergency system SUSAN.
Safety importance	High
Expected schedule	Medium term
Follow-up	Dedicated presentation

<table>
<tr><td colspan="2">Switzerland</td></tr>
<tr><td colspan="2">Topic 2: Loss of safety systems</td></tr>
<tr><td>Issue No</td><td>CH 2.2</td></tr>
<tr><td>Title</td><td>Enhancement of SFP cooling (all NPPs)</td></tr>
<tr><td>Content</td><td>The following measures are planned for enhancing the SFP robustness, according to the Swiss National Action Plan:
1. For the KKB and KKM power plants the additional specially protected system for SFP cooling will be implemented (by 2015).
2. Backfitting of two physically separated connections for the external SFP feed so that accident management measures can be implemented without the need to enter the storage pool area (where not already available, by 2012; at the Beznau NPP in 2013).
3. Backfitting of an accident proof SFP level and temperature measurement instrumentation (1E qualification) for all Swiss NPPs (by 2014).
4. Improvement of the earthquake resistance and backfitting of a venting duct to remove heat from the Beznau SFP storage building in case of boiling SFP water (by 2014).
5. Backfitting of a diversified heat sink at the Mühleberg NPP (see issue CH 2.1) which serves also for SFP cooling (by 2017).</td></tr>
<tr><td>Safety relevance</td><td>In case of failure of operational systems for SFP cooling as well as installed alternative SFP cooling systems, the accident management measures should be implemented. In order to implement the accident management measures it is necessary to perform some manual actions in the storage pool area (e.g. to establish hose connections extending to the SFP or to operate valves). These actions may be necessary under aggravated conditions (heat, steam, radiation) that substantially impair implementation of accident management measures. As a consequence, there is a challenge for the timely implementation of the necessary accident management measures in order to prevent the fuel damage in the SFP. In addition, in accordance to the view of Swiss regulatory authority ENSI, the in-plant accident management measures to remove decay heat in case of a failure of SFP cooling at KKB and KKM do not provide adequate coverage. At both NPPs the SFP cooling systems used for operational purposes are dependent on the primary ultimate heat sink. The cooling of the SFP at these NPPs is not secured by water supply from alternate cooling sources in order to prevent the damage to fuel assemblies.</td></tr>
<tr><td>Background</td><td>Availability of SFP cooling alternative systems
In case of a failure of the systems used in operation for cooling the spent fuel pools (SFP), staggered (defence-in-depth) measures come into play. Initially, their aim is to use permanently installed alternative systems (e.g. the shutdown cooling system at KKM) to restore a cooling circuit. For this purpose, the relevant sections of the first safety train (at KKG, KKL and KKM) are available and, at KKG, those of the second safety train are also available for SFP cooling. In this case, some manual measures may have to be implemented by the plants' operating staff. Operation of the systems as such is handled from the main</td></tr>
</table>

	control rooms (KKG, KKL, KKM) or from the emergency control room (at KKG only). The respective measures are stipulated in accident procedures. At KKB and KKM cooling of the SFP is ensured by safety train 1, which is not qualified against seismic hazard level H2. Cooling by safety train 2 is not possible, safety train 3 (cooling by mobile means) is credited (long time delays before cooling is needed). In case of loss of safety train 1, vaporisation and/or evaporation volume is compensated by re-injecting water into the SFP. These AM measures (safety train 3) are implemented with the help of mobile operational equipment kept available on-demand on site.

Manual measures in the storage pool area

At the KKB, KKL and KKM plants, it is necessary to implement manual measures in the storage pool area, e.g. to establish hose connections to the SFP or to operate valves. By contrast, the injection into the SFP at the KKG plant uses a connection that is permanently installed in the annular space and pipes in the independent pool cooling system.

SFP earthquake protection

ENSI states in the **EU Stress Test Swiss National Report** that except for KKM, the seismic robustness of the SFP in Swiss nuclear power plants can be rated as high, on the basis of the information from the operators. For this reason, KKM intends to improve the earthquake resistance of the pool slot plugs as they are the limiting component.

SFP flood protection

With regard to flood protection of the SFP cooling system, at KKB and KKM safety train 1 is not protected, safety train 2 is not available, safety train 3 is credited.

The following table summarizes the above described SFP cooling means.

NPP	Safety Train 1 Normal operation systems for SFP cooling	Safety Train 2 Permanently installed alternative systems	Safety Train 3 Mobile cooling means
KKB	X (not qual. to H2, not protected against flood)	-	X (manual measures in SFP area necessary, mobile equipment)
KKG	X	X	X (manual measures in SFP area necessary, permanently installed connection)
KKL	X	-	X (manual measures in SFP area necessary, mobile equipment)
KKM	X (not qual. to H2, not protected against flood)	-	X (manual measures in SFP area necessary, mobile equipment)

Proposed improvement measures

In order to avoid the need to enter the storage pool areas (possibly under aggravated conditions) to carry out and monitor the accident management measures, ENSI has directed that appropriate back-fitting measures must be implemented (**Swiss National Action Plan**, **EU Stress Test Swiss National Report**). In its first order of 18 March 2011 /A-2/, ENSI stipulated that two physically separate injections for the external supply of the SFP must be back-fitted by 31 December 2012 where they are not already in place. The equipment must be qualified or designed against earthquakes of hazard level H3, and refilling of the pools must be possible without entering the pool areas.

All the operators are under obligation to install accident-resistant displays to monitor the temperature and filling level of the spent fuel pools in the main control rooms (KKL, KKM) and also in the specially protected emergency control rooms and/or special emergency control rooms (KKB, KKG, KKL, KKM) by 31 December 2012, where these facilities are not already in place.

In its assessment of the reliability of the spent fuel pool cooling in connection with the third order /A-4/, ENSI asked that the pool cooling at KKB must be improved. KKB proposed to install equipment for pressure relief of the spent fuel pool storage building in the event that all spent fuel pool cooling systems should fail.

The integrity of the spent fuel pool at KKM is limited by the seismic resistance of the pool slot plugs. KKM intends to improve the earthquake resistance of the pool slot plugs as they are the limiting component. This measure is not included in the **Swiss National Action Plan**.

Improvement measures are summarized in the following table.

#	Subject	Deadline	NPP			
			KKB	KKG	KKL	KKM
1	Backfitting of a new SFP cooling system	By 2015	X			X
2	Backfitting of a physically separated additional feed for the SFP (accident management measure)	By 2012 (KKB by 2013)	X	X	X	X
3	Backfitting of accident-proof filling level and temperature instrumentation for the spent fuel pools (SFP)	By 2014	X	X	X	X
4	Improvement of earthquake resistance of the SFP storage building and backfitting of a venting duct to remove heat from the SFP storage building	By 2014	X			
5	Backfitting of a diversified heat sink	By 2015				X
6	Improving the earthquake resistance of the SFP slot plugs	Unknown				X

References:

ENSI (2011). EU Stress Test Swiss National Report. ENSI Review of the Operators' Reports. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf

ENSREG (2012). Switzerland. Peer review country report. Stress tests performed on European nuclear power plants. http://www.ensreg.eu/node/392

EU Stress Test: Swiss National Action Plan Follow up of the Peer Review 2012 Year-End Status Report. http://www.ensreg.eu/node/697

To be discussed	The presentation should describe in more detail the safety concept and design of the proposed measures and answer the following questions: ➢ What will be the safety margin (e.g. time to SFP fuel damage) gained by KKB, KKM additional specially protected system for SFP cooling? ➢ What will be the new level of earthquake resistance for the KKB SFP storage building? ➢ What will be the new level of earthquake and flood resistance for the KKB and KKM additional specially protected system for SFP cooling?
Safety importance	Medium
Expected schedule	Long term
Follow-up	Dedicated presentation

<table>
<tr><td colspan="2">Switzerland</td></tr>
<tr><td colspan="2">Topic 2: Loss of safety systems</td></tr>
<tr><td>Issue No</td><td>CH 2.3</td></tr>
<tr><td>Title</td><td>KKG: Ensuring availability of on-site special emergency power supply</td></tr>
<tr><td>Content</td><td>Procurement of mobile local power generation units (size: approx. 500 kVA).</td></tr>
<tr><td>Safety relevance</td><td>In case of long-lasting total SBO (SBO and loss of any other diverse back-up AC sources) there is real threat to the integrity of fuel in the RCS and SFP. Without available on-site emergency power source, the heat removal for RCS or SFP cannot be ensured (except by alternative mobile equipment). Assuring availability of emergency power supply would extend the operability of the dedicated equipment, and thus prevent a damage of the fuel.</td></tr>
<tr><td>Background</td><td>In the majority of Swiss NPPs, at least one medium-sized mobile AM emergency power unit (at least 120 kW / 150 kVA) is available locally, i.e. in the plant itself. At KKG, units of this sort must be requested from the immediate vicinity and transported to the plant because the previously available local KKG emergency power unit was relocated to the external Reitnau storage facility.

According to additional information, KKG plans to procure local power generation units (size: approx. 500 kVA).

References:
ENSREG (2012). Switzerland. Peer review country report. Stress tests performed on European nuclear power plants. http://www.ensreg.eu/node/392</td></tr>
<tr><td>To be discussed</td><td>The information of interest is the status of procurement and operability of the dedicated on-site emergency power supply units.</td></tr>
<tr><td>Safety importance</td><td>High</td></tr>
<tr><td>Expected schedule</td><td>Medium term</td></tr>
<tr><td>Follow-up</td><td>Check list</td></tr>
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Switzerland	
Topic 2: Loss of safety systems	
Issue No	**CH 2.4**
Title	KKB: The enhancement of the AC power supply
Content	Replacement of the supply from hydro-power plant by the emergency diesel generators (two for each plant unit).
Safety relevance	At Beznau NPP the 4th Safety Layer of the electrical energy supply includes the safety trains (two per each unit) from the hydro-power plant that are not seismically qualified. Their availability is the challenging issue for the case of an earthquake.
Background	Even before the events at Fukushima, where several power plant units at the same site were simultaneously affected by a severe accident, potential for improvement regarding the special emergency supply had been identified at KKB. The major AUTANOVE project that has been initiated in 2008 aiming at the replacement of the existing KKB emergency hydroelectric power supply by four emergency diesel generators for the two units. The DGs shall be installed in two separate buildings protected against earthquake (level not specified) and flooding. The **EU Stress Test Swiss National Report** states that all electrical components involved in emergency and special emergency electrical power supply systems (except the Hydro backed supplies) have a 1E classification and are qualified against earthquake. KKM also has two supply trains from hydro-emergency power supply. At KKM the emergency power supply system for safety train 1 has only one emergency power unit and therefore does not satisfy the single failure criterion. References: ENSI (2011). EU Stress Test Swiss National Report. ENSI Review of the Operators' Reports. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf
To be discussed	The presentation should describe in more detail the safety concept and design of the proposed measure and highlight technical characteristics such as: ➢ Current situation at KKB (e.g. consumers supplied by the 2 supply trains from hydro-emergency power supply), challenges in hydro-power supply availability, impact of unavailability. ➢ New EDGs capacity, location/separation, resistance to external events, consumers supplied, time required for start, autonomy with fuel reserves on site. ➢ Why is not a similar modification envisaged for KKM, which also has 2 supply trains from hydro-emergency power supply and only 1 DG (KKB has 1 for each unit with cross connection possibility)?

Safety importance	High
Expected schedule	Long term
Follow-up	Dedicated presentation

Switzerland	
Topic 2: Loss of safety systems	
Issue No	**CH 2.5**
Title	KKB: Enhancement of the primary pump seals system
Content	The additional, robust seal water system will be installed, which will be part of the bunkered emergency system.
Safety relevance	At all Swiss nuclear power plants, except of Beznau the primary pumps are inherently leak-proof after shutdown. At the Beznau NPP, seal water injection is necessary to prevent a reactor coolant pump seal LOCA.
Background	ENSREG (Compilation of recommendations and suggestions. Peer review of stress tests performed on European nuclear power plants. ENSREG 2012) recommended "The use of temperature-resistant (leak-proof) primary pump seals". At the Gösgen, Leibstadt, and Mühleberg NPP, the primary pumps are inherently leak-proof after shutdown. At the Beznau NPP, seal water injection is necessary to prevent a reactor coolant pump seal LOCA. This issue is not discussed in the **EU Stress Test Swiss National Report** or in the ENSREG **Peer Review Report**. The **Swiss National Action Plan** states that at the Beznau NPP, an additional, robust seal water system is planned to be installed by 2014, which will be part of the bunkered emergency system. References: EU Stress Test: Swiss National Action Plan Follow up of the Peer Review 2012 Year-End Status Report. http://www.ensreg.eu/node/697 ENSI (2011). EU Stress Test Swiss National Report. ENSI Review of the Operators' Reports. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf ENSREG (2012). Switzerland. Peer review country report. Stress tests performed on European nuclear power plants. http://www.ensreg.eu/node/392
To be discussed	The presentation should describe in more detail the safety concept and design of the proposed measure, and in particular the safety improvement brought by its implementation (e.g. how long would it take, without seal water injection, to reach a critical situation).
Safety importance	High
Expected schedule	Short term
Follow-up	Dedicated presentation

3.3 Topic 3: Severe Accident Management

SWITZERLAND	
Topic 3: Severe Accident Management	
Issue No	**CH 3.1**
Title	Containment hydrogen management
Content	Before the Fukushima accident, most Swiss NPPs were not equipped with passive autocatalytic recombiners for severe accidents. Only KKB has PARs with a limited capacity for BDBAs. More reliance on passive systems is envisaged for the future. Furthermore, pressures from hydrogen combustion so far have been calculated on the basis of complete adiabatic isochoric combustion, without taking the effects of higher local concentrations into account. Further analyses are to be performed. Other lessons learned from Fukushima concern the study of hydrogen management in the containment venting system and the qualification of hydrogen monitoring systems for severe accidents.
Safety relevance	Hydrogen deflagration or detonation can lead to early containment failure, and to large early releases (i.e. to a severe accident with very high consequences, compared to accidents with late containment failure or intact containment). Therefore, it is of high importance to understand the Swiss activities, in particular regarding the comprehensiveness of the analyses planned and to ascertain that appropriate measures are taken wherever required.
Background	According to the **Licensees' Stresstest Reports** (AXPO 2011), most Swiss NPPs are not equipped with PARs for severe accidents: Only KKB has passive recombiners with a limited capacity for BDBAs (sufficient for hydrogen releases from interaction of the molten core with concrete, but not for hydrogen releases from zircaloy oxidation, which were not seen as realistic threat to the containment). At KKG, it is assumed that in most BDBA scenarios, the containment atmosphere will be inertised by steam. KKL is provided with an ignition system for hydrogen, requiring DC from batteries. At KKM, the containment is inertised with nitrogen; the main strategy to avoid hydrogen deflagrations and explosions consists of preventing the intrusion of oxygen into the containment. In the **National Stresstest Report** (ENSI 2011), ENSI states that pressures from hydrogen combustion in the primary containment so far have mainly been calculated on the basis of complete adiabatic isochoric combustion in the primary containment with a hydrogen concentration of 10 % in the relevant control volume. This largely corresponds to the international state-of-the-art. However, it neglects the fact that hydrogen may accumulate locally in higher concentrations, which can lead to more energetic combustion and hence to higher pressure. Further analysis is therefore required by ENSI and will be followed up in the frame of the oversight activities (section 6.3.1). In the **Peer Review Country Report** (ENSREG 2012) for Switzerland, it is

	recommended that the regulator assess the opportunity of requiring more reliance on passive systems for hydrogen management for severe accident conditions and that the regulator considers further studies on the hydrogen management for the venting systems (sections 4.2.13 and 4.3). ENSI has required further analyses by the operators. In the **Swiss Report to the 2nd CNS EOM** (CH 2012), it is listed that Switzerland plans "re-evaluation of hydrogen risks" until 2015 (section 7). Regarding KKM, ENSI specifically intends to require analyses of the threat of hydrogen burning to the containment venting system in 2013 (reply of ENSI to recommendations of category 2 of the Austrian expert statement). In the **National Action Plan (NAcP)** (ENSI 2013a), it is stated that all Swiss NPPs have provisions against hydrogen in the containment (e.g. recombiners, igniters, N_2 inertization, mixing system), without specifying which measures are installed in which plant, and for which conditions (DBA, BDBA) they are designed. It is also stated that the licensing authority will require further improvements for (passive) hydrogen management at least in some of the plants (section 3.1). Furthermore, it is pointed out that ENSI has started discussing the boundary conditions for further analyses to be conducted by the licensees. The need for PARs has also been studied (section 8.1). The schedule for further studies and improvement is not presented in the NAcP. However, the **Aktionsplan Fukushima 2013** (ENSI 2013b) describes in some detail the activities planned for 2013. Various aspects of hydrogen hazards in case of severe accidents are to be re-visited. A number of analyses are listed which have to be performed by the licensees, and submitted by the end of 2013 (see below). Evaluating the whole process of dealing with severe accident management, from the Stresstest 2011/2012 to the National Action Plan Peer Review in April 2013, a number of recommendations from reviewers and requirements from ENSI have been formulated which concern hydrogen management in the containment (and also in other buildings of the NPP). In particular, the following issues can be identified: 1. Further analyses of hydrogen combustion: Analyses of hydrogen combustion in the primary containment so far have been performed on the basis of complete adiabatic isochoric combustion with a hydrogen concentration of 10 % in the relevant control volume. The possibility of higher local concentrations, leading to more energetic combustion, is neglected in these analyses. Therefore, further analyses have been required by ENSI (ENSI 2011, Section 6.3.1). In the Swiss National Action Plan (ENSI 2013a), it is stated that ENSI has started discussing boundary conditions for further analyses with the licensees (Section 8.1). 2. More reliance on passive systems for hydrogen management for severe accident conditions: So far, passive autocatalytic recombiners are used in only one Swiss NPP (KKB), with limited capacity for severe accidents. The hydrogen instrumentation is battery backed up for a minimum of 4 hours. Considering this, the stresstest peer reviewers recommended that ENSI considers the possibility of requiring more reliance on passive systems (ENSREG 2012, Sections 4.2.1.3 and 4.3). In the Swiss National

	Action Plan (ENSI 2013a), it is stated that the need for PARs has already been studied (Section 8.1). 3. Further studies on the hydrogen management for the venting systems: Filtered venting plays an important role for hydrogen control at the Swiss NPPs. Therefore, the stresstest peer reviewers recommended that ENSI considers further studies on the hydrogen management for the venting systems (ENSREG 2012, Sections 4.2.1.3 and 4.3). ENSI confirmed that the threat of hydrogen combustion in the venting system is an open issue, requiring investigation (ENSI 2102b). 4. Qualification of hydrogen monitoring systems for severe accidents: All Swiss NPPs are equipped with hydrogen monitoring systems. However, the hydrogen monitoring systems are not qualified for severe accidents. This is stated in the Swiss National Action Plan (ENSI 2013a), Section 3.1. No activity in this context is mentioned in the National Action Plan; however, it appears obvious that this issue requires follow-up. Regarding future activities, the National Action Plan only very generally states that the licensees will have to provide additional studies and identify possible backfitting measures, to be evaluated by ENSI. However, the Aktionsplan Fukushima 2013 (ENSI 2013b) describes in some detail the activities planned for 2013. Correspondence to the issues identified and listed above can be established. For these items, the following analyses and investigations are relevant: • *Prüfung von Robustheit und Umfang der Messeinrichtungen im Zusammenhang mit der Beurteilung der Wasserstoffgefährung,* (corresponds to item 4. above) • *Aktualisierung der Analysen zur Wasserstoffgefährdung sowie Untersuchung der Ausbreitung von Wasserstoff aus dem Containment in andere Gebäude des Kernkraftwerkes,* (corresponds to item 1. above) • *Überprüfung der vorhandenen Maßnahmen und Vorschriften zum Schutz gegen die Wasserstoffgefährdung,* (general point, could encompass item 2. above) • *Überprüfung des Containmentdruckentlastungspfads betreffend Wasserstoffgefährdung.* (corresponding to item 3. above) Issue CH 3.1 focuses on hydrogen management in the containment. Therefore, the aspect of hydrogen migration from the containment in other buildings is not further dealt with here. References: AXPO (2011). Schlussbericht des Kernkraftwerks Beznau zum EU-Stresstest, TM-511-R 11043, 28.10.2011 http://static.ensi.ch/1326186544/stresstest-kkb_geschw.pdf CH (2012). National Report of Switzerland for the Second Extraordinary Meeting in Accordance with Article 5 of the Convention, May 2012 http://static.ensi.ch/1336738953/swiss_national_report_to_the_second_cns_extraordinary_meeting.pdf

	ENSI (2011). EU Stress Test Swiss National Report – ENSI Review of the Operators' Reports, December 2011 http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf ENSI (2012b). ENSI-Stellungnahme zu den Empfehlungen der Kategorie 2 des Fachgutachtens KKM der österreichischen Umweltbundesamte GmbH, Dezember 2012 http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/kernenergie/Muehleberg/ensi-an-8146_geschwaerzt.pdf ENSI (2013a). EU Stresst Test: Swiss National Action Plan, Follow up of the Peer Review 2012 Year-end Status Report, January 2013 http://www.ensreg.eu/sites/default/files/ENSI_SwissAP_ENG_121231_final.pdf ENSI (2013b). Aktionsplan Fukushima 2013, February 2013 http://static.ensi.ch/1362073505/20130228_aktionsplanfuksuhima2013.pdf ENSREG (2012). Peer review country report – Switzerland. Stress tests performed on European nuclear power plants. http://www.ensreg.eu/sites/default/files/Country%20Report%20CH%20Final.pdf
To be discussed	The workshop should focus on the items 1 to 4 listed in the background section. An appropriate time would be after the submittal of the results of the investigations by the licensees and the evaluation of this material by ENSI, allowing for some leeway in case further work is regarded as necessary. The following questions should be addressed: ➢ How do the investigations planned for 2013 according to "Aktionsplan 2013" correspond to the items 1 to 4, in detail? Are these items fully covered? What are the result of the analyses and investigations performed in 2013 (and of further investigations, if any)? ➢ Which concrete measures for safety improvements, if any, are planned as a result of these analyses and investigations? As far as no improvement measures are planned – how is this justified, how is it decided whether measures are needed or not? ➢ What is the schedule for improvement measures, if any? Can it be expected that they can be fully implemented by 2017 (final deadline for the post-Fukushima activities)? ➢ How will safety be improved by the measures which are planned (if any)? How does the state of the NPPs before implementation compare with the state after implementation of the measures?
Safety importance	High
Expected schedule	Medium term
Follow-up	Dedicated workshop

SWITZERLAND	
Topic 3: Severe Accident Management	
Issue No	**CH 3.2**
Title	Safety improvements for spent fuel pools
Content	One of the issues the Fukushima accident called attention to is the safety of spent fuel pools. At Fukushima Daiichi, cooling of the SFPs was interrupted for several days, and accurate, reliable information on the state of the pools was not available for a longer period of time. In Switzerland, a number of measures are planned to improve the reliability of heat removal from the pools, in particular in case of earthquakes, as well as to back-fit accident-proof instrumentation. It is also taken into account that access to the SFP building could be severely impeded in case of an accident, and it should be possible to feed coolant into the pool from outside.
Safety relevance	Loss of cooling of a spent fuel pool will eventually lead to evaporation of the coolant, followed by overheating and melting of fuel elements, combined with hydrogen production. The development of a critical situation takes a relatively long time (a few days to weeks, depending on the inventory of the pool, the fuel burnup, and the decay time since unloading from the reactor). However, once shielding of the fuel elements is significantly reduced by water evaporation, counter-measures are becoming increasingly difficult, if they require access to the pool. If the fuel overheats and melts, hydrogen explosions threaten and very large releases are likely to occur. By back-fitting of additional cooling systems and instrumentation, including the option of feeding coolant into the pools from outside the building, the chances to successfully manage accidents which implicate the spent fuel pools are increased.
Background	In the **Swiss National Report** for the EU stress test (ENSI 2011) the Swiss regulator ENSI mentions several safety improvements that are planned for the near future for Swiss NPPs. Among others there are several measures relevant for SAM for the spent fuel pools: a. Backfitting of accident-proof filling level and temperature instrumentation for the spent fuel pools SFP, by 2014 (all plants) b. Backfitting of physically separated additional feed lines for the SFP, by 2012 (all plants) c. Backfitting of a venting duct to remove heat from the SFP storage building, by 2014 (only KKB) The **National Action Plan** (ENSI 2013a, section 2.10) lists the following measures for enhancing SFP robustness: • Backfitting of two additional feed lines for SFP cooling without the need to entering the SFP building (by 2012, at KKB by 2013) – this measure corresponds to b) above. • Backfitting of accident-proof SFP level and temperature measurement instrumentation (by 2014) – corresponds to a) above.

	• Improvement of the earthquake resistance and back-fitting of a venting duct to remove heat from the SFP building at KKB (by 2014) – the latter corresponds to c) above. • Backfitting of a new SFP cooling system that is qualified as safety system for KKB and KKM (by 2015) • Backfitting of a diversified heat sink at KKM which serves also for SFP cooling (by 2017) The deadlines correspond to those given in the National Stresstest Report (apart from a delay for measure b) at KKB); furthermore, new measures have been planned which were not mentioned in the National Stresstest Report. The deadline in the last case appears to be rather late; however, it has to be taken into account that the back-fitting of a diversified heat sink constitutes a major and complicated project. In the **Aktionsplan Fukushima 2013** (ENSI 2013b, February 2013), only the back-fitting of cooling systems at KKB and KKM is briefly mentioned; otherwise, there is no direct reference to measures concerning spent fuel pools. The project of back-fitting a diversified heat sink, however, is dealt with in the Aktionsplan Fukushima 2013 and the deadline (2017) is confirmed. It is part of the "Gesamt-Nachrüstungsprojekt" (overall back-fitting project) DIWANAS. References: ENSI (2011). EU Stress Test Swiss National Report – ENSI Review of the Operators' Reports, December 2011. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf ENSI (2013a). EU Stresst Test: Swiss National Action Plan, Follow up of the Peer Review 2012 Year-end Status Report, January 2013. http://www.ensreg.eu/sites/default/files/ENSI_SwissAP_ENG_121231_final.pdf ENSI (2013b). Aktionsplan Fukushima 2013, February 2013. http://static.ensi.ch/1362073505/20130228_aktionsplanfuksuhima2013.pdf
To be discussed	Questions which should be addressed in a presentation are: ➢ Status of the backfitting measures quoted above from the National Action Plan. ➢ How will safety be improved by these measures? How does the state of the NPPs before implementation compare with the state after implementation of the measures? Next year could be an appropriate time for a dedicated presentation since some measures will already be completed by then, whereas others will be well on the way to implementation.
Safety importance	High
Expected schedule	Short term
Follow-up	Dedicated presentation

SWITZERLAND	
Topic 3: Severe Accident Management	
Issue No	**CH 3.3**
Title	Safety improvements planned for Swiss NPPs – strategy for deployment of mobile equipment
Content	Shortly after the Fukushima accident, die NPP operators in Switzerland acquired mobile diesel generators to be used for emergency power supply in case the stationary diesel generators are not available. In order to maximize the safety improvement gained by the mobile diesels, it is important to have a comprehensive strategy for their use, which is being developed.
Safety relevance	This measure is a consequence of the important role mobile equipment, in particular mobile electricity generators, is to play in the future for accident management. Mobile electricity generators are important to increase the chances to successfully manage severe accidents, by providing an additional line of defence against station blackout. With a comprehensive strategy for their use, planning in detail which consumers should be supplied for different accident scenarios, the safety improvement resulting from the provision of mobile generators can be maximized.
Background	According to the **Swiss National Report** for the EU stress test (ENSI 2011), mobile diesel generators for accident management are available at all Swiss nuclear power plants. However, the Swiss regulator ENSI states that there is still the need to develop a comprehensive strategy for the targeted deployment of the mobile accident management emergency diesels in order to secure selected DC and/or AC consumers in the long term under total SBO (resp. SBO) conditions (section 5.1.5). No date is provided for this measure. In section 8.2, the **National Action Plan** (ENSI 2013a)) refers, among other issues, to the deployment of mobile AM emergency diesels. It is mentioned that ENSI has conducted inspections on all four sites to check the new AM equipment, deployment strategy, procedures and connection points. The analysis of the inspection results is still in progress. The **Aktionsplan Fukushima 2013** (ENSI 2013b, February 2013) states that the inspections showed that sufficient means are available to avoid core damage after a station blackout. The results of the inspections will be further evaluated in the first quarter of 2013. Depending on the outcome of the evaluation, ENSI will decide whether measures in addition to those planned for the Aktionsplan 2013 regarding the increase of safety margins will be required (section 3.4). The increase of safety margins is treated in section 4.4. In this section, there is only a brief reference to mobile devices and the procuration of additional mobile generators is mentioned. There is no reference to the development of a comprehensive strategy for deployment of mobile emergency diesels. The schedule for completion of this measure is not clear at present.

	References: ENSI (2011). EU Stress Test Swiss National Report – ENSI Review of the Operators' Reports, December 2011 http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf ENSI (2013a). EU Stresst Test: Swiss National Action Plan, Follow up of the Peer Review 2012 Year-end Status Report, January 2013 http://www.ensreg.eu/sites/default/files/ENSI_SwissAP_ENG_121231_final.pdf ENSI (2013b). Aktionsplan Fukushima 2013, February 2013 http://static.ensi.ch/1362073505/20130228_aktionsplanfuksuhima2013.pdf
To be discussed	Questions which should be addressed in a presentation are: ➢ Status of the development of a comprehensive strategy for the targeted deployment of the mobile accident management emergency diesels – what has been achieved so far, which further activities are planned, what is the schedule? ➢ What are the final results of the evaluation of the inspections which were performed 2012, regarding mobile emergency diesels? Did they lead to additional measures being required by ENSI? ➢ How does the development of the comprehensive strategy fit into the activities to increase safety margins, as described in the Aktionsplan Fukushima 2013? ➢ How will safety be improved by this measure? How does the original state of the NPPs compare with the state after implementation of the measure? It can be assumed that the evaluation of the inspections mentioned above has already been completed. Other than that, the further schedule for this activity is not clear; it would be of interest to get information soon.
Safety importance	High
Expected schedule	Short term
Follow-up	Dedicated presentation

SWITZERLAND	
Topic 3: Severe Accident Management	
Issue No	**CH 3.4**
Title	Power supply of instrumentation necessary for AM measures (KKM, possibly also other NPPs)
Content	Power supply of some of the instrumentation necessary for accident management measures at NPP Mühleberg is not provided by a bunkered system. It depends on less robust systems. This issue will be investigated as part of the post-Fukushima action plans. It could also be relevant for other Swiss NPPs. It is closely connected to CH 3.5 below.
Safety relevance	For the application of SAMGs sufficient information about the plant status is necessary. The availability of the power supply for the respective instrumentation should be as high as possible. Therefore it should definitely be provided by the most robust systems.
Background	Considerations in the context of the **Austrian Expert Statement on NPP Mühleberg** (UBA 2012) showed that the power supply of some of the instrumentation necessary for AM measures is not provided by the bunkered SUSAN system. The power supply depends on less robust systems. This point is addressed in the reply of ENSI to recommendations of category 2 of the Austrian expert statement. ENSI confirms that this issue will be further investigated in the framework of the post-Fukushima action plans. No schedule is given. No information about the situation in other plants available. The issue should also be raised for the other Swiss NPPs. This issue is not explicitly addressed in the **National Action Plan** (ENSI 2013a), although the general topic of instrumentation is dealt with in several sections. In the **Aktionsplan Fukushima 2013** (ENSI 2013b), ENSI refers to section 4.4 (Erhöhung der Sicherheitsmargen) when discussing the Austrian Expert Statement. However, the issue of power supply for instrumentation required for AM measures is not addressed there. References: ENSI (2013a). EU Stresst Test: Swiss National Action Plan, Follow up of the Peer Review 2012 Year-end Status Report, January 2013. http://www.ensreg.eu/sites/default/files/ENSI_SwissAP_ENG_121231_final.pdf ENSI (2013b). Aktionsplan Fukushima 2013, February 2013. http://static.ensi.ch/1362073505/20130228_aktionsplanfuksuhima2013.pdf UBA (2012). Fachstellungnahme zu sicherheitstechnischen Aspekten des Schweizer Kernkraftwerks Mühleberg, Umweltbundesamt Wien, 2012. http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP03

	85.pdf
To be discussed	Questions which should be addressed in a presentation are: ➢ Which investigations have already been performed or are planned regarding the power supply of instrumentation necessary for AM measures at KKM (scope, schedule)? ➢ Is this Issue also relevant for other NPPs in Switzerland? If so, which investigations have already been performed or are planned? ➢ Are these investigations covered, without being explicitly mentioned, by an activity described in the Aktionsplan Fukushima 2013? ➢ Is it already foreseeable whether measures will result from the investigations? If so, scope and schedule? How will safety be improved by the measures? The schedule of this measure is not clear. This Issue could be discussed together with CH 3.5 (see below).
Safety importance	High (at least for KKM)
Expected schedule	Medium term
Follow-up	Dedicated presentation

SWITZERLAND	
Topic 3: Severe Accident Management	
Issue No	**CH 3.5**
Title	Systematic assessment of the operability/availability of Accident Management measures at KKM
Content	The operability of some accident management measures at the NPP Mühleberg appears questionable in case of certain external events, for example regarding external feed for drywell spray and flooding system in case of external flood. This point is not specifically addressed in the relevant Swiss documents which are available; in particular, no re-assessment of the operability of the measures concerned is mentioned in these documents. This Issue is closely connected to CH 3.4 above.
Safety relevance	Accident Management Measures are designed for events and situations in which the safety systems for fulfilling relevant safety functions are not available. A major prerequisite for the effectiveness of AM measures is their operability under these conditions. Otherwise they would fail concurrently with the safety systems. Therefore the operability/availability of AM measures for external and internal events should be systematically assessed.
Background	In the context of the EU stress test the NPP Mühleberg in its report (BKW 2011) mentioned different AM measures that could be applied in case of certain external events. However considerations in the context of the **Austrian Expert Statement on NPP Mühleberg** (UBA 2012) showed that the operability of some of the AM measures seems questionable for the conditions prevailing in case of these external events. (For example, the connection nozzles of the drywell spray and flooding system are installed at the outside of the SUSAN building. It is not clear, up to which flooding height connection of pipes is still possible.) Therefore it was recommended in the expert statement to reassess the operability of these measures for all the boundary conditions that have to be assumed in accident situations. This point is briefly addressed in the reply of ENSI to selected aspects of the Austrian expert statement (ENSI 2012b). However, only general information on SAMGs, PSA and HRA (human reliability analysis) is provided; the issue in question is not clarified in detail. This issue is not explicitly addressed in the **National Action Plan** (ENSI 2013a). In the **Aktionsplan Fukushima 2013** (ENSI 2013b), ENSI refers to section 4.4 (*Erhöhung der Sicherheitsmargen*) when discussing the Austrian Expert Statement. However, the issue of availability/operability of AM measures at KKM is not systematically addressed there. References: BKW (2011). EU Stress Test – Kernkraftwerk Mühleberg. AN-BM-2011/121, Oktober 2011. http://static.ensi.ch/1326186582/stresstest-kkm-rev-_geschw.pdf ENSI (2012a). ENSI-Stellungnahme zu ausgewählten Aspekten des

	Fachgutachtens KKM der österreichischen Umweltbundesamte GmbH, September 2012. http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/kernenergie/Muehleberg/ensi_stellungnahme_umweltbundesamt_gmbh_oesterreich_geschwaerzt.pdf ENSI (2013a). EU Stresst Test: Swiss National Action Plan, Follow up of the Peer Review 2012 Year-end Status Report, January 2013. http://www.ensreg.eu/sites/default/files/ENSI_SwissAP_ENG_121231_final.pdf ENSI (2013b). Aktionsplan Fukushima 2013, February 2013. http://static.ensi.ch/1362073505/20130228_aktionsplanfuksuhima2013.pdf UBA (2012). Fachstellungnahme zu sicherheitstechnischen Aspekten des Schweizer Kernkraftwerks Mühleberg, Umweltbundesamt Wien, 2012 http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0385.pdf
To be discussed	Questions which should be addressed in a presentation are: ➢ Which activities have already been performed or are planned regarding the systematic assessment of the operability/availability of Accident Management measures at KKM (scope, schedule)? ➢ Are these investigations covered, without being explicitly mentioned, by an activity described in the Aktionsplan Fukushima 2013? ➢ Is it already foreseeable whether measures will result from the investigations? If so, scope and schedule? How will safety be improved by the measures? The schedule of this activity is not clear. This Issue could be discussed together with CH 3.4 (see above).
Safety importance	High
Expected schedule	Medium term
Follow-up	Dedicated presentation

SWITZERLAND	
Topic 3: Severe Accident Management	
Issue No	**CH 3.6**
Title	Operability of pneumatic valves under accident conditions (especially RPV depressurization for NPP Mühleberg (KKM))
Content	At Mühleberg NPP, it is questionable whether pressure reduction via the four main RPV steam safety and relief valves is guaranteed during accident conditions. Hence, the pressure head of certain accident management equipment for water injection might be insufficient. This point is not specifically addressed in the relevant Swiss documents which are available.
Safety relevance	Operability of certain AM measures might be influenced be the function of pneumatic valves. In that case the operability of AM measures depends on the availability of equipment for the supply of pressurized air supply under accident conditions. This issue should be systematically assessed. In case of KKM the supply of pressurized air cannot be guaranteed for a longer period of time under accident conditions. Therefore the closure of the RPV main steam relief valves has to be assumed. Only the two diverse motor driven valves can be kept open. Due to their smaller capacity injection systems with sufficient pressure head have to be available. Otherwise core damage might occur.
Background	Considerations in the context of the **Austrian Expert Statement on NPP Mühleberg** (UBA 2012) showed that pressure reduction via the four main RPV steam safety and relief valves might not be guaranteed during accident conditions due to insufficient availability of pressurized air necessary to keep the valves open. As a consequence the pressure head of certain AM equipment foreseen for water injection into the RPV might be insufficient. This point has not been addressed in the reply of ENSI to selected aspects the Austrian expert statement (ENSI 2012a). This issue also is not explicitly addressed in the **National Action Plan** (ENSI 2013a) and in the **Aktionsplan Fukushima 2013** (ENSI 2013b). References: ENSI (2012a). ENSI-Stellungnahme zu ausgewählten Aspekten des Fachgutachtens KKM der österreichischen Umweltbundesamte GmbH, September 2012. http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/kernenergie/Muehleberg/ensi_stellungnahme_umweltbundesamt_gmbh_oesterreich_geschwaerzt.pdf ENSI (2013a). EU Stress Test: Swiss National Action Plan, Follow up of the Peer Review 2012 Year-end Status Report, January 2013. http://www.ensreg.eu/sites/default/files/ENSI_SwissAP_ENG_121231_final.pdf ENSI (2013b). Aktionsplan Fukushima 2013, February 2013. http://static.ensi.ch/1362073505/20130228_aktionsplanfuksuhima201

	3.pdf UBA (2012). Fachstellungnahme zu sicherheitstechnischen Aspekten des Schweizer Kernkraftwerks Mühleberg, Umweltbundesamt Wien, 2012. http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0385.pdf
To be discussed	Questions which should be addressed in a presentation are: ➢ Which activities have already been performed or are planned regarding the operability of pneumatic valves under accident conditions at KKM (scope, schedule)? ➢ Are these investigations covered, without being explicitly mentioned, by an activity described in the Aktionsplan Fukushima 2013? ➢ Is it already foreseeable whether measures will result from the investigations? If so, scope and schedule? How will safety be improved by the measures? The schedule of this activity is not clear.
Safety importance	High
Expected schedule	Medium term
Follow-up	Dedicated presentation

SWITZERLAND	
Topic 3: Severe Accident Management	
Issue No	**CH 3.7**
Title	Safety improvements planned for Swiss NPPs – cliff-edge effect in shutdown phases
Content	In certain phases during shutdown, the primary and/or secondary containment of Swiss NPPs are open. This makes it more difficult to bring accidents under control, and could lead to a cliff-edge effect. The question whether restoring containment integrity during shutdown in case of a total SBO represents a time-critical measure is to be further analysed, in the framework of a detailed analysis of total SBO, which includes low power and shutdown states.
Safety relevance	If, in case of severe fuel damage, containment isolation has not been achieved, there will be significant, unfiltered releases. The consequences of an accident can be drastically increased by a failure of containment isolation.
Background	In the **Swiss National Report** for the EU stress test (ENSI 2011) the Swiss regulator points out, in the section dealing with maintaining the containment integrity after occurrence of significant fuel damage (section 6.3), that the primary and/or secondary containment of the Swiss NPPs are open in certain phases during shutdown, which could make it more difficult to bring accidents under control and could lead to a cliff-edge effect. Therefore, ENSI will follow up on the question whether restoring containment integrity during shutdown in the case of a total SBO represents a time-critical measure. No date is provided for these investigations. In section 8.2, the **National Action Plan** (ENSI 2013a)) refers, among other issues, to the issue whether restoring containment integrity during shutdown in case of a total SBO represents a time-critical measure. It is stated that this issue has been retained for further analysis. A detailed analysis of total SBO is foreseen in the future, also for low power and shut down states. Depending on the results, measures could be envisaged. It is not clear when this analysis will be started, with which schedule. There is no reference to it in the **Aktionsplan Fukushima 2013** (ENSI 2013b); in particular, it is not addressed in section 3.4 of this plan (long-term loss of electricity supply). References: ENSI (2011). EU Stress Test Swiss National Report – ENSI Review of the Operators' Reports, December 2011. http://static.ensi.ch/1326182677/swiss-national-report_eu-stress-test_20111231_final.pdf ENSI (2013a). EU Stresst Test: Swiss National Action Plan, Follow up of the Peer Review 2012 Year-end Status Report, January 2013. http://www.ensreg.eu/sites/default/files/ENSI_SwissAP_ENG_121231_final.pdf

	ENSI (2013b). Aktionsplan Fukushima 2013, February 2013. http://static.ensi.ch/1362073505/20130228_aktionsplanfuksuhima2013.pdf
To be discussed	Questions which should be addressed in a presentation are: ➢ What will be the scope of the analysis of total SBO, in particular of the parts dealing with low power and shutdown states? Which durations for SBO will be considered? ➢ When will this activity be started, with which scheduled? Is it covered, without being explicitly mentioned, by an activity described in the Aktionsplan Fukushima 2013? ➢ Is it already foreseeable whether measures will result from the analysis? If so, scope and schedule? How will safety be improved by the measures? The schedule of this activity is not clear.
Safety importance	Medium
Expected schedule	Medium term
Follow-up	Dedicated presentation