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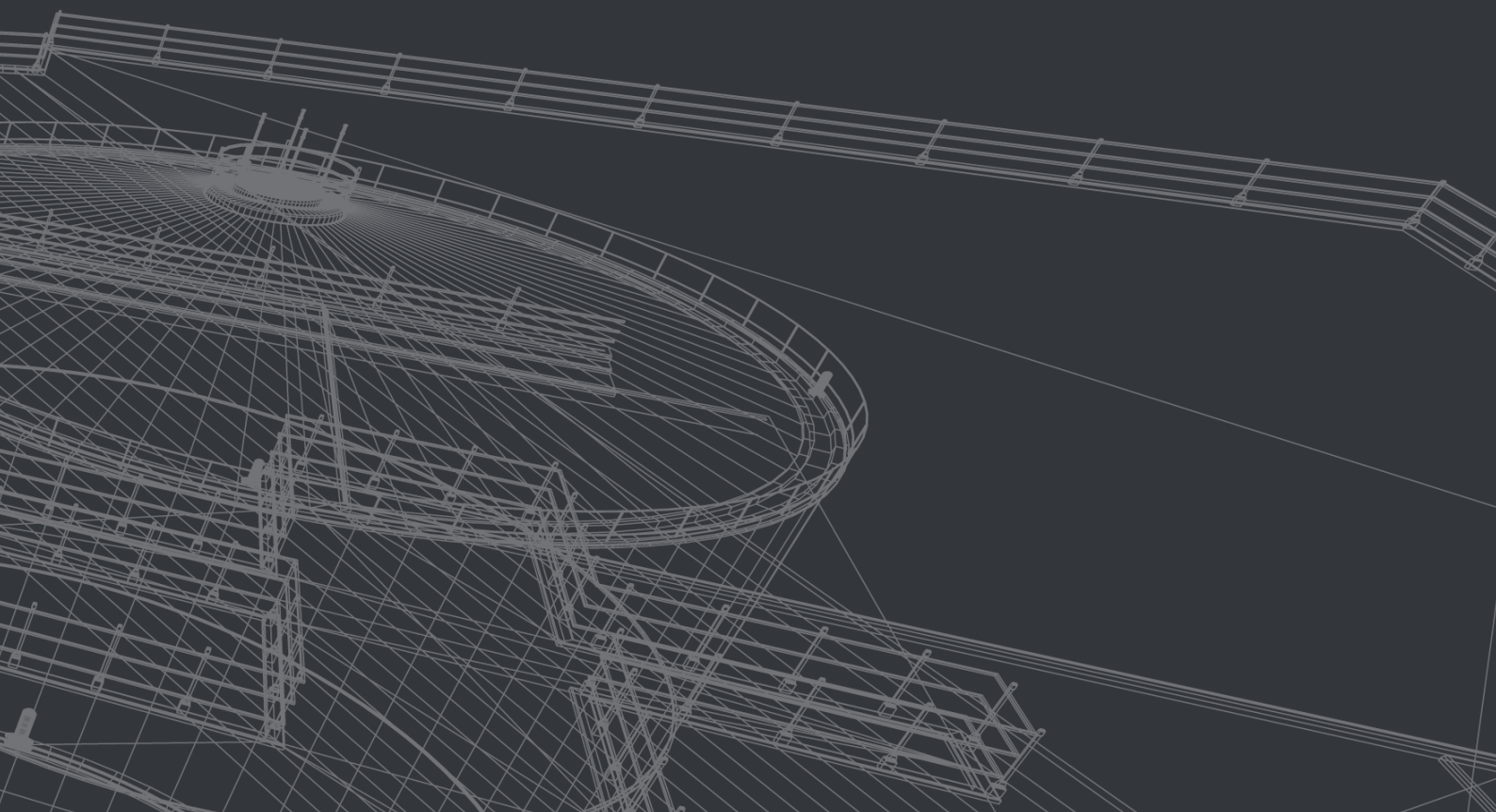
Swiss Federal Nuclear Safety Inspectorate ENSI

Action Plan Fukushima 2015



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1 Introduction

Immediately after the reactor accidents at the Fukushima Dai-ichi nuclear power plant in Japan on 11 March 2011, ENSI initiated measures for a renewed review of the safety of Switzerland's nuclear power plants. The measures were contained in four formal orders issued by ENSI. The first three formal orders (dated 18 March, 1 April and 5 May 2011) called for immediate measures and supplementary analyses.

The immediate measures comprised the establishment of a joint external emergency storage facility for the Swiss nuclear power plants, including the necessary plant-specific hook-up points for Accident Management (AM) equipment, and backfits to provide external injection into the spent fuel pools. The additional reassessments focused on the design of the Swiss nuclear power plants against earthquakes, external flooding and a combination thereof. Screening investigations were also requested regarding the coolant supply for the safety and auxiliary systems and the spent fuel pools.

In parallel with these investigations by the licensees, ENSI itself conducted topical inspections during 2011, entailing reviews of the cooling systems already in place for spent fuel pools, protection against external flooding and systems for filtered containment venting. These topical inspections were continued during 2012: they included the plants' strategies in case of a prolonged loss of power supply, processes for the assessment of external operating experience, and the emergency rooms available in the Swiss plants. The radiation protection equipment available on site, which is a basic prerequisite for coping with a severe accident, was inspected at all the nuclear power plants during 2013. Radiation protection equipment is also essential so that the emergency rooms can be used by the emergency response organisation in the longer term.

The results of ENSI's reviews confirmed that the Swiss nuclear power plants display high levels of protection against the impacts of earthquakes, flooding and combinations thereof, and that appropriate precautions have been put in place to cope with a loss of power supply and of the ultimate heat sink. The safety case has been demonstrated for all the analysed accidents on the basis of the hazard assumptions that are currently applicable. This means that compliance with the basic statutory requirements for fulfilling the fundamental safety functions (reactivity control, cooling of the fuel elements and confinement of radioactive substances) is guaranteed. In order to continue improving safety, however, ENSI has stipulated a series of additional requirements for substantial backfits, e.g. a requirement for a flood-proof and earthquake-resistant diversified ultimate heat sink. ENSI is supervising the work carried out by the nuclear power plants to meet these requirements in the course of its ongoing supervisory activities, either by drawing up reviews, issuing permits or carrying out on-site inspections and checks.

In its fourth formal order issued on 1 June 2011, ENSI requested the licensees to take part in the EU stress tests. ENSI reviewed the documentation for the EU stress tests submitted by the licensees in the Swiss country report on the EU stress tests (ENSI-AN-7798 dated 31 December 2011). On 10 January 2012, further formal orders were issued requiring clarification of three major open points arising from the analysis of the final reports by the Swiss nuclear power plants for the EU stress tests. Switzerland's submissions for the EU stress tests then underwent a peer review process. The results of the peer review at European level confirm ENSI's conclusions regarding the safety of Swiss nuclear power plants, and they also provide an overview of the condition of plants in Europe. ENSI is

currently implementing the two recommendations made by the peer review team for Switzerland, which relate to scenarios beyond the design basis. In addition, ENSI is participating in the follow-up work on the EU stress tests in order to track implementation of the recommended measures in Europe (see sections 3.8 and 4.8), and actively collaborated on the updating of the WENRA Reactor Safety Reference Levels. ENSI will implement the recently adopted WENRA Reactor Safety Reference Levels during the periodic revision of its regulatory framework.

In parallel with the activities mentioned above, ENSI published four reports during 2011 in relation to the event analysis of the Fukushima accident:

- Fukushima sequence 11032011, Event Sequences in Fukushima Dai-ichi and Dai-ni following the Tohoku-Chihou-Taiheiyou-Oki Earthquake on 11.03.2011, ENSI-AN-7614 Rev. 1 (26 August 2011)
- Fukushima analysis 11032011, In-depth Analysis of the Accident at Fukushima on 11 March 2011, With Special Consideration of Human and Organisational Factors, ENSI-AN-7669 (29 August 2011)
- Fukushima lessons 11032011, Lessons Learned and Checkpoints based on the Nuclear Accidents at Fukushima, ENSI-AN-7746 (29 October 2011)
- Fukushima impact 11032011, Radiological Effects of the Nuclear Accidents at Fukushima on 11.03.2011, ENSI-AN-7800 (16 December 2011)

The knowledge obtained from analysing the events of the accident at Fukushima was reviewed to determine its applicability to Switzerland, and a summary of insights was compiled in the ENSI report entitled "Lessons Learned" in the form of a series of checkpoints. Further points were added on completion of the analyses for the EU stress tests. The current overview can be found in Annexes 1 and 2. The list of points identified is reviewed continuously on the basis of the latest findings and is updated as necessary. Processing of the checkpoints will probably be completed by the end of 2015. Accordingly, ENSI is planning the publication of a concluding report on the Fukushima action plans during the course of 2016.

The Fukushima action plans serve the purpose of ensuring transparency as regards processing of the identified points until they are implemented. They also provide an instrument for the planning of supervisory work and the assessment of new knowledge gained from the Fukushima accident. Progress with processing the identified points is documented and published. The action plan itself is updated by February of the year in progress by identifying key issues for that year. ENSI's annual reporting also provides information about the processing status. Beyond that, the public may be informed on specific issues should the need arise.

ENSI report	**Publication date**
Fukushima Action Plan	February
Oversight Report, Radiation Protection Report Research and Experience Report	April - June
National Action Plan for Follow-Up to the EU Stress Tests (as instructed by ENSREG)	December - January

2 ENSI's supervisory culture project

The nuclear supervisory authority plays a pivotal role in the overall "structure" of nuclear safety as through its supervisory work it has an influence on the safety and related safety culture of the organisations it supervises. This correlation was emphasised once again by the accident that took place at Fukushima. The influence exerted by the authority on those it supervises depends mainly on the adopted supervisory approach and the authority's supervisory culture alongside the legal and institutional framework.

It is therefore essential for the supervisory authority to continuously question its influence on those it supervises and their safety cultures, and to routinely check whether the supervisory culture it lives by is appropriate and serves the purpose of fulfilling its legislative mandate with regard to protecting people and the environment.

Although these insights were by no means new to ENSI, the accident at Fukushima did, however, represent an additional incentive to launch a systematic process of self-reflection with regard to the authority's supervisory culture. ENSI initiated a corresponding supervisory culture project in 2012. The project stretched over a period of three years and was split into three phases during which the entire ENSI workforce was repeatedly and actively involved. The project was managed by a team consisting of representatives from all disciplines and hierarchical levels.

During the first phase, the supervisory culture at ENSI was characterised on the basis of concrete examples of the authority's supervisory work. This enabled the identification of a number of focus areas in relation to the supervisory culture.

This basis was used during the second phase to develop a consolidated summary of the supervisory culture's target values and objectives (TARGET), its focus areas and recommendations for action. The central values of the targeted supervisory culture developed jointly by ENSI's workforce were taken into consideration and subsequently integrated in the new ENSI Mission Statement 2014.

A package of measures was developed during the third phase in 2014 for the purpose of implementing the TARGET supervisory culture formulated during the second phase. The measures include improvements to employee training and education, the promotion of ENSI internal and intra-departmental cooperation, project management optimisation, improvements to fundamental supervisory principles and implementation of the ENSI Mission Statement in supervisory activities.

All of these measures are long term in nature and aimed at firmly establishing in routine supervisory activities and in the culture at ENSI, the very process of reflection on its supervision and its impact on the safety (culture) of the supervised organisations as launched within the scope of the project. They serve continuous improvement in view of how ENSI fulfils its mandate and therefore represent a contribution towards protecting people and the environment from the hazards of utilising nuclear energy for peaceful purposes (Art. 1 Nuclear Energy Act).

3 Retrospective of 2014

3.1 Seismic instrumentation

The subject of earthquakes has come under renewed scrutiny from different angles due to the events that took place at Fukushima. The issues under discussion included the advantages and drawbacks of an upstream automatic scram by means of seismic instrumentation.

The seismic instrumentation currently installed in the plants was summarised and documented in a report. The systems in place serve to assess whether a seismic event fulfils or exceeds the criteria of an OBE or SSE. Corresponding alarm notifications are displayed in the control room. The measures and procedures based on these notifications are documented in the corresponding operating and emergency documentation. The seismic instrumentation in place today does not directly trigger a scram. However, a scram can be triggered by other signals or by the operator.

On an international level, it emerged that an upstream automatic scram by means of seismic instrumentation (on-site) is only used in areas with increased seismic activity. Early warning systems (off-site) are not used in these locations.

In 2012, the licensees of Switzerland's nuclear power plants demonstrated deterministically in their safety cases that the plants can cope with seismic accelerations with an exceedance frequency of 10^{-4} per year. The advantage of an upstream automatic scram by means of seismic instrumentation therefore lies primarily in increasing existing safety margins.

Triggering and completing a scram before the arrival to the plant of the seismic waves prevents the components involved in the scram from being subjected to the seismic loads while performing their functions. In order to evaluate the safety gain, the potential reduction in core damage frequency (CDF) was estimated on the basis of available probabilistic safety analyses. The reduction lies between 0.1 and 2 % of the total CDF, depending on the plant in question. The potential for false alarms triggered by a new upstream automatic scram by means of seismic instrumentation would, however, also result in a slight CDF increase that is slightly less than the mentioned reduction.

Systems for implementing an upstream automatic scram by means of seismic instrumentation are unable to guarantee scram completion prior to the maximum ground acceleration for seismic events taking place less than 20 kilometres away. That is why the advantage of such a system depends on the seismic hazard at the location in question. According to recent seismic studies, the seismic hazard at the Swiss sites is mainly due to earthquakes taking place less than 20 kilometres away. This in turn lowers the possible reduction of CDF.

On the basis of the conducted investigations it can be concluded that backfits of this nature are not mandatory from a deterministic and probabilistic viewpoint and on account of similar backfits to European plants.

3.2 Containment integrity during outages

Fairly large containment openings are present for a specified period during shutdowns in connection with the annual refuelling and maintenance outages in order to transport material and equipment or to allow access by individuals. ENSI has identified a need for clarification with regard to this plant state. It involves a review of the measures in place to restore containment integrity in the event of an accident with a prolonged loss of power (Station Blackout, SBO). ENSI has substantiated the scope of the clarifications needed on the basis of reviews of probabilistic safety analyses, technical specifications, emergency operating procedures and Severe Accident Management Guidance. Corresponding letters with plant-specific requests for additional information were sent to plant licensees. All licensees submitted their responses within the specified period (by the end of October 2014). The information provided by licensees comprises the required and available time for action with regard to reclosing the containment under SBO conditions as well as identified potential for improvement.

3.3 Extreme weather conditions

In 2012, ENSI defined the requirements for the probabilistic hazard analyses and safety case needed to demonstrate adequate protection of plants against extreme weather conditions. Quantitative analyses are required for the hazards posed by extreme winds, tornadoes, extreme air and water temperatures, heavy rainfall on the plant site and snow levels. In contrast, qualitative analyses are suitable for the following hazards: hail, freezing rain, drought, forest fires, freezing conditions and combinations of exceptionally arduous winter conditions and extremely severe summer conditions.

The design-basis values for buildings and equipment required to cope with the hazard in question must be presented as proof of adequate plant protection. It is also necessary to demonstrate that these values can withstand the anticipated loads. The margin in relation to the design basis must also be stated.

The hazards to be reviewed within the scope of extreme weather conditions can be divided into instantaneously occurring hazards, which comprise wind, tornadoes, heavy rainfall, hail and freezing rain. These loads occur within a very short period of time and must coped with by the plant's design (mainly that of its buildings). The lead time for action with regard to the remaining hazards ranges from a number of hours to a few days so that the plant can be properly and timely shut down as a precaution and other measures to control the hazards can be executed.

The licensees have submitted hazard studies for the hazards named above as well as evidence of adequate plant protection to ENSI. The task of drawing up hazard analyses was assigned to specialists in mathematical and statistical evaluation. An assessment of historical data and climate change was carried out by swissnuclear itself.

A review of the submitted hazard analyses has been delayed as ENSI considers more in-depth clarification necessary in certain areas (e.g. with regard to the plausibility of hazard results and regional evaluations). This is also the reason why the review of the safety case submitted in 2014 (i.e., related to all hazards except air and water temperatures) has also been delayed.

3.4 Increase in safety margins

The analyses relating to the increase in safety margins (ERSIM) were submitted to ENSI on time by 30 April 2014. The analyses cover the events of "earthquake" and "external flooding".

One of the project's purposes is to provide a systematic summary of the safety margins for the three safe shutdown paths ascertained in previous studies. The three shutdown trains are the conventional safety systems, the special emergency safety systems and the Accident Management (AM) systems. A particular focus was placed on the third shutdown train of "AM measures" and their inclusion in the plants' overall safety concept. The summary is also be used to highlight any weak points that may exist and to develop recommendations for improvements.

In the analyses for increasing the safety margins it was required to use the current hazard assumptions accepted by ENSI for the events of "earthquake" and "external flooding" with an exceedance frequency of 10^{-4}/year as a reference.

The safety margin for the event of "earthquake" is defined as the ratio of the seismic capacity of the unit under consideration (component, shutdown path, plant) to the Peak Ground Acceleration (PGA) from the PRP Intermediate Hazard (PRP-IH) with an exceedance frequency of 10^{-4}/year.

The safety margin for the event of "external flooding" is defined as the difference between the critical flood height leading to the failure of the unit under consideration and the reference flood height with an excess frequency of 10^{-4}/year.

ENSI initially subjected the reports submitted by the licensees to a cursory review. Due to a number of additional demands, the licensees were required to provide supplementary information and, in one case, a thoroughly revised analysis by the end of October 2014. Contrary to the original schedule, detailed reviews have therefore not yet been completed for all plants and no decisions on the continuation and expansion of the ERSIM project have been made as yet.

In the case of KKG, ENSI drew an initial overarching evaluation on the basis of the analysis results relating to the safety margins for "earthquake" events by giving due consideration to the extensive backfits that KKG proposed in view of long-term operation. In its analysis, KKG did not reference the hazard assumptions based on PRP-IH as preliminarily accepted by ENSI, and instead opted to reference stricter values from the latest hazard assumptions based on the PEGASOS Refinement Project (PRP) that have not yet been confirmed by ENSI. In view of the possible long-term operation of KKG for more than 40 years, ENSI has concluded that at least the shutdown path 2 (special emergency safety systems) must provide a significant safety margin with regard to the seismic hazard and that the scope of special emergency safety functions must be extended.

The evaluation of the results of the ERSIM analyses of other plants will be completed by the end of the first quarter of 2015.

A review of the requirements for emergency equipment is another issue that was addressed within the scope of "increasing safety margins". The requirements for emergency equipment were incorporated into the draft of Guideline ENSI-G02 "Design principles for existing nuclear power plants". The draft is currently under discussion at ENSI and will subsequently be made available for external consultation. The specifications for emergency equipment take into consideration the lessons learned from Fukushima together with the subsequent backfits in Switzerland and other countries and updates to the requirements of international regulations (especially to the WENRA Safety Reference Levels, the IAEA and the NRA [Japan], etc.).

3.5 Hydrogen management

With regard to the management of hydrogen, licensees were required to investigate the impact of hydrogen combustion in relation to beyond design-basis accidents in containment and the spread of hydrogen into adjacent rooms. Furthermore, plants with non-inerted containment (i.e. all plants except KKM) had to develop an approach to equipping the containment with passive autocatalytic recombiners (PARs) or to review the existing PAR design concept. The plants are currently equipped with different hydrogen management systems, including active igniters, active recombiners and active/passive mixing systems. KKM is equipped with an inerted containment system. All plants are equipped with a filtered venting system.

All licensees have submitted the required documents regarding the hydrogen hazard in case of severe accidents. CFD codes and system codes were used for the, in some cases, highly detailed numerical simulations. In summary, ENSI's review confirmed that hydrogen management in Swiss nuclear power plants is of a high standard, but that safety can be increased still further by taking appropriate measures. KKG will equip its containment with PARs. KKL will provide for a solution with passive igniters and PARs. KKB will increase its hydrogen reduction capacity through PARs. Following the implementation of ENSI's requests or backfits, all Swiss nuclear power plants will have installed passive systems to tackle the hydrogen hazard. Ignitable hydrogen concentrations in rooms outside of containment are not anticipated in the event of a severe accident if the tightness (integrity) of the containment is as per design and the Accident Management (AM) measures in place are implemented successfully. Additional reviews and enhancements to the corresponding provisions will be considered on a plant-by-plant basis. For instance, KKM is required to develop a solution for measuring the concentration of hydrogen in the reactor building and to assure the supply of water to the outer torus by means of an AM measure. This completes the measures against the hydrogen hazard within the scope of the Fukushima action plan. The next steps are a part of ongoing supervision.

3.6 Severe Accident Management

ENSI completed its review of the reports submitted by nuclear plant licensees on the deployment strategy for their emergency response organisation in 2014. These reports set out the deployment strategy for the working locations of the emergency staff and supporting elements, with a view to a lengthy deployment lasting days or weeks. ENSI established that licensees have further improved emergency preparedness inside the plants. Extensive consideration of the radiological impact on personnel inside the plant was made together with indications for potential improvements.

Despite differences in the degree of detail and scope, all plants face similar challenges under the stricter boundary conditions of a severe accident as specified by ENSI. ENSI has therefore defined the emergency rooms, the availability of equipment and material, the protection of employees, the number of employees and their management and coordination as focal review points with regard to internal plant emergency preparedness.

ENSI considers it a necessity for emergency staff to have at least two options with regard to emergency rooms: one set of rooms should be located on the plant site and another at a distance to

the plant that allows for safe and effective action by the emergency staff even under the more adverse boundary conditions outlined by ENSI. Nuclear power plant licensees have realised that it would be beneficial to choose from a number of pre-evaluated external emergency rooms. In the meantime, all nuclear power plant licensees have evaluated suitable external premises for those parts of the emergency organisation that do not have to be located on site. ENSI considers it a necessity to include external emergency centres as a fixed option in emergency plans and to document them accordingly in the emergency documentation. The corresponding plans should go as far as necessary to enable the licensee to fulfil his obligatory tasks at any time and allow the external emergency centre to be used as a point of contact by the entire emergency organisation. It is already clear that this will require a high degree of preparation and coordination. ENSI has requested nuclear power plant licensees to plan and make provisions for the installation of an external emergency centre of this nature.

Furthermore, ENSI considers it a necessity to ensure access to equipment that would be needed in an emergency under the anticipated conditions, including radiation protection equipment as well as supplies for the emergency teams. According to reports from the plant licensees, the emergency teams would initially be left to their own devices under the specified conditions as they would not have immediate access to equipment from the external storage facility in Reitnau. However, the storage facility in Reitnau offers additional options for supplying teams with essential equipment and materials. For this reason, the nuclear power plants have meanwhile acquired additional mobile equipment and made it available on site. Whilst access to technical equipment under accident conditions has been of course studied in detail , access to work and protection equipment and, in particular, to the supplies available to the emergency teams is not yet at the same level at every plant. ENSI includes these among the "suitable means" for managing accidents. As part of its review and in view of this issue, ENSI has required licensees to provide adequate on-site storage to all means that would be needed for emergency preparedness under the specified stricter boundary conditions until such time as means from the external facility in Reitnau or neighbouring power plants become available.

Personnel protection has also gained greater international significance since the accident at Fukushima. Through suitable measures, the licensee must ensure that the effective dose to which the personnel deployed to manage an accident (i.e. plant employees and external personnel) are exposed is limited. This requires the effective doses to which all personnel are exposed to be evaluated and documented. In the event of an accident, the skin and incorporation dose must be reliably ascertained alongside direct radiation (whole body dose). The potential development of respiratory toxins must also be considered in relation to personnel protection. ENSI therefore required licensees to introduce and report on the technical and organisational provisions that make it safe to stay at the plant under consideration of the quality of air in the rooms used.

As means of communication are essential for the effective management and coordination of necessary measures in the event of an accident, a failsafe fall-back level for communication with emergency response partners must be provided for. This point was not scrutinised in detail during the review as communications between emergency response partners are currently undergoing evaluation in a separate project.

3.7 Emergency management at Swiss national level

a) IDA NOMEX

The report by the working group on the review of the reference scenarios (IDA NOMEX measure 14) was forwarded by ENSI to the Federal NBCN Crisis Management Board (BST ABCN) together with the consultation report in the second quarter of 2014. BST ABCN has acknowledged the reports and has tasked the project committee for the emergency preparedness concept (concept for emergency preparedness in the vicinity of nuclear power plants) with recommending a reference scenario based on the reports. The recommendation developed as a result was presented to and approved by BST ABCN in the fourth quarter of 2014.

The report by the working group on the review of the emergency planning zone (EPZ) concept (IDA NOMEX measure 18) was submitted in mid-2014 to the Federal government and the cantons for consultation. The consultation report and the report by the working group were presented to the BST ABCN during the fourth quarter of 2014 and approved by way of acknowledgement.

The results of these two IDA NOMEX measures will be incorporated in the emergency preparedness concept that is currently undergoing a review under the guidance of the FOCP. They also have an influence on the ongoing overall review of the Radiological Protection Ordinance and the planned amendments to the NBCN Operations Ordinance and the Emergency Preparedness Ordinance.

Thus, ENSI has concluded the four measures for which it was responsible as project leader within the IDA NOMEX framework. BST ABCN routinely informs the Federal government on the implementation status of IDA NOMEX; it is anticipated that the conclusion of IDA NOMEX will be possible in 2015.

b) Dispersion of contaminants in watercourses

On the basis of the Fukushima Action Plan, ENSI reviewed the existing procedures and measures to determine their effectiveness in protecting drinking water. In 2013, ENSI collaborated with the Federal agencies involved in emergency preparedness (the National Emergency Operations Centre (NEOC), the Federal Office of Public Health (FOPH) and the Federal Office for the Environment (FOEN)) and the cantons concerned to carry out a situation analysis on this aspect. The analysis showed that the statutory regulations and the existing emergency response procedures and measures are basically suitable for protecting people and the environment. However, a need for verification was ascertained with regard to a few points that were summarised in four work packages. ENSI has taken over the project leader role for two of the packages. At the end of 2014, the status of completion of the work packages was as follows:

Work package 1: Review of accidents with regard to liquid releases and the development of a concept for dealing with large quantities of contaminated water.

At the end of 2013, all four nuclear power plants had described in reports the radioactive liquid releases into watercourses to be expected in the event of operational occurrences and design-basis accidents. ENSI has reviewed these reports and is in agreement with the nuclear power plants that design-basis accidents would only lead to low radioactive discharges into the groundwater or river in the order of magnitude of a few multiples of the long-term discharge limits.

Additionally, the GSKL (Group of Swiss Nuclear Power Plant Managers) has submitted a basic concept for dealing with large quantities of contaminated water to ENSI, including a schedule for the next steps. ENSI has reviewed the basic concept and formulated additional requirements. The GSKL submitted a revised concept at the end of June 2014. Following a comprehensive review, ENSI then declared its agreement with the revised basic concept. It does, however, expect its comments to be taken into due consideration in the plant-specific studies to be submitted by the end of November 2015.

Work package 2: Review of reporting channels

A meeting with relevant cantons chaired by the National Emergency Operations Centre (NEOC) took place on 16 December 2014. During the meeting, it was ascertained that the reporting channels between nuclear power plants, ENSI, NEOC and the cantons will be just as effective in the event of an accident involving the discharge of contaminated water into the environment. It was agreed that the cantons will review and, where necessary, improve their internal reporting channels to the water treatment plants by the end of the third quarter of 2015.

Work package 3: Review of radiological criteria for alarm initiation and the introduction of immediate measures by the end of 2014.

In cooperation with the FOPH and the NEOC, ENSI has developed the radiological criteria for alarm initiation and the introduction of immediate measures in the event of a discharge of radioactive substances into the Aare and Rhine rivers and documented them in a memo. As a result of this review, ENSI will define more precisely the obligation to notify the non-routine discharges into the environment defined in section 4.4 of Guideline ENSI-B03.

Furthermore, ENSI has developed rules of thumb for estimating the activity concentration levels and flow times following a nuclear power plant accident involving the discharge of radioactive substances into the Aare or Rhine rivers.

Work package 4: Review and supplementation of the environmental monitoring programme

The FOPH has reviewed the existing environmental monitoring programme with the result that four continuous measuring stations for monitoring the gamma activity of river water downstream from the nuclear power plants will be installed by FOPH before the end of 2015. Two measuring stations are currently in trial operation.

3.8 EU stress tests follow-up

The so-called stress tests were carried out at European level following the accident at the Fukushima Dai-ichi nuclear power plant in Japan on 11 March 2011. They were ordered by the European Commission and took place in every member state with nuclear power plants. Switzerland participated voluntarily. In 2012, a European peer review process took place on the basis of the reports from the 17 participating countries. This complex review process resulted in recommendations both for individual countries and for the EU as a whole. The national recommendations were listed in a peer review report. The general recommendations for the EU

were published in the "Compilation of stress tests peer review recommendations and suggestions" (shortened to "Compilation of Recommendations").

At the end of 2012, the participating countries submitted a "National Action Plan" (NAcP) to the EU that reported on the current implementation status of all recommendations (both on national and European level) from the stress tests peer review process. In the spring of 2013, the NAcPs were subjected to a peer review within the framework of an international workshop, whereby Switzerland's NAcP received a positive evaluation. Questions from the general public were also answered during the course of the process.

The European Nuclear Safety Regulators Group (ENSREG) called for an update to all NAcPs by the end of December 2014 in view of a renewed peer review to be held during a workshop in the spring of 2015. The Swiss NAcP http://static.ensi.ch/1419332464/swiss-nacp-2014-final.pdf was submitted to ENSREG on time on 22 December 2014. The report summarises the status of Switzerland's implementation of the recommendations formulated by ENSREG and adopted by various international committees. The latest version of the Swiss NAcP lists the international recommendations in a cross-reference table together with national checkpoints (see section 5.1) and open points (see section 5.2).

All documents relating to the EU stress tests and its follow-up are accessible via the ENSREG web site. The web page http://www.ensreg.eu/EU-Stress-Tests can be used as start page. The reports for each country including the results of the peer review can be found under http://www.ensreg.eu/EU-Stress-Tests/Country-Specific-Reports.

4 Key issues in 2015

The following key issues were specified for ENSI's post-Fukushima activities during 2015, based on their safety significance and on synergies with ongoing projects:

1. Implementing the lessons learned on the safety and supervisory culture
2. Containment integrity during outages
3. Extreme weather conditions
4. Increase in safety margins
5. The effects of non-nuclear hazardous substances
6. Severe Accident Management
7. Dispersion of contaminants in watercourses
8. EU stress tests follow-up

4.1 Implementing the lessons learned on the safety and supervisory culture

The accident at Fukushima made it clear once again that the safety of nuclear power plants cannot be seen merely as a technical issue but rather one that calls for an integrated view of the overall socio-technical system, i.e. the human, technological and organisational elements of a nuclear power plant and their complex interaction with one another. The safety culture that the plant lives by plays a pivotal role, i.e. the values, world views, behaviours and characteristics of the physical environment that define or show how the plant licensees deal with nuclear safety and the importance they accord to it. ENSI sets great store by the safety culture within the framework of its regulatory supervision. After the accident at Fukushima, the safety culture became a focal point of attention in the context of supervisory measures with a specific reference to Fukushima.

However, the accident at Fukushima also made it clear that the focus must not concentrate solely on the plant licensee but rather on the entire "structure" of nuclear safety and all the actors involved in it (licensees, manufacturers and suppliers, authorities, political institutions, the media and the general public, etc.). The latter interact with each other in many different ways and mutually influence each other through their respective roles, behaviours and cultures. Accordingly, they influence nuclear safety and the safety culture of nuclear power plant licensees. One of these actors is the supervisory authority that must endeavour to achieve and maintain a positive safety culture ("supervisory culture") and critically question its influence on nuclear power plant licensees. In light of the events at Fukushima, ENSI established a three-year project aimed at initiating a process of self-reflection on the authority's supervisory culture and deriving concrete measures from it (see section 2).

The activities ENSI has derived from the lessons learned from the accident in Fukushima will be discussed in a report.

Milestones:

4th quarter of 2015 ENSI: Compilation of a report on implementing the lessons learned with regard to the safety and supervisory culture.

4.2 Containment integrity during outages

Fairly large containment openings are present for a specified period during shutdowns in connection with the annual refuelling and maintenance outages in order to transport material and equipment or to allow access by individuals. ENSI identified the necessity for additional studies on the measures in place to restore containment integrity with regard to SBO accidents during this plant configuration. At ENSI's request, licensees submitted additional analyses which included identified potential for improvement. Licensee statements will be reviewed by ENSI during the course of 2015.

Milestones:

2nd quarter of 2015 ENSI: Review of the documents submitted by licensees.

4.3 Extreme weather conditions

The review related to extreme weather conditions has been delayed due to the increased efforts ENSI has to undertake to evaluate the hazard analyses. ENSI will conclude its review of all hazard analyses during the second quarter of 2015. The review of the safety cases related to all hazards will be completed in the fourth quarter of 2015.

Milestones:

2nd quarter of 2015 ENSI: Review of hazard analyses.

4th quarter of 2015 ENSI: Review of the safety case in cases related to extreme weather conditions.

4.4 Increase in safety margins

ENSI intends to conclude its review on the submitted analyses on the increase in safety margins by the end of the first quarter of 2015. Any backfits derived therefrom will be followed up in the course of ongoing supervisory activities. The insights gained during the first quarter of 2015 will be used as a basis to determine which events the ERSIM project will be extended to include. Analysis will focus in particular on the events linked to extreme weather conditions.

Milestones:

1st quarter of 2015 ENSI: Evaluation of analyses on the increase in safety margins (earthquakes and extreme flooding).

1st quarter of 2015	ENSI: Decision on the continuation and extension of the ERSIM project through additional analyses relating to the increase in safety margins
4th quarter of 2015	ENSI: Review of the additional analyses relating to the increase in safety margins.

4.5 The effects of non-nuclear hazardous substances

The deployment strategies developed by nuclear power plants frequently provide for manual intervention by their staff in the event of nuclear accidents that exceed the design basis. Flammable and explosive liquids and gases as well as caustic or hazardous chemicals are present on every power plant site. The question arises to what extent conventional hazardous substances could interfere with managing beyond design-basis accidents and what countermeasures are available. In early 2015, ENSI will specify the scope of the clarifications needed and require the nuclear power plants to submit their considerations. The reports provided by the licensees will then be reviewed by ENSI.

Milestones:

1st quarter of 2015	ENSI: Specification of the scope of the clarifications needed.
3rd quarter of 2015	NPPs: Submission of answers and documents regarding the specified scope of the clarifications.
4th quarter of 2015	ENSI: Review of the documents submitted by licensees.

4.6 Severe Accident Management

Pursuant to the Emergency Preparedness Ordinance, the authorities involved in an emergency (including nuclear power plant licensees, ENSI and the cantons) must ensure that adequate personnel and equipment are available to manage emergencies. This applies in particular to qualified radiation protection personnel on the plant site. ENSI will verify the availability of adequate personnel, in particular in view of emergencies.

Milestones:

2nd quarter of 2015	ENSI: Request of information from the NPPs in relation to the minimum personnel levels during normal operation and for dealing with severe accidents.
3rd quarter of 2015	NPPs: Submission of documents on minimum personnel requirements.
4th quarter of 2015	ENSI: Review of the documents submitted by licensees.

4.7 Dispersion of contaminants in watercourses

The work packages presented in section 3.7 (Retrospective of 2014) will be further processed and concluded during 2015.

Work package 1: The nuclear power plants will conclude their plant-specific studies on dealing with large quantities of contaminated water and submit corresponding reports by the end of November 2015. ENSI will then review the studies.

Work package 2: The cantons will conclude their internal reviews of reporting channels by the end of the third quarter of 2015.

Work package 3: The review of the radiological criteria for alarm initiation and the introduction of immediate measures under ENSI's lead is virtually complete and documented in two reports. It is intended to bring the amendment to Guideline ENSI-B03 described in section 3.7 (Retrospective of 2014) into force during 2015.

Work package 4: The FOPH intends to conclude the installation of the new measuring system for continuous radiological monitoring of river water downstream from nuclear power plants by the end of 2015.

Milestones:

4th quarter of 2015	NPPs: Submission of plant-specific studies on dealing with large quantities of contaminated water.
4th quarter of 2015	ENSI: Amendment to the obligation to notify non-routine discharge into the environment as defined in section 4.4 of Guideline ENSI-B03.

4.8 EU stress tests follow-up

ENSREG is organising a new international workshop on the updated NacPs for April 2015 as a part of follow-up activities to the EU stress tests. The NAcPs will be subjected to a peer review. The process also provides the general public with an opportunity to pose questions relating to the NAcPs via the ENSREG website http://www.ensreg.eu/node/3762. The results of the review will again be summarised in a so-called rapporteurs report. The report will present the activities by the participating countries that have taken place since Fukushima as well as those implemented since the last workshop. Switzerland will actively participate in the review and concluding workshop.

Milestones:

2nd quarter of 2015	ENSI: Participation in the peer review of NAcPs and the concluding international ENSREG workshop.

5 Annexes

Legenda to column 3 (status/action plan)

2015 Key issue of the action plan for 2015
LA Issue has been incorporated into ongoing supervisory activities
NI Issue yet to be initiated
B Issue dependent on IDA NOMEX

5.1 Annex 1: List of checkpoints from "Lessons Learned"

No.	Designation	Status / action plan	**Description**	Implementation text
1	PP1	2015	**The hazard assumptions for earthquakes and external flooding, and also for extreme weather conditions, must be re-evaluated to take account of the latest knowledge.**	Earthquakes: the first review of the seismic safety case based on intermediate hazard assumptions was completed in June 2012. At the end of 2013, the operators handed in to ENSI a final report on the PEGASOS Refinement project (PRP). ENSI will issue a final assessment of the PRP in 2015 and will redefine the hazard assumptions for each of the NPP locations. External flooding: hazard assumptions were reviewed in 2011. Combination of earthquakes/earthquake-induced flooding was covered in 2012. Extreme weather conditions: New studies have been compiled by the operators for the required hazards, and proof of adequate protection was submitted to ENSI in 2014. The information from the operators is currently under review at ENSI.
2	PP2	LA	**The control strategies for a prolonged loss of electric power supply must be re-evaluated on the basis of knowledge gained from Fukushima.**	The strategies were reviewed during topical inspections in all NPPs at the end of 2012: the plants have effectively continued to develop their existing strategies on a targeted basis and adequate resources for AM are available in order to prevent core damage after an SBO.
3	PP3	LA	**It should be checked whether the coolant supply for the safety systems and the associated auxiliary systems is guaranteed from a diverse source which is safe against earthquakes, flooding and contamination.**	Screening analyses of coolant supply were completed in 2012; at all plants except Mühleberg, adequate redundancies are available in order to guarantee the coolant supply. KKM must backfit a diverse coolant supply. The applications for alternative back-fitting measures (if any) which KKM must implement in order to operate until 2019 were submitted in mid-2014. ENSI reviewed these applications and issued its safety evaluation in January 2015 (report ENSI 11/1999).

No.	Designation	Status / action plan	**Description**	Implementation text
4	PP4	LA	**It should be checked whether the requisite tightness of buildings containing important safety equipment is guaranteed in case of flooding of the site.**	The safety cases for the 10,000-year flood were accepted by ENSI in 2011. Other additional requirements were incorporated and followed up in the course of the project ERSIM and of the ongoing supervisory activities.
5	PP5	LA	**On the basis of experience gained from the Fukushima accident, it should be checked whether the availability of the instrumentation required to assess the condition of the plant is guaranteed adequately even in extreme situations.**	Backfitting of instrumentation to monitor the spent fuel pools was required in the formal order dated 05.05.2011. Backfitting projects for this purpose are in progress in all NPPs; permits for these have been issued by ENSI, which also supervises the implementation. Activities in connection with accident instrumentation were covered in section 3.7 of the 2014 Fukushima Action Plan. The requirements for emergency equipment were incorporated into the draft of Guideline ENSI-G02 "Design principles for existing nuclear power plants" (see section 3.4).
6	PP6	LA	**It should be checked whether control of leaks and the long-term cooling of the spent fuel pools are guaranteed in case of severe accidents.**	Reviews took place in 2011 and 2012. Permits for backfitting projects at the Beznau and Mühleberg NPPs are being issued by ENSI, which also supervises the implementation.
7	PP7	LA	**It should be checked whether tests and inspections regarding the prevention of hydrogen explosions should be extended to additional areas of the plants beyond the primary containment.**	In 2013, ENSI required a reconsideration of various aspects of the hydrogen hazard in case of severe accidents in the reactor. Topics are: analyses of the hydrogen hazard, including propagation of hydrogen from the containment into other buildings of the nuclear power plant, robustness and scope of the measuring equipment, measures and procedures in place, review of the containment venting path. The operators submitted the installation-specific studies promptly by the end of June 2014. After a detailed review, ENSI has concluded that each plant has adequate preventive measures in place against the hydrogen hazard in case of beyond design basis accidents. Nevertheless, appropriate measures could further increase safety in all the plants. One of ENSI's requests was for all the nuclear power plants to have suitable passive means of counteracting the hydrogen hazard at their disposal. ENSI will continue to track the implementation of the measures and/or backfittings in the course of ongoing supervision.
8	PP8	LA	**The design and operation of the systems for filtered venting of the containment must be addressed again.**	The filtered venting system was examined both in the EU stress tests ("Measures and design to protect containment integrity") and in the course of topical inspections by ENSI which relate specifically to knowledge gained from the accident at Fukushima Dai-ichi. The reviews have confirmed the suitability of these systems. Aspects of hydrogen management related to the filtered venting systems are considered under PP7.

No.	Designation	Status / action plan	**Description**	Implementation text
9	PP9	LA	**It is necessary to carry out a new review of the earthquake and flood design of the monitoring network for automatic dose rate measurement in the vicinity of nuclear power plants (MADUK), in relation to experience gained from the Fukushima accident.**	ENSI has reviewed the specific requirements on the basis of knowledge acquired through IDA NOMEX. This knowledge was taken as the basis for a study to derive the requirements for redundant and reliable measurement and forecasting systems used in the emergency response organisation (see PP5).
10	PP10	LA	**It should be checked whether the emergency control center (ECC) and the substitute ECC at the Swiss nuclear power plants still meet the requirements, based on the experience gained from the Fukushima accident.**	Requirements for technical emergency preparedness equipment at nuclear installations are stipulated in ENSI guideline B12. Inspections were conducted at all NPPs in 2012 and 2013 covering the emergency rooms and the radiation protection equipment that could be deployed in case of an event. The review report on the deployment strategies for the emergency response organisations submitted by the NPPs was issued in 2014. In this review report, ENSI concluded that external emergency centres must be included in the emergency plans as a fixed option (also see section 3.6). The work will continue to be tracked by ENSI in the course of its ongoing supervisory activities.
11	PP11	LA	**The access control system for nuclear power plants and the associated arrangements must be reviewed to determine the accessibility of rooms where intervention is required in case of severe accidents, while maintaining appropriate plant security. Monitoring of radiation protection must continue to be guaranteed in this context.**	This issue was initially addressed in the course of existing supervisory activities taking into consideration the additional knowledge gained from the Fukushima accident. Follow-up will continue in the course of ongoing supervisory activities.
12	PP12	LA	**The emergency measures for heat removal in case of a complete failure of the cooling water supply must be reviewed and verified under conditions resulting from the disruption of the infrastructure and the power supply.**	After the construction of the Reitnau external storage facility, resources were already made available in June 2011 for use in a situation of this sort in order to maintain the cooling function independently of the permanently installed safety systems. In addition, this issue was analysed as part of the EU stress tests. Topical inspections were carried out on the issue of a complete loss of the AC power supply, and improvements were implemented in the plants. The comprehensive review of the deployment of resources from the Reitnau external storage facility took place in 2013 in connection with an alarm exercise and the 2013 general emergency exercise.
13	PP13	LA	**It should be checked whether the alternative supply of water and power for emergencies is ensured.**	Operational resources have been held in readiness at a central point at the Reitnau storage facility since 2011; in addition, storage facilities with appropriate emergency resources have been set up at the NPP sites. Hook-up points at the NPPs have been backfitted as necessary. The plants' provisions for water injection in case of an SBO were successfully reviewed by ENSI on the basis of inspections. Periodic reviews are conducted as part of the regular emergency exercises.
14	PP14	LA	**It is necessary to examine the water resources that can be made available to supply the reactor pressure vessel, the spent fuel pools and the containment.**	Available reserves of water have already been reviewed and are already documented in the existing emergency procedures. This topic will be reconsidered again as part of the "Increase in safety margins" key issue (see section 3.4).

No.	Designation	Status / action plan	**Description**	Implementation text
15	PP15	B	**Emergency management must be reviewed to determine further potential for improvement.**	Implementation is taking place under the auspices of IDA NOMEX, e.g. as part of IDA NOMEX measure 4 "Personnel and materials" and IDA NOMEX measure 24 "Obligations on individuals". The resultant specific requirements for nuclear installations are being supervised by ENSI. Reporting on the complete package of IDA NOMEX measures is undertaken by the Federal NBCN Crisis Management Board. IDA NOMEX measures 14 ("Review of reference scenarios") and 18 ("Review of the zone concept") for which ENSI was tasked with the lead, were also completed in 2014 (see section 3.7). In addition, the deployment strategies for the NPPs' emergency response organisations were reviewed in 2014 to determine their potential for improvement (see PP10 and section 3.6).
16	PP16	LA	**ENSI has identified the following issues for improving emergency planning and emergency exercises:** **a The decision-making guidance for emergency management in case of severe accidents (SAMG) at nuclear power plants, including the newly planned checkpoints to deal with severe accidents, must be reviewed on the basis of knowledge gained from the Fukushima accident. In this regard, it is particularly necessary to check:** **- whether adequate consideration is given to a prolonged Station Blackout (SBO) and the simultaneous occurrence of events in multiple-unit plants;** **- whether there is any need for measures, auxiliary resources and equipment that must be available to ensure subcriticality in the long term in case of severe accidents.** **b Consideration given to accidents involving a prolonged SBO in the planning of emergency exercises.** **c Examination of whether the procedures are trained often enough during emergency exercises. Particular attention should given here to a functioning inter-organisation chain of communication across the various organisations.**	The Swiss NPPs have a comprehensive system of accident and emergency procedures, complemented by the SAMG. ENSI considers that a new assessment in the light of events at Fukushima would serve the interests of safety. In the course of ongoing supervisory activities, there will be re-assessments of the regulatory requirements (ENSI-B12) and the implementation of the SAMG in the plants. In connection with the implementation of ENSI's formal order dated 18.03.2011, an external emergency storage facility (Reitnau) for all NPPs in Switzerland was already established on 01.06.2011. Among other items, stocks of boron compounds are kept in readiness here to ensure the long-term maintenance of subcriticality. Guideline ENSI-B11 has been amplified since 2011 so that, as a new feature, the planning must also include recurring emergency exercises focusing on the deployment of the fire brigades and the security forces. In addition, the option of conducting longer exercises has been incorporated into ENSI-B11. The cross-organisational and cross-border communication chain is especially being examined during general emergency exercises.
17	PP17	B	**It should be checked whether and to what extent the communication facilities are designed with adequate redundancy and diversity.**	Implementation will take place under the auspices of IDA NOMEX. The resultant specific requirements for nuclear plants will be supervised by ENSI. In 2013, the Swiss POLYCOM security radio network was introduced at ENSI as an alternative communication system. The option of satellite-based communication is under examination (see section 3.7 of the 2014 Fukushima Action Plan). Furthermore, the FOCP is working on a solution for secure communication for civil protection purposes, with the participation of the KKM SVS (Consultation and coordination mechanism of the Swiss safety network) and in collaboration with the Army.

No.	Designation	Status / action plan	**Description**	Implementation text
18	PP18	B 2015	**It must be ensured that adequate staff is available at all times to accomplish all necessary emergency management activities.**	Implementation will take place under the auspices of IDA NOMEX (also see PP15). The resultant specific requirements for nuclear plants will be supervised by ENSI. The review report on the deployment strategies for the emergency response organisations submitted by the NPPs was issued in 2014 (also see section 3.6). For 2015, ENSI will carry out a special review of the staffing level for qualified radiation protection personnel during an emergency in the NPPs (see section 4.6).
19	PP19	LA	**Measures that increase the organisation's ability to react to unexpected events must be reviewed again on the basis of experience gained from Fukushima.**	Actions related to this issue are followed up by the Human and Organisational Factors section in the course of ongoing supervisory activities.
20	PP20	LA	**Transmission of plant parameter data must be re-evaluated with respect to an alternative, independent means of data transmission.**	The specific requirements have been drawn up by ENSI on the basis of knowledge acquired through IDA NOMEX. The FOCP is working on a solution for secure communication for civil protection purposes, with the participation of the KKM SVS (Consultation and coordination mechanism of the Swiss safety network) and in collaboration with the Army.
21	PP21	B	**The evacuation concepts must be reviewed, taking account of knowledge gained from the Fukushima accident.**	Implementation will take place under the auspices of IDA NOMEX by the FOCP.
22	PP22	B	**Coordination with other international partners is required to determine whether and how an international network for central international emergency support can be set up.**	Implementation will take place under the auspices of IDA NOMEX. The resultant specific requirements for nuclear plants will be supervised by ENSI. Switzerland specified arrangements for collaboration with RANET (Response and Assistance Network) in 2013, and it has been a member since March 2014. Since September 2013, the FOPH has been a member of REMPAN, the Radiation Emergency Medical Preparedness and Assistance Network within the WHO (World Health Organization).
23	PP23	LA	**It should be checked whether the necessary information regarding forecasts of releases and radiation exposure is provided in a timely and continuous manner in case of accident.**	In 2013, the requirements for redundant and reliable measurement and forecasting systems were specified in connection with IDA NOMEX measure 10 (see section 3.7). The transmission of forecasts was reviewed again in the course of the 2013 general emergency exercise.

No.	Designation	Status / action plan	**Description**	Implementation text
24	PP24	B	**The following improvement measures were identified regarding information provided to the general public:** **a It must be ensured not only that the requisite infrastructure and the necessary individuals and/or organisations and equipment are available for crisis communication, but also that the necessary means of communication are in place. The relevant precautions must be taken. Regular training must be provided on the associated procedures. This point also includes a functioning network of experts who are available to the media to supply neutral and objective information.** **b It should be checked whether the organisational responsibilities for informing the public as well as the local authorities and support staff are clearly stipulated, and are uniformly understood by all involved parties.** **It should be checked whether the timely communication of radiological effects, including calculated forecasts, is also ensured beyond Switzerland's borders.**	Implementation will take place under the auspices of IDA NOMEX (e.g. in connection with IDA NOMEX measure 116 "Information agreement, information in the event of an NPP accident within Switzerland", which is being handled by the FOCP). In 2013, ENSI introduced the Swiss POLYCOM security radio network as an alternative communication system. The option of satellite-based communication is under examination (see section 3.7 of the 2014 Fukushima Action Plan). Prompt transmission of information on radiological effects, including forecasts, is examined on a recurring basis in the course of general emergency exercises. The last examination of this sort took place during the 2013 general emergency exercise. The FOCP is working on a solution for secure communication for civil protection purposes, with the participation of the KKM SVS (Consultation and coordination mechanism of the Swiss safety network) and in collaboration with the Army.
25	PP25	2015	**It is necessary to examine the extent to which the release of non-nuclear hazardous substances in case of beyond design basis accidents could exert an additional influence on the accident sequence, and which counter-measures are required.**	The issue of "Impacts of non-nuclear hazardous substances in case of events beyond the design basis" is a key point for 2015 (see section 4.5).
26	PP26	LA	**The process of evaluating and examining the applicability of national and international operating experience must be optimised on the basis of knowledge gained from the Fukushima accident.**	ENSI has continued to optimise the relevant internal structures. The internal processes have been adapted on the basis of operating experience feedback from international events. The effectiveness of these optimisation measures will be reviewed during the periodic audits of ENSI's management system.
27	PP27	LA	**It must be guaranteed that the knowledge gained from national and international operating experience (event analysis) in the licensees' organisations reaches all the relevant individuals and units (including those at group level).**	Inspections of this aspect were carried out by ENSI at all NPPs in the fourth quarter of 2012. The plants have processed the requirements derived. ENSI will follow this issue up in the course of its ongoing supervisory activities.

No.	Designation	Status / action plan	**Description**	Implementation text
28	PP28	LA	**It must be ensured that internationally harmonised assessment criteria for nuclear safety are established at the highest level of safety.**	Switzerland collaborates continuously in the Safety Standards Groups (SSC) and other important IAEA bodies. Under the auspices of WENRA, ENSI advocates the development of harmonised Safety Reference Levels (SRL) and their implementation in European countries that use nuclear energy. In 2013, six new working groups within the RHWG (Reactor Harmonisation Working Group) drew up proposals for the integration of new knowledge from the EU stress tests into the SRLs. The revised SRLs were adopted by WENRA after the public consultation in 2014. When revising its regulatory framework, ENSI will implement the newly adopted WENRA Reactor Safety Reference Levels.
29	PP29	LA	**Greater importance should be accorded also at international level to the recommendations resulting from international reviews (IRRS, OSART) and from the regular Periodic Safety Reviews (PSR). The transparency of ENSI's supervision and of the operators' safety-related activities must be increased.**	An OSART mission was carried out at KKM in October 2012. The OSART follow-up mission was completed in June 2014, after which the report on the results was published. By the end of 2012, ENSI had drawn up an action plan for the proposed improvements arising from the IRRS mission in 2011, with a view to the Follow-Up Mission. The IRRS Follow-Up-Mission will take place in April 2015. The sixth Review Meeting on the Convention on Nuclear Safety (CNS) took place in March/April 2014. Switzerland achieved good results at this meeting. The Swiss proposal to amend the CNS (Article 18) was discussed on this occasion, and was forwarded to a Diplomatic Conference. In February 2015, the conference decided to adopt the "Vienna Declaration on Nuclear Safety" by consensus, instead of the proposed amendment. This declaration incorporated Switzerland's original requests.
30	PP30	2015	**ENSI is reviewing the significance of the lessons from the Fukushima accident for its supervisory activities.**	Long before the accident in Japan, ENSI endeavoured to adopt a questioning attitude towards its own supervisory strategy. By the end of 2014, ENSI had completed an internal project for this purpose on the subject of supervisory culture (see section 2). The knowledge gained from this project, and findings concerning the plants' safety culture, will be summarised by ENSI in a report during 2015 (see PP37 and section 4.1). The regulatory framework is being reviewed in the course of ongoing supervisory activities. Specific issues are covered in other checkpoints.
31	PP31	LA	**Additional operational resources must be kept in readiness for radiation protection in case of severe accidents.**	Additional radiation protection equipment has been held at the Reitnau external storage facility since 2011. Reviews to determine the adequacy of the resources held in readiness are conducted at regular intervals. In 2013, inspections of the radiation protection equipment stored at the NPP sites were carried out.

No.	Designation	Status / action plan	**Description**	Implementation text
32	PP32	LA	**It is necessary to examine whether the emission and immission measurements in place on the power plant sites in order to determine the activity releases are guaranteed in case of loss of offsite power or loss of normal emergency power.**	The review is being carried out as part of the Periodic Safety Reviews (PSR). KKM met the requirement for the high dose rate sensor in the stack, which is used as incident instrumentation, at the start of 2014. Work on the required improvements is under way at KKL. For KKB, ENSI will carry out the assessment during the current PSR. For KKG, the review was carried out in the course of an inspection in 2014, with the result that the preventive measures taken are adequate.
33	PP33	LA	**It is necessary to examine the extent to which the availability of the meteorological data required for dispersion calculations is guaranteed in case of extreme natural events.**	In 2013, the requirements for redundant and reliable measurement and forecasting systems were specified in connection with IDA NOMEX measure 10. Implementation will take place in the course of ongoing supervisory activities and as part of the FOCP project on secure communication for civil protection purposes.
34	PP34	B	**It is necessary to stipulate arrangements for dealing with contamination in the area surrounding nuclear installation following severe accidents.**	The specific requirements for the implementation of this checkpoint are being defined on the basis of knowledge acquired from IDA NOMEX, in connection with the total revision of the Radiological Protection Ordinance; this is taking place under the lead management of the Federal Office of Public Health (FOPH). The public consultation is planned during 2015.
35	PP35	2015	**It is necessary to examine how to deal with large volumes of contaminated water, radioactive waste or environmentally hazardous substances in case of severe accidents.**	At the end of 2013, the NPPs submitted a concept for dealing with the input of radioactive contaminants into groundwater and watercourses in case of beyond design basis accidents. ENSI carried out its review and issued its comments in 2014 (also see section 3.7). Work on this topic will continue in four "work packages", and it will also be a key point in 2015 (see section 4.7).
36	PP36	2015	**As part of the emergency planning for severe accidents, it must be ensured that sufficient radiation protection staff is available on site.**	This issue will be followed up as a key point in 2015 (also see section 4.6).
37	PP37	2015	**The knowledge gained from the Fukushima accident must be taken into account in the programmes to foster and develop the safety culture in Swiss nuclear power plants.**	Knowledge gained from the accident at Fukushima was integrated into the activities related to safety culture at the NPPs and at ENSI during 2012, and this will be continued in subsequent years as part of the regular activities related to safety culture. The knowledge gained from activities related to safety culture and supervisory culture will be summarised by ENSI in a report during 2015 (see PP30 and section 4.1).

5.2 Annex 2: List of open points from the EU stress tests

No.	Designation	Status / action plan	**Description**	Implementation text
38	OP2-1	LA	**ENSI will follow up on the question as to whether in the Swiss nuclear power plants automatic scrams should be triggered by the seismic instrumentation.**	An upstream automatic scram by means of seismic instrumentation has not yet been implemented in Swiss nuclear power plants. A working group was set up at ENSI in 2013. A report on the advantages and drawbacks of an upstream automatic scram via the seismic instrumentation was completed at the start of 2015 (see section 3.1).
39	OP2-2	LA	**In respect of seismic proof that has still to be supplied, ENSI will follow up on a more detailed examination of the seismic robustness of the isolation of the containment and the primary circuit.**	Proof was submitted by the licensees in 2012 and the cursory review by ENSI was completed. The subsequent detailed review by ENSI was completed by mid-2013. Based on the positive results from the review, it was possible to close OP2-2.
40	OP2-3	LA	**ENSI will follow up on measures to improve the seismic stability of the containment venting systems in case of beyond design basis accidents for KKG and KKL.**	Proof was submitted by the licensees in 2012 and the cursory review by ENSI was completed. The subsequent detailed review by ENSI was completed by mid-2013. Based on the positive results from the review, it was possible to close OP2-3.
41	OP3-1	LA	**ENSI will follow up on the impacts of a total debris blockage of hydraulic engineering installations.**	Proof was submitted by the licensees (KKB, KKG and KKM) in 2012. For KKB and KKM, ENSI determines that no cliff-edge effects from debris blockage are to be expected. At the end of 2013, the licensees (KKB, KKG and KKM) submitted refined analyses based on 2D model calculations in combination with the transport of solid matter. ENSI reviewed the refined analyses in 2014.
42	OP4-1	2015	**ENSI will follow up on the proofs of protection against extreme weather conditions, including combinations thereof.**	Requirements were defined by ENSI in 2012. In 2014, the operators submitted new hazard studies for this purpose, together with corresponding proof of the adequate safety of the installations. ENSI will review this documentation in 2015.
43	OP5-1	LA	**ENSI will follow up on the development of a comprehensive strategy for the targeted deployment of the mobile accident management emergency diesels in order to secure selected direct current and/or alternating current consumers in the long term under total SBO (or an SBO) conditions.**	Inspections of this aspect were carried out by ENSI in the fourth quarter of 2012. The results were assessed in the first quarter of 2013. Follow-up measures will continue to be supervised by ENSI in the course of its ongoing supervisory activities.
44	OP6-1	LA	**From the point of view of risk minimisation, ENSI will follow up on the extent to which the current deployment strategies for the venting systems in severe accidents should be retained.**	The deployment strategy for the containment venting systems in case of severe accidents was re-examined during 2014 in connection with the issue of hydrogen management. ENSI's review confirmed that hydrogen management in the Swiss nuclear power plants is of a high standard, but that safety can be increased still further by taking appropriate measures. One of ENSI's requests was for all the nuclear power plants to have suitable passive means of counteracting the hydrogen hazard at their disposal. Implementation of the requested backfitting measures is tracked in the course of ongoing supervisory activities.

No.	Designation	Status / action plan	**Description**	Implementation text
45	OP6-2	2015	**ENSI will follow up on whether restoring containment integrity during shutdown in case of a total SBO represents a time-critical measure.**	ENSI specifically defined the need for clarification at the start of 2014, and all the operators submitted their responses promptly (by the end of October 2014). The information submitted by the operators will be reviewed in 2015.
46	PRT-1	2015	**The peer review team recommends considering the assessment of margins with respect to extreme weather conditions exceeding the design bases, e.g. by extending the scope of future PSRs.**	ENSI specified detailed requirements for the probabilistic hazard analyses and the proof of adequate protection of plants against extreme weather conditions in 2012. In 2014, the licensees submitted their safety cases to ENSI, including an appreciation on the availability of safety margins. ENSI will complete its review of the operators' information in 2015.
47	PRT-2	LA	**It is recommended that the regulator assesses the opportunity of requiring more reliance on passive systems for hydrogen management for severe accident conditions. It is also recommended that the regulator considers further studies on the hydrogen management for the venting systems.**	In 2013, ENSI required a reconsideration of various aspects of the hydrogen hazard in case of severe accidents in the reactor. The topics are: analyses of the hydrogen hazard, including the propagation of hydrogen from the containment into other buildings of the nuclear power plant, robustness and scope of the measuring equipment, measures and procedures in place, and review of the containment venting path. The operators submitted the installation-specific studies promptly by the end of June 2014. After a detailed review, ENSI has concluded that each plant has adequate preventive measures in place against the hydrogen hazard in case of beyond design basis accidents. Nevertheless, appropriate measures could further increase safety in all the plants. One of ENSI's requests was for all the nuclear power plants to have suitable passive means of counteracting the hydrogen hazard at their disposal. ENSI will continue to track the implementation of the measures and/or backfittings in the course of ongoing supervision.

6 Abbreviations

AM	Accident Management
BST ABCN	Federal NBCN Crisis Management Board (Bundesstab für ABCN-Ereignisse)
CDF	Core Damage Frequency
CNS	Convention on Nuclear Safety
ENSI	Swiss Federal Nuclear Safety Inspectorate (Eidgenössisches Nuklearsicherheitsinspektorat)
ENSREG	European Nuclear Safety Regulators Group
ERSIM	Increase in Safety Margins
EU	European Union
FOCP	Swiss Federal Office for Civil Protection
FOEN	Federal Office for the Environment
FOPH	Federal Office of Public Health
GSKL	Group of Swiss Nuclear Power Plant Managers (Gruppe der schweizerischen Kernkraftwerksleiter)
IAEA	International Atomic Energy Agency
IDA NOMEX	Interdepartmental Working Group to Review Emergency Preparedness Measures in case of Extreme Events in Switzerland (Interdepartementale Arbeitsgruppe zur Überprüfung der Notfallschutzmassnahmen bei Extremereignissen in der Schweiz)
IRRS	Integrated Regulatory Review Service
KKM SVS	Consultation and Coordination Mechanism of the Swiss Safety Network (Konsultations- und Koordinationsmechanismus Sicherheitsverbundes Schweiz)
MADUK	Monitoring network for automatic dose rate measurement in the vicinity of nuclear power plants (Messnetz zur automatischen Dosisleistungsüberwachung in der Umgebung der Kernkraftwerke)
NAcP	National Action Plan
NEOC	National Emergency Operations Centre
NPP	Nuclear Power Plant

NRA	Nuclear Regulation Authority
OBE	Operating Basis Earthquake
OP	Open Point
OSART	Operational Safety Review Team
PAR	Passive Autocatalytic Recombiner
PEGASOS	Probabilistic Seismic Hazard Analysis for Swiss Nuclear Power Plant Sites (Probabilistische Erdbebengefährdungsanalyse für die KKW-Standorte in der Schweiz)
PGA	Peak Ground Acceleration
PP	Checkpoint (Prüfpunkt)
PRP	PEGASOS Refinement Project
PRP-IH	PRP Intermediate Hazard
PSR	Periodic Safety Review
RANET	IAEA Response and Assistance Network
REMPAN	WHO Radiation Emergency Medical Preparedness and Assistance Network
RHWG	WENRA Reactor Harmonisation Working Group
SAMG	Severe Accident Management Guidelines
SBO	Station Blackout
SRL	Safety Reference Level
SSE	Safe Shutdown Earthquake
WENRA	Western European Nuclear Regulators' Association
WHO	World Health Organisation

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

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ENSI-AN-9106
Published 28.02.2015