The Verification and Validation of SAMGs at Khmelnitsky NPP

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SAMG Implementation
SAMG Development

KhNPP started the SAMG development process after the Fukushima accident, therefore, many of lessons learned were taken into consideration for the SAMG development approach, that was based on:

- IAEA Severe Accident Management Programmes for Nuclear Power Plants
- IAEA Fundamental Safety Principles
- NNEGC Energoatom Severe Accident Analysis and SAMG development Program
Ukrainian Approach

The approach applied in Ukraine was to develop the Severe Accident Management Guidelines for the pilot unit (Zaporizhia-1) with further dissemination to other NPPs with power units of the same design.

Depending on the reactor upper unit position, 2 parts of the SAMG were developed for ZNPP-1:

- **Upper unit installed** – SAMG for power operations
- **Upper unit dismantled** – SAMG for shutdown states
KhNPP-1 and KhNPP-2 SAMG for power operations was adopted with consideration for differences between the pilot ZNPP-1 and KhNPP units and was implemented in March 2016.

KhNPP-1&2 SAMG for shutdown states will be implemented by December, 2017.

KhNPP Engineering and Technology Service is in charge of the SAMG development and implementation processes.
Chapter 2

SAMG Verification
In 2009, the Utility / NNEGC Energoatom developed a SAMG Implementation Program for all Ukrainian NPPs. Pursuant to the Program requirements, the Utility also developed a governing document for the SAMG verification process “SAMG Verification and Validation Guidelines” PL-D.0.41.610.
Verification of KhNPP SAMG for power operations used the approach applied by the pilot ZNPP-1 (sitting at a table, using analytical calculations, and evaluating the time needed for desired actions and operations).

To obtain the verification experience, KhNPP personnel was widely involved in the pilot ZNPP-1 SAMG verification.
Verification Process Milestones

At the initial stage, a Plant Order was issued to specify the:

- List of participants / experts;
- Documents to be used for the verification;
- Verification Supervisor.

At the main stage, experts verified the SAMG (unit 1&2), filling verification forms with comments / suggestions and forwarding them to the Verification Supervisor for analysis and revising.
Verification Process Milestones

At the final stage of the verification process, a Verification Report was developed and submitted to the Contractor for development of an updated SAMG revision.

The Verification Supervisor is responsible for the SAMG updating and compliance with verification results.
Khmelnitsky NPP has implemented a database for receiving feedback on the use of Emergency Operating Procedures (EOPs) and Severe Accident Management Guidelines.

SAMG comments / suggestions identified during the initial personnel training, emergency drills and TSC continuous training were incorporated into the feedback database and followed with the Chief Technologist’s decision to update the SAMG upon the comments / suggestions received, if necessary.
Having gained experience from the previous verification, Khmelnitsky NPP has developed proposals for the Utility’s SAMG Verification and Validation Guidelines:

- to expand the expert team with personnel from other departments
- to invite TSC members from other Ukrainian NPPs to the expert team
Chapter 3

SAMG Validation
The governing document for the SAMG validation is the SAMG Verification and Validation Guidelines PL-D.0.41.610.

To obtain validation experience, KhNPP personnel was widely involved in the pilot ZNPP-1 SAMG validation.
KhNPP Full Scope Simulator

KhNPP main validation tool is the Full Scope Simulator built in 1996. However, the FSS applicability is limited by the existing model.

The FSS model supports scenarios developed for both design-basis and beyond-design-basis accidents without severe core damage or severe SFP fuel damage.
Full Scope Simulator Upgrade

Pursuant to the Comprehensive Upgrade Program 2017-2021, the following FSS activities are envisaged:

- Severe accidents module upgrade
- Core model replacement
- FSS system models upgrade to incorporate shutdown states
- Containment model upgrade
- SFP model upgrade
Ukraine’s Comprehensive / Complex Safety Upgrade Program (CCSUP) aims to implement:

- Mobile equipment - 2017;
- Post-accident Monitoring System (PAMS) - 2018;
- Containment venting and other measures.

Following the CCSUP measures implementation and FSS upgrade, the SAMG validation approach will be revised to provide maximum realistic environment for the validation.
Taking into account the actual FSS features, Khmelnitsky NPP applies a combined *Simulator Sessions & Round Table Discussions* method for emergency / severe accident drills and validations.

During FSS sessions, MCR staff can implement actions as long as they are within the FSS model scope. The process is further simulated according to a developed scenario (for drills) or Contractor suggestions (for validation).
Validation Process Specificity

The main part of SAMG activities with involvement of both teams (TSC experts and MCR staff) took place during round-table discussions in the FSS pre-training room.

Time-keeping records from the field were provided for certain SAMG actions.

For long-term operations, preliminary time assessments were provided and data was taken from various emergency preparedness test / drill reports.
At the initial stage, a Plant Order was issued to specify the:

- Validation Program
- List of participants / experts
- Validation Supervisor

The Validation Program comprises the process description, validation scenarios (covering all the guidelines) and validation criteria.
Validation Process Milestones

At the main stage, Validation Supervisor aligned the team work with the scenarios and personnel performed / discussed conduct of SAMG actions. At the same time, experts formulated comments / suggestions to SAMG improvement and then forwarded completed validation forms to the Validation Supervisor.

At the final stage, the Supervisor reviewed the validation forms for their relevance, developed a Final Report and submitted it to the Contractor to launch SAMG updating.
For the second validation (SAMG for shutdown states), a preliminary meeting was arranged to:

- Demonstrate training materials on SAMG validation process, materials to be validated and applied validation approach
- Provide instructions on how to validate the SAMG
- Clarify process objectives and participants tasks.
Participants

Representatives of the following organizations were invited to validation of the SAMG for shutdown states:

- Utility
- Ukraine’s Regulator
- State Scientific and Technical Center
- Contractor, and
- Other NPPs
Validation Report

The approach to development of reporting documentation was changed to allow establishing a more suitable format for grouping comments / suggestions. The new approach will be incorporated into the Utility Guideline.

To make the use of validation and verification results more convenient, the two reports are combined into a single document “KhNPP SAMG Verification and Validation Report”.
Chapter 4

V&V and emergency preparedness
In 2015, the Utility Guideline was revised upon all Ukrainian NPPs’ suggestions based on the verification and validation experience.

At the moment, the Guideline are being updated to meet valid requirements of the Ukrainian Regulator for:

- Physical separation of the TSC experts and MCR staff (in separate rooms).
- Justification of duration of certain validation actions.
The area of emergency preparedness has a specific practice to conduct regular peer reviews – once per every two years.

These peer reviews verify the status of Accident Management Procedures (including the SAMG) at Ukrainian NPPs.

The objective is to improve the Accident Management Procedures and reveal implementation process deficiencies.
A Council of emergency preparedness experts (from all Ukrainian NPPs) is established. The experts review issues related to emergency documentation, including the validation and verification processes. The Council convenes meetings every three months. Based on Peer Review Reports, minutes of the Council meetings and emergency drill reports we develop measures for emergency documentation improvement.
Thank you for your Attention!