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HARMO

IMPLEMENTATION OF A DECISION SUPPORT SYSTEM FOR NUCLEAR EMERGENCIES

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Abstract

We present the development and implementation of a decision support system (DSS) for ENSI's emergency response organisation (ERO) to be used for emergencies in nuclear installations in Switzerland.
In a first step detailed here, a tool for the assessment of reactor safety and radiation protection was created; in a second step, a DSS for ENSI's entire ERO shall be established.

Overview: Emergency preparedness and response in Switzerland

■ ENSI is the regulatory authority for all nuclear installations in Switzerland. As stipulated by law, it maintains its own emergency response organisation (ERO). This includes an alarming system capable of ensuring that the emergency response task force becomes operational no later than one hour after notification by the utility.

■ In case of a nuclear emergency in Switzerland, multiple national and international partners are involved in the emergency response.

■ As part of the emergency response chain, ENSI is tasked with providing assessments, prognoses, and recommendations to the emergency response partners, including advising the decision maker on the implementation of emergency protective measures for the population (EPM). Such recommendations are typically based on airborne dispersion simulations using the system JRODOS.

Objectives and approach

■ **Objective 1:** In case of an accident, an efficient synthesis of available information is crucial for ENSI's ERO to ensure a situation specific response in a timely manner.

■ **Objective 2:** From the perspective of ENSI ERO's partners, the layout, formulation, and presentation of ENSI's assessments, prognoses, and recommendations is of considerable importance.

■ To address these two objectives, as a first step, we developed and implemented a software-based DSS for ENSI ERO's reactor safety and radiation protection groups between 2019 and 2021. In a second step, we will expand this DSS to include all ERO groups as well as ERO staff meetings. This second step is planned to be completed by 2026 and is to be presented later.

■ As part of the continuous improvement drive for ENSI's ERO, this endeavour includes digitisation of the mostly paper-based forms used within the ERO and moving from multiple topic-based reports to one consolidated report for the EPR partners after each ERO staff meeting.

Implementation at ENSI for the ERO's radiation protection group

■ All products of ENSI's ERO containing results from airborne dispersion and dose simulations can be created in a standardised format at the push of a button with the DSS presented here. Previously, these products had to be created manually in a rather cumbersome process. This greatly reduces both the amount of time spent on producing these products and the probability for human errors.

■ In addition, ERO staff can create easily understandable graphic visualisations of the areas affected by potential atmospheric radioactive discharges and for EPM recommended by ENSI (examples of these two products are shown in Figs. 1 and 2).

■ Furthermore, the DSS visualises meteorological parameters relevant for the radiological situation assessment (example shown in Fig. 3).

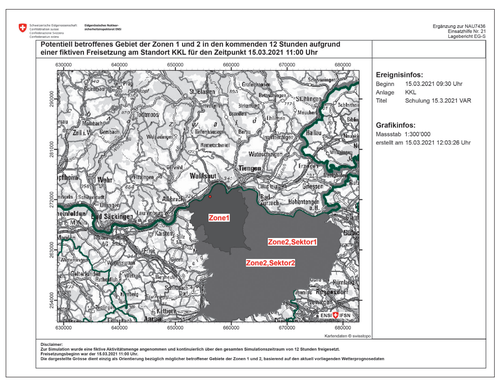

Figure 1

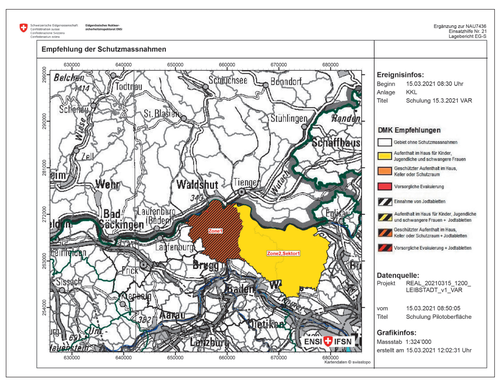

Figure 2

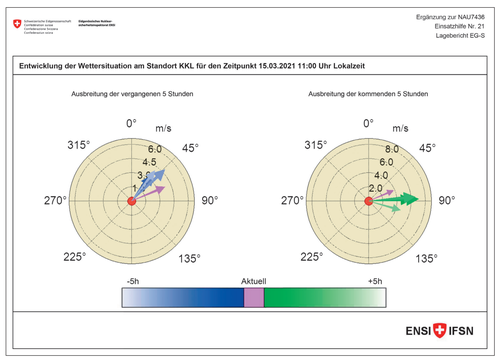

Figure 3

Further information:

Implementation at ENSI for the ERO's reactor safety group

■ Inspired by the IAEA IEC's Reactor Assessment Tool (RAT) with questionnaire and simplified plant graphic, ENSI developed its own questionnaires for the different types of nuclear installations in Switzerland (pressurised water reactors in operation, boiling water reactors both in operation and in the process of dismantling, research reactors, interim storage facilities, etc.). These questionnaires focus on functions and components vital for plant control and the mitigation of an event's impact on the environment.

■ In addition to the questionnaires, simplified plant schemata were developed for each of the different types of nuclear installations, visualising the questionnaire's functions and components as parts of the nuclear installation. By filling in the questionnaire in the digital DSS, the corresponding parts of the plant schema are colour-coded automatically with signal colours, indicating their state. These simplified plant schemata can then be used to give a concise overview of the plant's condition and they're designed to be readily understood by members of ENSI ERO's other groups and the emergency response partners.

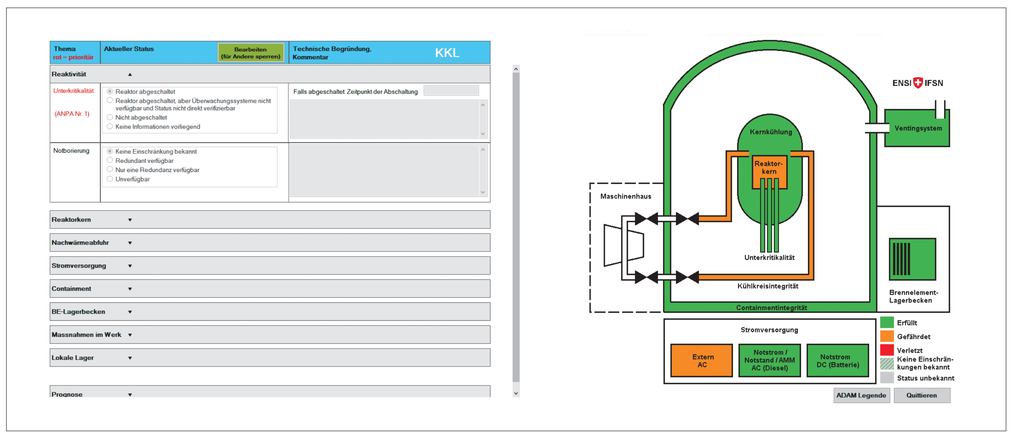

Figure 4

Design and user experience

■ Due to its intended use in case of an emergency situation, design and user experience play a crucial role. ENSI chose a very minimalistic approach, without hidden elements or fancy features (Fig. 5 shows the user interface when creating the EPM graphic).

■ Both ERO groups have their own forms, which can be viewed by everybody but edited only by the group responsible. When a user is editing a form, all the other users are blocked from editing in parallel and the editing user is indicated to everybody.

■ A status bar containing central information such as emergency classification or overview of protection objectives complements the topical forms.

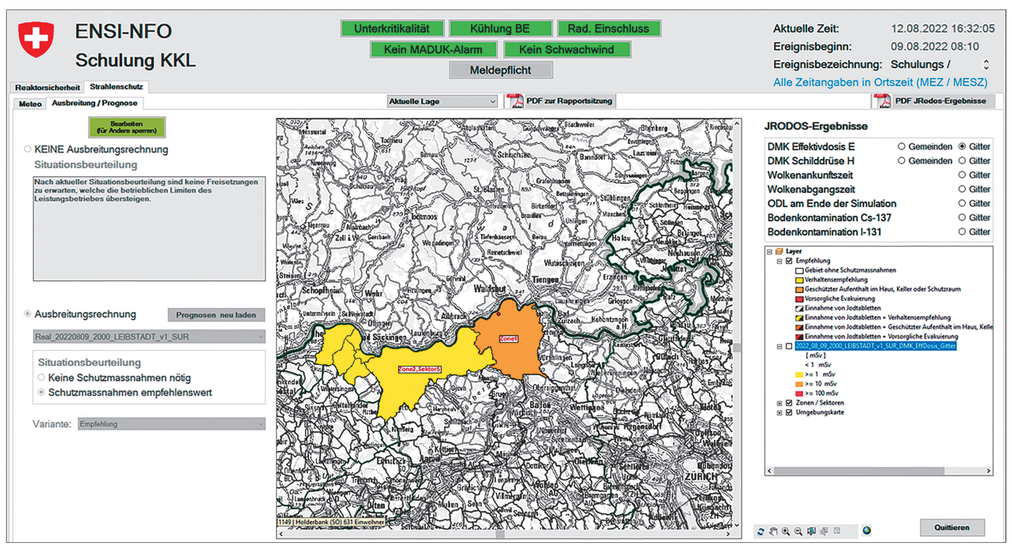

Figure 5

Conclusion and outlook

■ First applications of this new DSS in the context of exercises have confirmed its positive effects both inside ENSI's ERO and for our external partners.

■ At the same time, they have demonstrated the need for even more extensive automation, semi-automation and standardisation, especially for ENSI ERO's other groups. These aspects will be considered in a second step, the development of the DSS for the entire ERO.

■ A central aspect of this development is the design of a consolidated report published by ENSI's ERO instead of multiple topic-based reports currently produced and published separately by the ERO groups.

■ With the continuation of the developments presented in this poster, ENSI aims to further strengthen ENSI ERO's assessment, prognosis and decision-making process as well as to improve the communication towards our external EPR partners.