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Emergency preparedness for Small Modular Reactors (ESMOR) – project aims and preliminary results



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Introduction

Sweden and the EU have long-term commitments in climate policy and energy security. Due to the major shift towards electrification of industry, transport, and society, Sweden aims to establish 2.500 MW_e of new nuclear power capacity by 2035.

Small Modular Reactors (SMRs) are rapidly emerging as a contributing solution for future fossil-free energy systems globally including Sweden. SMRs are expected to offer greater flexibility in operation, geographical location, offer potential for lower costs (standardization and factory-produced units built in series), and reduced risks (passive safety systems that enhance safety margins) compared to traditional large-scale nuclear reactors.

While there are benefits with SMRs they still present radiological risks. SMRs may require new approaches to emergency preparedness and involve a broader range of actors, some with limited or no previous experience of nuclear safety and radiological emergency preparedness.

From a system safety perspective and for developed emergency preparedness, involved actors need to understand the preparedness process and their and other's areas of responsibility, be able to plan, coordinate, communicate and exchange knowledge and experiences regarding emergency preparedness.

The aim of the multidisciplinary project ESMOR is to identify challenges and opportunities for developing radiological emergency preparedness related to SMRs. Research questions are:

- 1) How can international SMR emergency preparedness recommendations be adapted to the Swedish context?
- 2) How prepared are the actors involved, and how does prior experience of emergency preparedness influence their readiness?
- 3) How do actors perceive and make sense of SMRs and their role in emergency preparedness?
- 4) How can current understanding of radiological and nuclear emergency preparedness be developed for future SMRs in Sweden?

Project findings will contribute to recommendations for developing local radiological emergency preparedness and fostering effective collaboration among actors.

Methods

ESMOR employs a qualitative approach, partly based on social constructivism and theories of sensemaking, combining

- reviews of international standards and scientific studies of emergency preparedness and SMRs;
- semi-structured interviews on actors' knowledge, expectations, and sensemaking on SMRs and emergency preparedness;
- focus group discussions with actors on responsibilities and expectations; forms of cooperation and collaboration; and needs for knowledge and support.

Actors include authorities, state and municipal rescue services, municipalities, county administrative boards, energy producers, and technology vendors. The study distinguishes between actors with and without prior experience in radiological emergency preparedness planning.



Illustration of three small modular reactors in a landscape (AI).

Currently, an operator of an existing Swedish nuclear power plant is planning for SMRs, and 13 Swedish municipalities have expressed interest in hosting SMRs, as they have applied for funding for pre-evaluation from the Swedish Environmental Protection Agency.

Preliminary results

- High expectations for SMRs exist across actors and SMRs are viewed as offering solutions on energy supply, economic benefits, long-term local development, and future municipal progress.
- For several actors the strategic thinking around SMR is abstract, complex, and in many cases at an early stage. Conceptual confusions around SMR technologies exist and emergency preparedness is generally not in actors' minds.
- Concerns regarding the geographical extension of emergency planning zones around SMRs and whether an all-hazard approach to emergency preparedness is sufficient for local authorities has not reached the agenda among the actors.
- Actors with prior experience of radiation emergency preparedness show awareness of radiation risks and the introduction of SMRs is expected to require adjustments rather than substantial changes to current practices.
- Actors without prior experience tend to postpone addressing preparedness issues, expecting future guidance from authorities. Their limited knowledge of radiation emergency preparedness means that norms, routines, and sometimes resource needs are not yet considered.
- There are fragmented interaction patterns and varying levels of experience among actors which currently do not support the emergence of comprehensive emergency preparedness.
- There is a need for increased knowledge about energy systems among local authorities, municipalities and the general public.

Conclusions

High expectations for SMRs exist but some conceptual confusions regarding SMR technologies persist. SMRs in Sweden are still in an early development phase, with unclear requirements around emergency planning zones, regulatory processes, technology choices, and preparedness responsibilities.