

Application of the RODOS system to determination of the restricted use area and emergency planning zones for the planned nuclear power plant in Poland



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- The purpose of the project was to perform simulations of the dispersal of radioactive contamination in atmosphere, terrain contamination and doses from ionizing radiation in the vicinity of NPP, making use of the models of the RODOS system in order to make first comparison of potential size of the restricted use areas and emergency planning zones for five technologies of nuclear reactors considered in the Polish Programme of Nuclear Energy.

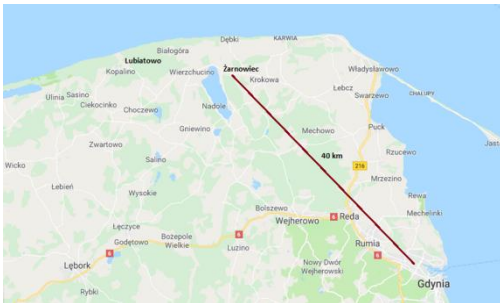
- **OOU1:** Annual effective dose received from all exposure pathways in normal operation period zone limiting value: 0.3 mSv/year
- **OOU2:** Annual effective dose received from all exposure pathways in case of accident without core melt, zone limiting value: 10 mSv
- **OOU3:** In case of design basis accident: 2-days effective dose received from all pathways except of ingestion zone limiting value: 10 mSv
- **OOU4:** In case of design basis accident with extended conditions: 7-days effective dose from all pathways except of ingestion zone limiting value: 100 mSv
- **OOU5:** In case of design basis accident with extended conditions:
 - **OOU5a:** lifetime dose (50 adults, 70 children) effective dose received from all pathways except of ingestion zone limiting value: 1 Sv, or
 - **OOU5b:** if 30-days effective dose received due to from all pathways except of ingestion does not decrease below 10 mSv during first 2 years from the occurrence of radiation accident

Criteria for emergency planning zones

- Internal zone: for external exposure
 - **SPA1.** Absorbed radiation dose in internal human organs (bone marrow, lung, intestine, gonads and thyroid) and eye lens: $D_{\text{red marrow}} = 1 \text{ Gy}$ in 10 hours.
 - **SPA2.** Absorber radiation dose for fetus: $D_{\text{fetus}} = 0,1 \text{ Gy}$ in 10 hours.
- External zone:
 - **SPA3.** Effective dose: $E = 100 \text{ mSv}$ – received, during 7 consecutive days from the beginning of exposure.
 - **SPA4.** Equivalent dose for fetus: $H_{\text{fetus}} = 100 \text{ mSv}$ – received, during 7 consecutive days from the beginning of exposure.

Considered localizations and NPP technologies

- Two considered localizations:
 - Lubiatowo-Kopalino
 - Żarnowiec
- Five considered technologies:
 - ABWR GE-Hitachi USA/Japan
 - AP1000 Westinghouse USA
 - EC6 SNC-Lavalin (Candu) Canada
 - EPR EdF France
 - EU-APR KHNP Korea
- Information about source terms, obtained from the vendors:
 - based on different understanding of considered types of accidents
 - data delivered have various accuracy
- RODOS has some limitations:
 - lack of some models (e.g. dose for fetus, doses from C-14, H-3)
 - definition of integration times for dose calculations not enough flexible
 - problems with annual doses for normal operation period



Results for restricted use area for Żarnowiec

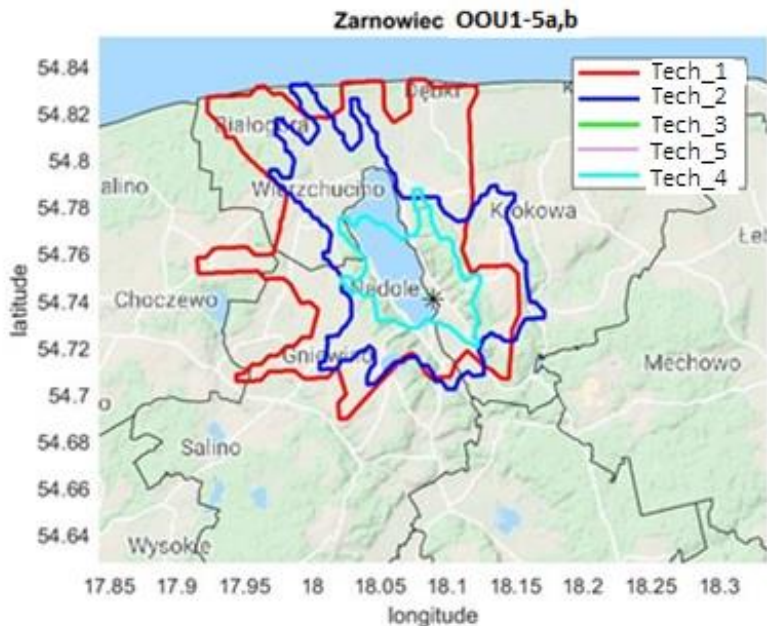
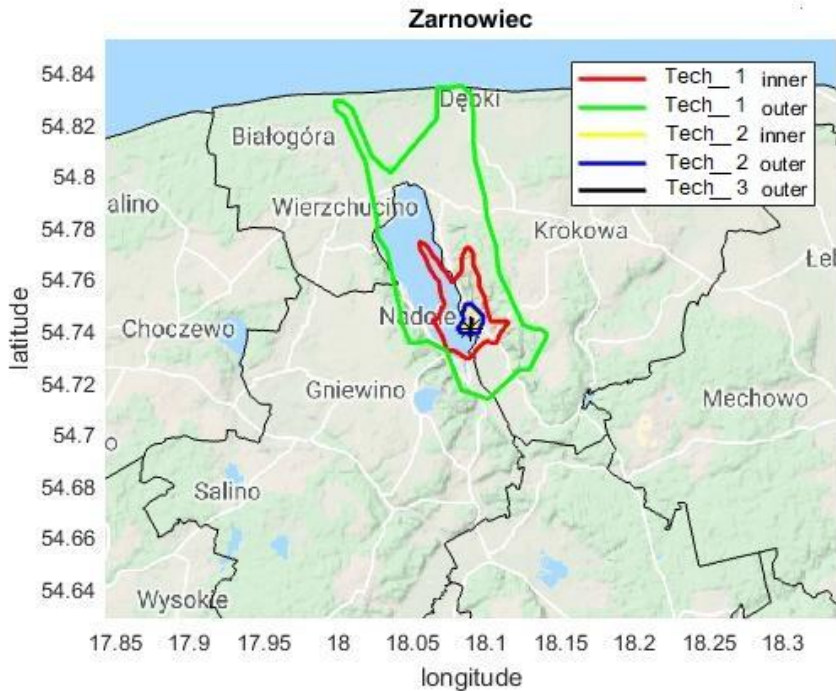


Fig. Borders of the restricted use area obtained taking into account all the criteria OOU1- OOU5a, b (right panel - in the case when the food dose was omitted in the OOU2 criterion) for all considered technologies in the Żarnowiec location

Max. Distance to Zone boundary [m]	Tech_1	Tech_2	Tech_3	Tech_4	Tech_5
	14363/1980	12217/415	0/0	5903/415	0/0

Results for emergency planning zones: Żarnowiec



Max. Distance to zone [m]	Tech_1	Tech_2	Tech_3	Tech_4	Tech_5
inner	10493	996	0	0	0
outer	11435	1094	484	0	0

Fig. Borders of emergency planning zones: outer and inner obtained for all considered technologies in the Żarnowiec location

- The most restrictive criterion is related to one-year dose from all pathways for accident without core melt.
- Proposition for new regulation – ingestion dose should be excluded.

Thank you for attention



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