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Swedish Radiation Safety Authority

Experience from the NKS EPHSOGAM exercise

AUG meeting in Dublin
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Background

- NKS (Nordic Nuclear Safety Research)
  - a forum for Nordic cooperation and competence in nuclear safety, including emergency preparedness (EP)
  - financed and supported by Nordic authorities, companies and other organisations
  - financing activities within reactor safety, decom and waste, EP, radioecology etc (in 2017 approximately 1.1 million euros + the same amount from contributions by participating organizations)
  - free publications (www.nks.org)

Early Phase Source Term Estimation From Gamma Spectra (EPHSOGAM)

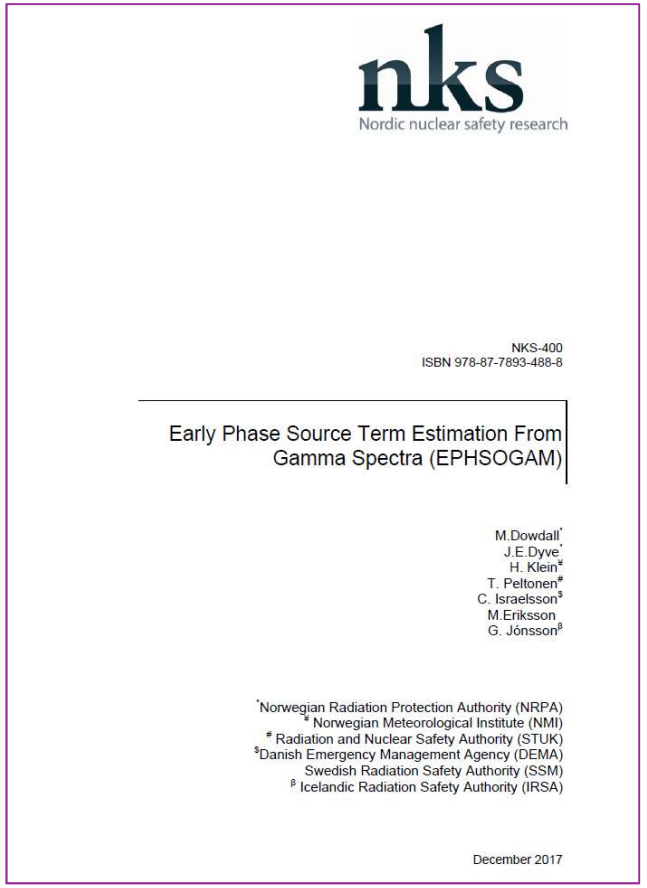
- NKS project 2017
- Purpose: with the help of simulated gamma spectra data attempt to estimate the released activity and the characteristics of the release event
- Participants: 7 participants from 7 countries managed to submit final results
- Each participants were told to store NWP data from met office for one week in March 2017.

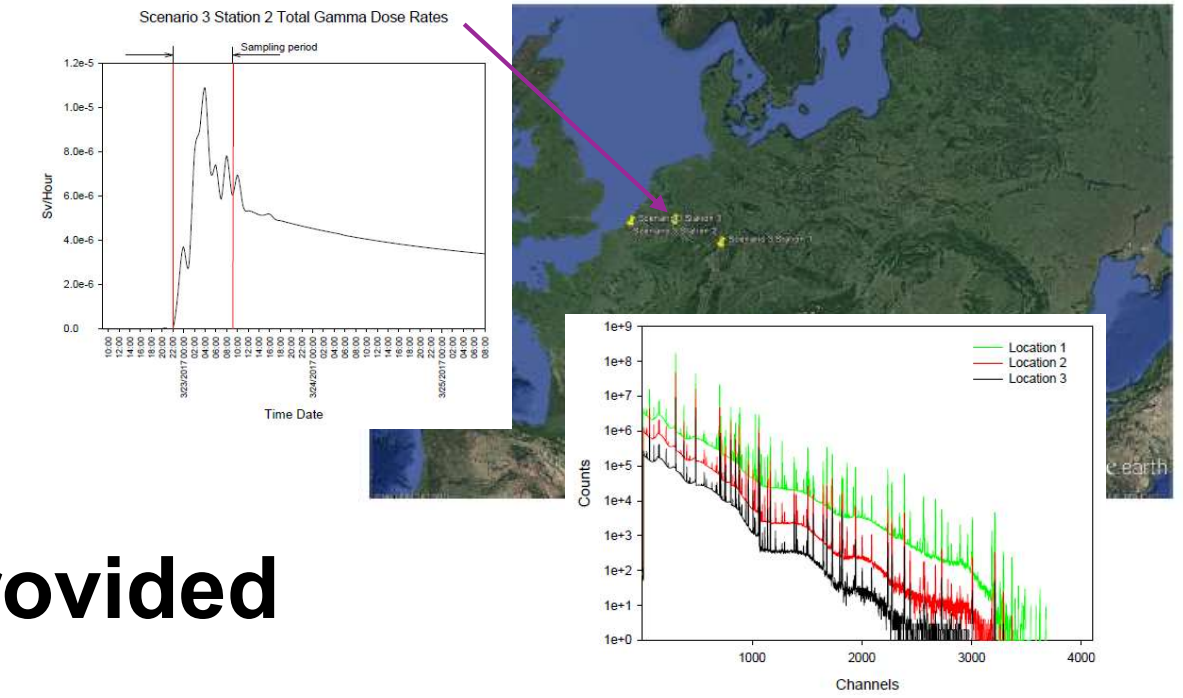
Publication

- NKS-400
- Authors: M.Dowdall*, J.E.Dyve*, H. Klein¥, T. Peltonen#, C. Israelsson$, M.Eriksson₳, G. Jónssonβ

http://www.nks.org/en/nks_reports/

*NRPA, ¥NMI, #STUK, $DEMA, ₳SSM, βGR





Example of information provided

- Each scenario will involve 3 monitoring stations. Information as to the locations of these stations will be provided.
- The stations were showing “sampling” for different periods of time with different volumes of air. 100% filter efficiency. No decay.
- Gamma total dose rates (except for scenario 4)

SSM contributions

- SSM performed the NKS EPHSOGAM exercise on the 5 September 2017 at the SSM premises in Stockholm.
- The SSM working group consisted of:
  - Anna Maria Blixt Buhr (ARGOS),
  - Mats Eriksson (Gamma analysis),
  - Sofia Eriksson (Gamma analysis),
  - Sara Ehrs (Gamma analysis),
  - Patric Lindahl (ARGOS),
  - Mikael Westin (Gamma analysis).

Gamma analysis

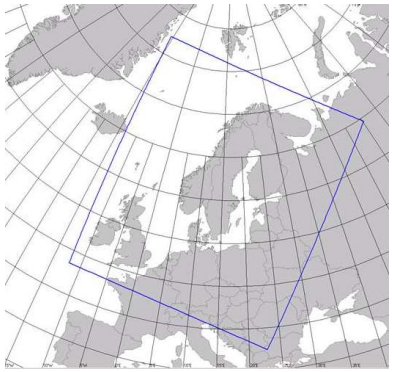
- The gamma analysis was performed in Genie 2000 (Canberra). Nuclear decay data from Brookhavens ENDF/B-VII.1 database.
- Nuclide identification was first done in the NUCLEONICA web application WESPA++.
- Shortly, the spectra was read into WESPA++, calibrated, and the gamma ray peaks were identified. We used the full JEFF-3.1 database with 1325 radionuclides and 54 004 gamma lines in the identification process.

Dispersion calculations

- Meteorological data from the NWP model HIRLAM provided by the Swedish Meterological and Hydrological Institute, SMHI
- Dispersion calculations and dose rate simulations made with RIMPUFF on ARGOS platform
- Limited to forward simulations and not possible to use back tracking trajectories or long-range models

Dispersion calculations

- Missing NWP data:
  - part of first day was missing => data from 14:00 pm instead of 00:01 am on 20th of March 2017
  - the requested area was not fully covered:



instead of

Methodology – simulations (1)

- Starting with scenario 3 (known release point) => the simulation parameters were tuned (to be able to do quick runs).
- Reduction of simulation time => only looking at the plume air concentration.
- The release time was changed until it was in line with the time of arrival (TOA) at the sampling station(s). TOAs were compared with the time of the first larger peak in the dose rate graphs.

Methodology – simulations (2)

- The other scenarios => to find out the release point we started with a large release of Kr-85 at 20 m height and a long (6 hours) release duration.
- Assumption: Closest sampling station = highest dose rate values. The spectra also gives an indication of the release duration.
- The prognosis length and/or the distance from the release point were increased in order to comprise all three sampling stations.

Methodology – simulations (3)

- Next step (keeping the guessed release point, time and duration fixed) => the released amount was changed to fit the total dose rate (ground and cloud) in a grid cell matching the positions of the sampling stations.
  - The relation between different radionuclides from the gamma spectra analysis were kept fixed in the assumed released activity.
  - In the scenario 2 and 4, the list of radionuclides was also a way to guess the release point.

Results – Scenario 1

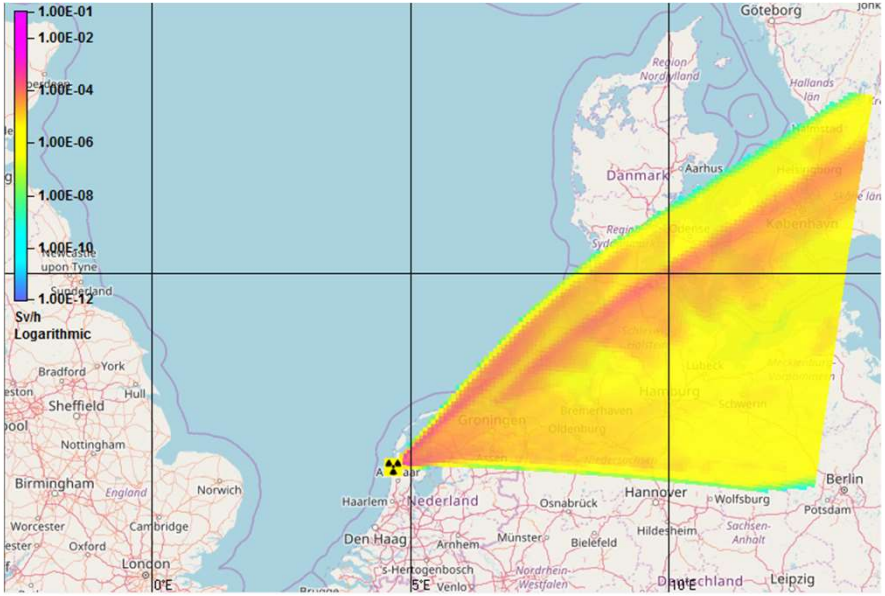
- Gamma spectra analysis
- No dispersion and dose calculations were made. Monitoring stations outside available weather data region.

Scenario 1 was based around a release from the reactor of a nuclear powered submarine at a location in the Mediterranean Sea near Spain

Results – Scenario 2

- Gamma spectra analysis
- Identification of release point, time and duration: incorrect guess due to missing data (in time).

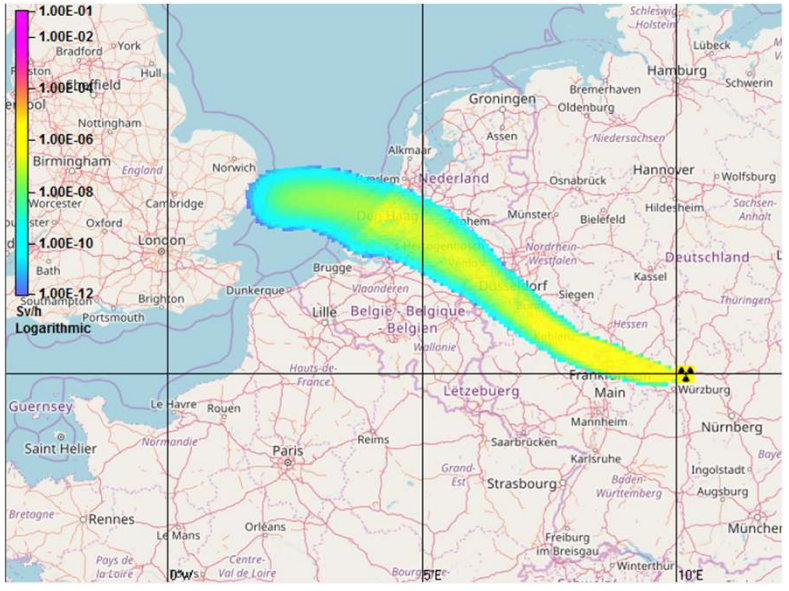
Scenario 2 was based on a large scale, acute release from the Sizewell B power plant in the United Kingdom



Results – Scenario 3

- Gamma spectra analysis
- The release time was estimated to be the correct one. The release duration was set to about 4 hours instead of the correct 12 hours (with several release intervals).
- Fairly good agreement in the estimation of total activity released.

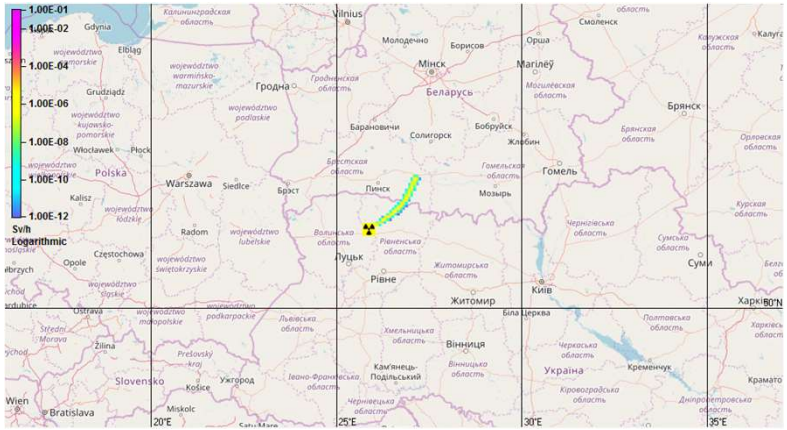
Scenario 3 was a large scale. prolonged release from the Grafrheinfeld facility in Germany (known release point but not when in time or amount)



Results – Scenario 4

- Correct radionuclides were identified from the gamma spectra analysis.
- Correct release point. The release time was estimated to be one hour later than the correct one.
- No estimation of the total activity released due to no given gamma dose rates (and lack of time). Assumed to be a small release.

Scenario 4 was a reality based scenario (Rivne NPP) and differed from the others in being a relatively small release with a low number of isotopes.



Summary

- Fruitful and fun exercise!
- Good collaboration between different teams at SSM
- Interesting to learn more about different participants approach to the problem. Inverse modelling!