

# Evaluation of the Radiological Emergency Field Operative Exercise, RE-FOX, taking place in Sweden 2012 with Nordic countries invited – Suggestion for a NKS-project

**FINCK R.R.<sup>1</sup>, HUBBARD L.M.<sup>1</sup>, & ÖSTLUND K.D.<sup>2</sup>**

<sup>1</sup>*Swedish Radiation Safety Authority, 171 16 Stockholm, Sweden*

<sup>2</sup>*Lund University, Department of Medical Radiation Physics, University Hospital, 221 85 Lund, Sweden*

**Abstract.** In September 2012, the Swedish Radiation Safety Authority (SSM) plans to conduct a Radiation Emergency - Field Operative Exercise (RE-FOX). The intention is to invite Nordic Authorities and organizations related to radiation safety, protection and measurements to take part in the exercise. The exercise is planned to include air-borne gamma spectrometry, car-borne gamma spectrometry, measurements with portable equipment, sampling and mobile laboratory analysis. A number of close reality scenarios will be built up, such as fallout of radioactive material (using dispersed short lived radionuclides), search of orphan sources, identification of hidden sources and possibly one or two scenarios simulating malevolent acts with radioactive material.

SSM suggests that a NKS-project be organized that will evaluate the measurement results from the RE-FOX exercise and perform a scientific follow-up of the methods and results. The good experience from earlier NKS-work after exercises with Nordic participation supports this approach. The main part of the follow-up could be done in workgroups, workshops or in mini-symposia, similar to what was done by NKS after previous Nordic exercises such as Resume-95, Resume-99 and Barents Rescue 2001. SSM can provide support to NKS for this follow-up.

The responsibilities for the exercise will be divided into two parts. Part one is the SSM part. Planning and conducting the exercise will be the full responsibility of SSM. NKS is invited to take part in general planning meetings so that NKS can start the planning and preparation of the follow-up work. Part two is the NKS-part. After the exercise, it is suggested that NKS takes the lead in evaluating the scientific parts of the exercise, document the results and conduct workshops and other relevant work to discuss methods and results and provide opportunities for participants to suggest improvements of measuring techniques and procedures. The main part of this work is intended for the year 2013.

**KEYWORDS: Nuclear Radiological Emergency Field Exercise NKS**

## INTRODUCTION

Nuclear accidents and radiological emergencies are rare. The organizations responsible for handling the consequences in the field will generally not receive much training when it comes to radiation measurements under conditions where the radiation situation is not under control. This means that first responders, including the field commanders, that have to handle the unknown situation generally have little or no practical experience from similar situations, unless they have undergone practical training in a radiation environment. It is, however, practically impossible to train all rescue workers fully for a radiological emergency. This would also be too costly for the society with regard to how seldom radiological emergencies occur. However, society should maintain a basic capability to respond to nuclear accidents and radiological emergencies in an adaptable way, depending on the seriousness of the situation. This means that it is necessary to at least have a well-trained central emergency organization that can perform all kinds of measurements and assessments in case a nuclear or radiological emergency should happen. Such organizations need to have knowledge, equipment and training. One

way to train measurements is to perform exercises where measurement equipment is used in close reality exercises using radiation sources. These can be natural radiation sources or anthropogenic sources such as fallout from previous radiological events or arranged situations that are set up in a fully controlled manner. Training expert teams, instructors and teachers in radiation protection and radiation measurement techniques in such radiation environments will give valuable experience to be used by the emergency organization if a real radiological emergency should occur. There is a history of performing such activities together in the Nordic countries. In the last 15 years, radiation field measurement exercises have been carried out in Nordic cooperation and with participants or observers from other European countries.

The series of Nordic field exercises was initiated in August 1995 when a NKS-project organized the Resume-95 (Rapid environmental surveying using mobile equipment) exercise in the area around the Vesivehmaa airfield in Finland. (Hovgaard et al, 1997). Soil sampling, *in situ* gamma spectrometry and car-borne and air-borne surveying were used to measure the deposition of caesium-137 from the Chernobyl accident and the occurrence of natural radionuclides. In addition, Resume-95 was the first Nordic exercise applying air-borne search of orphan gamma sources and a limited car-borne search. A small scale exercise to determine the activity and location of hidden point sources on the ground was also carried out (Finck and Mellander, 1997). The NKS Resume-95 exercise was the first of its kind and it was a success in many ways. It showed that air-borne and car-borne specialist teams from different countries could be called together and produce successful fall-out mapping and searches of orphan sources. Although the instrumentation may vary between the teams, the exercise showed that proper calibration methods could produce measurement results at an acceptable standard.

A second NKS-organized exercise, Resume-99, took place in September 1999 in the area around Gävle in Sweden. Measurement teams from the Nordic and Baltic countries participated. The deposition of caesium-137 was measured using soil sampling, *in situ* gamma spectrometry and car-borne spectrometric mapping (Karlsson et. al., 2000). Resume-99 showed that car-borne teams from different countries could join together to produce joint fallout maps if the instrumentation had undergone proper calibration. In September 2001 the Swedish Rescue Services Agency together with the Swedish Armed Forces and the Swedish Radiation Protection Authority (SSI) organized a large car-borne and air-borne search exercise, Barents Rescue 2001, Gamma Search Cell, in the military exercise fields around the town of Boden in northern Sweden. Twelve countries participated with search teams. (Finck & Ulvsand, 2003). The experiences and results from the Barents Rescue 2001 search exercise was evaluated and documented by NKS (Ulvsand et.al., 2002).

In May-June 2002 the ECCOMAGS Resume-2002 exercise was held in Scotland. The exercise was a Nordic-European project with the primary aim to evaluate the ability of airborne gamma spectrometry (AGS) teams in Europe to produce consistent dose rate and radionuclide deposition data. The work included a composite mapping task where each team was asked to measure part of a very large area. NKS provided support to the design of protocols and evaluation of measured data. A specific data format, the ERS-format (European Radiation and Spectrometry format) based on an idea from the NKS Resume-95 and Resume-99 exercises was developed and tested for the first time (Lauritzen et. al., 2003).

In September 2006 the Swedish Radiation Protection Authority organized a decontamination and monitoring exercise, DEMOEX, in the county of Halland in Sweden. Five Nordic countries were invited and participated in the exercise. In addition observers from 15 countries came to see the exercise activities. The exercise included air-borne and car-borne search for orphan sources and for the first time a "dirty bomb" monitoring scenario. (Finck et.al., 2008).

Nordic cooperation and NKS has played an important role in designing, conducting and evaluating field measurement exercises. For obvious reasons, the Swedish Radiation Safety Authority (SSM) would therefore like to propose that NKS takes an active part in the evaluation and follow-up of the next large field measurement exercise scheduled for September 2012. SSM has obtained Swedish funding for planning and conducting this exercise (RE-FOX 2012) and has the intention to invite Nordic countries to participate.

### **THE RE-FOX 2012 EXERCISE**

The RE-FOX (Radiological Emergency – Field Operative Exercise) 2012 is planned to take place in southern Sweden in the third week of September 2012. It will be planned and conducted by SSM in cooperation with the Swedish Civil Contingencies Agency (MSB), The National Board of Health and Welfare (SoS), The National Police Board (RPS), The Swedish Customs and The Swedish Armed Forces. Most of the practical preparations will be performed by Lund University and Gothenburg University under contract from SSM. SSM will invite Nordic authorities and research institutes working with radiation safety, protection and measurements to take active part in the exercise. Additional countries may be invited, but this will depend on the available space for the exercise. Countries will also be invited as observers to the exercise. The exercise will mostly take place on military exercise grounds that will be banned to public admittance. This makes it possible to build close reality scenarios using radioactive sources and radioactive material for contamination risk exercises.

The scenarios planned for the RE-FOX 2012 exercise are inspired from past experiences of Nordic NKS-organized field exercises using mobile car-borne and air-borne gamma spectrometry and from exercises of the Lärmät-type that have been carried out in Sweden each year since 2007. Lärmät-exercises are small 3 – 5 hour exercises focusing on a specific radiation protection and radiation monitoring issue (Östlund et. al., 2010). The scenarios suggested are also based on situations with radioactive fallout and radiological emergencies that have happened in the past and in situations that could possibly happen in the future, including situations with malevolent use of radiation.

At the time of the writing of this document, planning of the scenarios is still in a preliminary phase. NKS is encouraged to take a leading role in the shaping of evaluation procedures to take place during and after the exercise.

Scenarios that are being considered for the RE-FOX 2012 exercise are:

**Fresh fallout of radionuclides.** A “fallout” area will be created within a fenced off military exercise field using short lived radionuclides deposited on vegetation, grass and ground. The contaminated area will be in the order of a few thousand square meters. The exercise task is to investigate the “fallout” by hand held monitoring equipment including dose rate meters, vegetation and soil sampling with preparation and measurement of samples in a mobile laboratory, *in situ* gamma spectrometry and car-borne gamma spectrometry. Measurement data should be analyzed and the results from different measuring methods compared. Radiation maps could be produced in cooperation between teams. Dose prognoses could be calculated for a situation where the short-lived radionuclides are assumed to be long-lived radionuclides such as caesium-134 and caesium-137. There is a risk of being contaminated when entering the area, so participants have to use protective clothing and be prepared to decontaminate when leaving the area, which will also be a part of the exercise.

**Orphan sources.** A search scenario to locate orphan radiation sources over large distances and areas will be created. Both car-borne gamma spectrometry searches (CGS) and air-borne gamma spectrometry searches (AGS) or searches with total gamma monitors are planned to be included as well as search by foot with hand-held monitoring equipment. A number of search areas will be defined. The search areas will be so large that it will be difficult to search them slowly or with high spatial resolution in the limited time set out for the task (some hours for AGS and a day for CGS). Therefore, each search must be prioritized with regard to the information given by the scenario. This is thought to be a more realistic situation than in previous search exercises where there has been enough time to search the whole designated areas. It is also a thought that information from air-borne search should be usable to direct car-borne search teams or search on foot so that cooperation between AGS and CGS teams can be established. Whether this can be realized will be decided later.

**Container terminal.** A “container terminal” will be set up in the exercise area. The task is to locate possible radiation sources that could be inside the containers. The radionuclides, activities, positions and shielding should be determined and reported without access to the inside of the containers. The range of situations will vary from quite easy to rather difficult even for expert teams so that it will be a challenge to try to identify the radionuclides and configurations of some of the radiation sources. This represents a situation where a mobile detector is used to find radiation sources in a limited area. Another situation is where a stationary detector is used to scan passing goods, such as truckloads. It will be decided later if an exercise with passing goods could also be included in the scenario.

**“Dirty bomb” area.** This is an optional scenario. The thought is to build an area where a “dirty bomb” has exploded. Radionuclides (short lived) will be distributed according to the theory of particle distributions after an explosion and fire. It is a prerequisite for the scenario that the threat of additional explosions is absent and that injured people have been taken care of. This scenario will not be possible to create fully realistically, but it could be a step on the way to test measurement procedures under extreme situations. Each team will be allowed only a limited time in the area, because the dose rate in some areas could be quite high. As with all the scenarios, this scenario will also incorporate strict radiation protection procedures. To be effective in the area in the limited time, teams have to plan their procedures in advance. The exercise will give an opportunity to test these procedures in a close reality radiation situation.

**A radiological underground laboratory.** This is also an optional scenario. The scenario is an illegal radiological laboratory, with the suspicion that the intention is to create substances using radioactive material for use in malevolent acts towards people or society. The scenario starts with the police having suspicions that someone is planning malevolent acts using radioactive material and having found a place where preparations may have been undertaken. The police needs assistance from radiological expert teams in order to investigate the place. It is assumed that the place is safe to enter regarding conventional booby traps (not necessarily realistic in a real situation, but assumed here). It is not considered safe from the radiation point of view. The task for the exercise teams is to search the place, locate all radiation sources, document their location and activity and try to draw possible conclusions of the situation. In this scenario, as in the “dirty bomb” scenario it is necessary to plan the procedures for radiation protection, measurements and documentation in advance to be successful. The scenario will give an opportunity to test the planned procedures.

Additional scenarios that could be realized if there is enough interest in them:

- transportation accident with radioactive material,
- decontamination of a building and its close environment after fallout,
- handling injured and contaminated people after a radiological attack.

Planning and practical try outs of the scenarios will proceed in the months to come. SSM is commissioned to realise the RE-FOX exercise in September 2012. Funding for planning and conducting the exercise is in place and it will be the full responsibility of SSM to organize all practical set-ups for the scenarios and the infra structure for the whole exercise.

### **SUGGESTED ROLE OF NKS IN RE-FOX 2012**

SSM would like to propose that NKS takes an active part in the evaluation and follow up of the RE-FOX 2012 exercise. The responsibility for the exercise will be divided into two parts.

Part one is the SSM part. Planning and conducting the exercise will be the full responsibility of SSM. NKS is invited to take part in the general planning meetings so that NKS can start the planning and the preparation of the follow-up work. It is also open for NKS to suggest procedures to carry through the exercise with regards to methods to report measurement data, analyse results and gather experiences from the different exercise scenarios. For example, using common radiation data formats would ease the presentation of measured data. Here, NKS have made past contributions that could be of value.

Part two is the NKS-part. After the exercise, NKS is suggested to take the lead to evaluate the scientific parts of the exercise and conduct workshops and other relevant work that can improve radiation measurement methods in the future. Finally NKS could choose to organize the full documentation of the measurement results, much the same way as it was done for the Resume-95, Resume-99 and Barents Rescue 2001 exercises. The main part of this work is intended to be carried out in the year 2013.

### **SUMMARY AND CONCLUSION**

The Swedish Radiation Safety Authority is commissioned to conduct a Radiation Emergency – Field Operative Exercise (RE-FOX) in September 2012. SSM will invite Nordic authorities and organizations related to radiation safety, protection and measurement to take part in the exercise. The intention is to provide the opportunity to test end exercise radiation measurement procedures in close reality emergency scenarios. Air-borne gamma spectrometry, car-borne gamma spectrometry, measurements with portable equipment, sampling and mobile laboratory analysis are planned to be included. Scenarios will include fresh fallout (using dispersed short lived radionuclides), search of orphan sources, identification of hidden sources and maybe a “dirty bomb” scenario.

During the last 15 years NKS has played an important role when designing, conducting and evaluating field measurement exercises. SSM would, therefore, like to propose that NKS takes an active part in the evaluation and follow up of the RE-FOX exercise. This will include preparatory work before the exercise to plan for the evaluation of measured results from all Nordic teams. The main part of the NKS contribution will be after the exercise where NKS is suggested to take the lead to evaluate the scientific parts of the exercise and conduct workshops and document the results. The NKS part of the work should mainly take place in 2012 - 2013.

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