Proposal must be sent by e-mail
to justin.gwynn@nrpa.no
no later than
Friday, 15th of October 2010

Nordisk kernesikkerhedsforskning
Norrœnar kjarnöryggis rannsóknir
Pohjoismainen ydinturvallisuustutkimus
Nordisk kjernesikkerhetsforskning
Nordisk kärnsäkerhetsforskning
Nordic nuclear safety research

1. Summary information about the proposed activity

Name of the activity		Proposed acronym[1]
Using Bayesian Belief Network Modelling for Rapid Source Term Prediction after a Severe Accident		RASTEP
Start date	**End date**	**New / continued activity**
2011-01-01	2012-12-31	New activity
Proposed classification (E, W, M, R)		**Is the proposed activity aimed as a cross-over activity between the NKS-R and NKS-B programmes?**
E: Emergency preparedness		Yes

Short summary of the activity (max. 1800 characters)

The proposed activity aims at providing a basis for improving off-site emergency management by developing a computerized source term prediction tool. The name of the tool will be RASTEP (Rapid Source Term Prediction). RASTEP will use Bayesian belief networks (BBN) to model severe accident progression in a nuclear power plant. The output will be a set of possible source terms with associated probabilities. RASTEP consists of two fundamentally different parts, i.e., a BBN model used to model accident progression, predict plant states, and release paths, and a source term definition part used to characterise the source term (height, composition, amount, timing).
The BBN model is based on prior information from the plant PSA level 1 and model which is iteratively updated based on plant observables. Source term definition and severe accident progression uses information from deterministic severe accident analysis tools, e.g., MAAP. The tool shall interface with commonly used off-site dose calculation tools, e.g., LENA and/or ARGOS. The approach chosen aims at facilitating decision making in a situation with incomplete or partly contradictive information.
As input of plant information via automatic signal transfer is one option, the NKS project will include the issue of signal validation. Also, as the source term prediction part of the tool is crucial and separate from the BBN part, the possibility to integrate a deterministic source term prediction code will be explored.

List of participating organisations (including the co-ordinating one)

SSM (Swedish Radiation Safety Authority), Scandpower, OKG, FKA (Forsmarks Kraftgrupp), Ringhals AB, IFE Halden

Requested funding from the NKS in 2010. If continuation of activity is assumed beyond 2010, please estimate requested funding in later years.

In 2011: 400 (in 1000 DKK) Expected requested funding in later years (if applicable): 400

1: If this activity is a continuation of a previously funded NKS-B activity, please use the same acronym as before (a list of acronyms of ongoing activities can be found on the NKS-B web site)

Please note that the above information may be made public on the NKS web site **if** the proposal is accepted by the NKS Board

2. Relevance of proposed activity to NKS criteria

Summarise how the proposed activity will maintain and build up competence and informal Nordic networks

This is a cross-over activity between NKS-B and NKS-R, connecting some crucial aspects related to the use of probabilistic information for risk-based applications with the needs and challenges of emergency preparedness and prediction of off-site consequences from severe accidents. It will adddress a number of issues receiving considerable attention both nationally and internationally. Build-up of competence will be assured by forming a project group representing a number of different competences, by wide participation of end users in the

project, by holding project seminars, and by writing papers for international conferences and journals. The project includes participants from Sweden and Norway (SSM, Relcon Scandpower, Ringhals, Forsmark, OKG, and IFE Halden), and is performed with the active participation of all these organisations. In connection with the project seminars, wider participation will be encouraged, including relevant Finnish utilities and authorities. Specifically, RASTEP will be subject for a coming meeting between SSM and STUK.

Summarise the proposed activity's technical and scientific merits

The proposed activity aims at providing a basis for improving off-site emergency management by developing a computerized source term prediction tool using bayesian belief networks for modelling the plant during severe accident progression. In doing so, the activity addresses a number of issues that are currently under discussion, e.g., ways of making efficient use of the information from probabilistic safety assessments, ways of supporting decision making under uncertainty, and ways of providing timely and easily interpreted source term information to the emergency preparedness organisation.

Summarise what the proposed activity will deliver in the form of distinct and measureable goals

1. The activity will develop a documented analysis methodology, including the necessary QA procedures and procedures for validation and verification of developed BBN models.
2. In connection with this, it will result in the development of the RASTEP computer based tool and interface with required functionality, including required user and program interfaces.
3. As part of the activity work, basic RASTEP models will be developed for Swedish BWR:s and PWR:s.
4. Interfaces with some other tools will be developed, e.g. LENA or Argos.
5. Signal validation issues will be explored in connection with transfer of plant information.

Summarize who are the potential end users and how it has been ensured that the proposed activity is relevant for them

End users are in the areas of reactor safety and emergency preparedness. Involvement of potentila users will be assured through direct projct participation and participation in the project reference group, consisting of:

- Forsmarks Kraftgrupp AB / Staffan Hennigor
- OKG AB / Marcus Johansson
- Ringhals AB / Anders Henoch
- SSM (Swedish Radiation Safety Authority) / Wiktor Frid (and other)

In addition, project seminars will be held at the end of every project year.

Summarise the participation of 'young scientists' in the proposed work (Degree, masters, PhD, post doctoral level)

Two to three young experts on masters or PhD level will be involved for parts of the work.

Interfaces to other relevant projects (past or present NKS activities, national research programs, EU programs, etc.)

The work will be partly based on a pilot project performed in 2001-2005 within the EU project STERPS (part of the EU FP 5 and 6). The activity will include experience exchange with some other European organisations exploring the possibility of using BBN based source term prediction, e.g., GRS in Germany and NRG-Arnhem in the Netherlands. The signal validation part of the project has connections with the CAMS project (OECD Halden Reactor Project), which was initiated in NKS-SIK-2.7, and continued in NKS-RAK-2. As the IAEA has expressed interest in the project, discussions on arranging a seminar hosed by the IAEA have been initiated.

3. Co-ordination of activity

Institution or company	
Scandpower AB	
Activity co-ordinator	
Michael Knochenhauer	
Postal address	
Box 1288, SE-17225 Sundbyberg	
E-mail	
mkn@scandpower.com	
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4. Other organisations involved

Institution or company	Contact person	E-mail

SSM (Swedish Radiation Safety Authority)	Wiktor Frid	Wiktor.Frid@ssm.se
Institution or company	Contact person	E-mail
OKG	Marcus Johansson	Marcus.Johansson@okg.eon.se
Institution or company	Contact person	E-mail
Ringhals AB	Anders Henoch	Anders.Henoch@vattenfall.com
Institution or company	Contact person	E-mail
FKA (Forsmarks Kraftgrupp)	Staffan Hennigor	sig@forsmark.vattenfall.se
Institution or company	Contact person	E-mail
IFE Halden	Davide Roverso	Davide.Roverso@hrp.no
Institution or company	Contact person	E-mail

5. Assumed distribution of NKS funding amongst participants (in 1000 DKK)[1]

	2011	2012 - 2012
Scandpower	240	240
IFE Halden	160	160
Total	400 k DKK	400 k DKK

6. Assumed distribution of own contributions amongst participants (in 1000 DKK)[1]

	2011	2012 - 2012
SSM	500	500
OKG	80	80
FKA	80	80
Ringhals AB	80	80
Scandpower	80	80
Total	820 k DKK	820 k DKK

7. Milestones, deliverables

	Date

[1] Use decimal point (.) as a separator for decimals in all tables

Detailed project plan	2011-01-31
Reference group meeting	2011-04-30
Project seminar	2011-10-30
Final report	2012-12-31

8. Submission of proposal

This form must be sent by e-mail no later than the 15th of October 2010 from the official e-mail address of the activity co-ordinator (as given on this form) to justin.gwynn@nrpa.no .

Please use the *acronym* as a file name and add the number "1"

Is supplementary description (maximum 4 pages) included?
Yes (please click on drop-down form field at left to select "Yes" if needed)
Name of file: RASTEP2 (please use the acronym and add the number "2")

The date of sending will be regarded as the date of submission.

Please note that a confirmation of the reception of the proposal will be sent by the Programme Manager