NKS-R STATUS REPORT

Kaisu Leino
NKS-R Programme Manager
May 2013

Table of Contents

1 Status summary 3
1.1 Seminars 3
1.2 Young scientist travel support 3
1.3 Published reports 3
2 Activities initiated in 2012 3
3 Activities initiated in 2013 4
3.1 Decom-sem 4
3.2 DECOSE 5
3.3 DIGREL 5
3.4 DPSA 6
3.5 ENPOOL 6
3.6 Exam HRA 7
3.7 HUMAX 7
3.8 L3PSA 8
3.9 POOLFIRE 8
3.10 SADE 9
4 Overview of all NKS-R activities 2009-2012 10
Attachments 12
A1. Status report Decom-sem 12
A2. Status report DECOSE 13
A3. Status report DIGREL 15
A4. Status report DPSA 16
A5. Status report ENPOOL 18
A6. Status report Exam HRA 20
A7. Status report HUMAX 21
A8. Status report L3PSA 22
A10. Status report SADE 24

1 Status summary

This report gives a short overview and summary of the current status of the NKS-R program. Overall the work in NKS-R is progressing well. Since the last NKS Board meeting, 5 final reports from the NKS-R activities have been completed and published on the NKS website. Submit of some final reports from activities started in 2012 have been delayed, new schedules have been agreed. Contract have been agreed and signed with all activities started in 2012. All activities initiated earlier than 2012 have been finished.

1.1 Seminars

Two NKS-R seminars will be held this year: Decommissioning seminar 2013 and a seminar concerning DIGREL activity. The decommissioning seminar will be held 6-7th November 2013 in Halden. The DIGREL seminar will be held in the autumn, probably in October or November.

1.2 Young scientist travel support

No claims have been received this year. PC tries to find new channels to promote NKS to the young scientist. Young scientist travel support have been advertised on the NKS Facebook group.

1.3 Published reports

The following reports have been published on the NKS reports since the last board meeting in January. The latest published NKS-R reports consist only of the activities' final reports. Some of the activities prepare join reports with all the participants, when some activities prefer to write individual final reports. Lappeenranta University of technology (LUT) has divided their final report to two parts (NKS-280 and NKS-281). This is result of the other funding programs reporting requirements.

NKS-277	March 2013	Guidelines for reliability analysis of digital systems in PSA context — Phase 3 Status Report	DIGREL
NKS-278	April 2013	Safety culture in design	SADE
NKS-279	April 2013	Final report of MoReMO 2011-2012. Modelling Resilience for Maintenance and Outage	MoReMo
NKS-280	May 2013	PIV MEASUREMENTS AT THE BLOWDOWN PIPE OUTLET	ENPOOL-LUT
NKS-281	May 2013	PPOOLEX EXPERIMENTS ON THE DYNAMICS OF FREE WATER SURFACE IN THE BLOWDOWN PIPE	ENPOOL-LUT

2 Activities initiated in 2012

Nine activities were initiated in 2012. All the activities were initiated according the normal schedule in January, even the RASTEP activity, which followed individual schedule in 2011. Seven of the initiated activities are continuing activities and two are new.

Only two final reports are missing in 2012 activities. Final report of the DECOSE activity is expected to be delivered soon. The final report of the cross-over RASTEP activity is promised to be delivered in August 2013. Table 1 gives an overview of the status of 2012 NKS-R activities.

Table 1. NKS-R 2011 activities

Activity	Description	First invoice	Report	Second invoice	Report number
AIAS	Ad-/absorption and desorption/revaporisation behaviour of iodine aerosols on containment surface materials	x	x		
DECOSE	Debris coolability and steam explosion	x			
DIGREL	Guidelines for reliability analysis of digital systems in PSA context	x	x	x	NKS-277
ENPOOL	Experimental and numerical studies on suppression pool issues	x	x		NKS-280 NKS-281
MoReMO	Modelling resilience for maintenance and outage	x	x		NKS-279
Nordic-Gen4	Nordic nuclear forum for generation IV reactors	x	x	x	NKS-270
POOLFIRE	Predictive analysis of pool fires in enclosures by means of CFD models for risk assessment of nuclear power plants	x	x		
SADE	Safety culture in design and implementation of technological and organisational solution - improving resilience of the sociotechnical system through the life-cycle	x	x		NKS-278
RASTEP (cross-over activity R/B)	Using bayesian belief network modelling for rapid source term prediction after a severe accident	x	August 2013		

3 Activities initiated in 2013

Ten activities were started in 2013. Five are continuing activities and five are new. Contracts have been signed and agreed with all of these. In this chapter short description is given of all the activities. For more detailed status reports see attachments.

3.1 Decom-sem

Decom-sem:
Decommissioning seminar 2013
Activity leader: Niels Kristian Mark, Institutt for energiteknikk (IFE)

NKS-R funding: 200 kDKK

Milestones:
1. Project start (January 2013)
2. Meeting of the organizing committee (January 2013)
3. Call for abstracts (February 2013)
4. Invitations to the seminar distributed (February 2013)
5. Meeting of the organizing committee (May 2013)
6. Seminar (November 2013)

Status
The date and place for the seminar has been settled, and the seminar will be held 6-7th November in Halden. The location for the seminar, lunch and dinner have been decided and reserved. Program

committee has started to work with seminar program, invitations, dead-lines, which should be completed in May.

3.2 DECOSE

DECOSE
Debris coolability and steam explosion
Activity leader: Pavel Kudinov, Kungliga Tekniska Högskolan

NKS-R funding: 500 kDKK

Tasks:
Task 1. Investigation of the effect of geometry on coolability in 2D debris bed
Task 2. Investigation of the effect of debris agglomeration on coolability
Task 3. Investigation of the effect of initial pool subcooling on coolability
Task 4. Investigation of particulate debris spreading
Task 5. Investigation of the effect of the heaters' geometry on the DHF
Task 6. Development of advanced instrumentation
Task 7. Joint analytical activity on debris bed coolability
Task 8. Analysis of steam explosion in a Nordic BWR containment

Milestones:
1. Report on experimental and analytical work performed by VTT on COOLOCE experiments
2. Report on experimental work performed by KTH
3. Report on the DECOSIM code development and validation
4. Report on analysis of steam explosion in Nordic type BWRs by KTH and VTT

Status
The work is being done at KTH and VTT. The work have been started in both organisations as planned. All the tasks have been started and are progressing well. For more detailed status see attachement.

3.3 DIGREL

DIGREL
Guidelines for reliability analysis of digital systems in PSA context
Activity leader: Jan-Erik Holmberg, VTT Technical Research Centre of Finland

NKS-R funding: 300 kDKK

Milestones:
1. Kick-off meeting on software modelling and quantification
2. WGRISK task group meeting and WGRISK annual meeting in Paris
3. Final draft of the WGRISK guidelines
4. Final WGRISK guidelines
5. NKS (Nordic) seminar on software modelling and quantification
6. NKS report on software modelling and quantification

7. Final draft of the NKS report and seminar (covering all activities 2010 - 14)
8. NKS final report on guidelines of reliability analysis of digital I&C systems in PRA

Status
Activity is running on schedule. Taxonomy report have been updated. Two paper was written to PSA Castle meeting 2013, which was held in April. Generic digital I&C system example model have been updated slightly. Overall progress is 25 %.

3.4 DPSA

DPSA
Deterministic-Probabilistic Safety Analysis Methodology
Activity leader: Pavel Kudinov, Kungliga Tekniska Högskolan

NKS-R funding: 400 kDKK

Milestones:
1. Results of feasibility study on connection between conventional PSA, DSA and DPSA methods
2. Mapping, information collection and identification of areas of certain interest based on existing PSA
3. State of the art review of the probabilistic, deterministic and combined DPSA analysis
4. Results of analysis of core relocation scenarios taking into account timing of PSA Level 1 events and possible recovery actions on the melt conditions in the lower head

Status
DPSA work is being done at KTH, VTT and Scandpower. The work is progressing on schedule. All organizations have started working with all the milestones. See attachment for more detailed information.

3.5 ENPOOL

ENPOOL
Experimental and numerical studies on suppression pool issues
Activity leader: Timo Pättikangas, VTT Technical Research Centre of Finland

NKS-R funding: 600 kDKK

Deliverables of VTT:
1. CFD simulation of chugging in a PPOOLEX experiment with detailed temperature measurements
2. Fluid-Structure Interaction calculation of a PPOOLEX experiment
3. FEM calculation on the statistics of the structural response of a BWR containment
4. Report on the CFD and FEM calculations.

Deliverables of KTH:
1. Further development of the Effective Heat Source and Effective Momentum Source models.
2. Validation of the models against latest available PPOOLEX data.
3. Pre- and post- test simulations of the new series PPOOLEX tests.
4. Report on the model development and validation.

Deliverables of LUT:
1. Execution of the experiment series on mixing
2. Reporting of the mixing experiments
3. Execution of the experiment series on DCC
4. Reporting of the DCC experiments
5. Delivery of relevant experiment data to the simulation partners.

Status
VTT: CFD simulations of chugging in a PPOOLEX experiments has been performed (1), fluid-structure interaction calculation of a PPOOLEX has been started (2). Deliverables 3 and 4 are to be started later.
KTH: The development of the analytical model for prediction of amplitude and frequency of water level oscillation inside the blowdown pipe during chugging is ongoing (1), validation of the models is started (2), preparations for pre-test calculations are ongoing (3). Report will be written later (4).
LUT: Facility preparations for the tests are under way (1), the PIV measurement system is being tested with laser-induced particles and special filters (3). Deliverables 2, 4, and 5 have not been started.

3.6 Exam HRA

Exam HRA
Evaluation of existing applications and guidance on methods for human reliability analysis
Activity leader: Gunnar Johansson

NKS-R funding: 200 kDKK

Milestones:
1. Project seminar 1
2. Presentation of guidance document with requirements on HRA scope
(3. Project seminar 2)
(4. Presentation of guidance document with requirements on HRA methods)
(5. Summary report supported by separate task reports as appendences)

Status
The work is planned to for 20 months, however, the NKS funding is allocated for a year. Milestones 3-5 planned to be performance in 2014. The first project seminar will focus on status reporting and the development regarding guidance on scope of HRA applications. The seminar will be arranged in autumn 2013. The work progress so far: 2 work group seminar have been carried out.

3.7 HUMAX

HUMAX
Maximizing human performance in maintenance
Activity leader: Maren H. Rø Eitrheim, Institutt for energiteknikk (IFE)

NKS-R funding: 500 kDKK

Milestones:

1. Literature review
2. Case studies at Nordic NPP's
3. Survey to plants outside of the Nordic countries
4. Data analysis
5. Dissemination seminars
6. Final report

Status
The project is progressing according to plan. The literature review have been performed and discussed, and work on the three cases studies has been initiated. The project comprises three case studies. Interviews are planned to initiate before the summer vacation in Ringhals and Loviisa. Data gathering in TVO is planned to take place after the summer vacation.

3.8 L3PSA

L3PSA
Addressing off-site consequence criteria using level 3 PSA
Activity leader: Anders Olsson, Scandpower AB

NKS-R funding: 390 kDKK

Milestones:
1. Industry and Literature Survey
2. Appropriate Risk Metrics
3. Regulation, guides and standards
4. Pilot Application including tools for dispersion and consequence analysis
5. Development of a Guidance document

Status:
Two project meeting have been held. Project plan has been written. Scandpower leads the project but different organizations will take lead in different milestones. ES-konsult will take care of industry and literature survey, Risk Pilot leads appropriate risk metrics study, Scandpower leads regulation, guides and standards task and VTT takes care of pilot application.

3.9 POOLFIRE

POOLFIRE
Predictive analysis of pool fires in enclosures by means of CDF models for risk assessment of NPPs
Activity leader: Patrick Van Hees, Lund University

NKS-R funding: 360 kDKK

Milestones:
1. Implementation in case study
2. Workshop
3. Final report

Status

Number of fire test have been performed by Lund university. Modelling of the test campaign performed in 2012 is being done in Lund at the moment. The project is running as planned.

3.10 SADE

SADE
Safety culture in design - improving resilience throughout the life-cycle of nuclear power plant
Activity leader: Luigi Macchi, VTT Technical Research Centre of Finland

NKS-R funding: 500 kDKK

Milestones:
1. Selection of design case studies
2. Review and analysis of case studies
3. Workshop with experts

Status
Power companies have been contacted in Sweden and Finland. At the moment only one Finnish power company has authorised the case study. Three individual interviews and one group interview has been conducted. The transcription of the interviews and their translation into English is in progress. Regular meetings have been held within the project team. Delay in conducting the case studies due to difficulties in gain access and authorisation by the power companies.

4 Overview of all NKS-R activities 2009-2012

Last NKS board meeting in January PCs were asked to report the status of old NKS activities. At the coordination group meeting in April it was decided that PCs make a list of all activities started in 2009-2012. It is seen from the table below that only two NKS-R activities are unfinished. Activity is considered to be started after the January board meeting, and ended when the final report have been delivered.

Activity	NKS number	Started	Ended
HRA-Guidance	NKS_R_2009_73	01/2009	12/2010
IACIP	NKS_R_2008_61	01/2009	12/2009
INCOSE	NKS_R_2009_75	01/2009	04/2010
MOSACA	NKS_R_2008_69	01/2009	02/2010
NOMAGE4	NKS_R_2008_63	01/2009	03/2010
NROI	NKS_R_2008_70	01/2009	05/2010
POOL	NKS_R_2007_58	01/2009	09/2010
POOL(KTH)	NKS_R_2007_58	01/2009	10/2010
POOL(NUM)	NKS_R_2007_58	01/2009	12/2010
Safety Goal	NKS_R_2005_44	01/2009	12/2010
WASCO	NKS_R_2005_43	01/2009	12/2009
Decom-sem	NKS_R_2010_83	01/2010	12/2010
DIGREL	NKS_R_2010_86	01/2010	12/2010
IACIP	NKS_R_2008_61	01/2010	12/2010
INCOSE	NKS_R_2009_75	01/2010	05/2011
MOSACA10	NKS_R_2008_69	01/2010	01/2011
NROI	NKS_R_2008_70	01/2010	04/2011
POOL VTT	NKS_R_2007_58	01/2010	05/2011
POOL KTH	NKS_R_2007_58	01/2010	06/2011
POOL LUT	NKS_R_2007_58	01/2010	03/2011
AIAS	NKS_R_2011_98	01/2011	12/2012
DIGREL	NKS_R_2010_86	01/2011	01/2012
ENPOOL	NKS_R_2011_90	01/2011	03/2012
ENPOOL	NKS_R_2011_90	01/2011	05/2012
ENPOOL	NKS_R_2011_90	01/2011	05/2012
MoReMO	NKS_R_2011_95	01/2011	02/2012
NOMAGE4	NKS_R_2008_63	01/2011	11/2011
POOLFIRE	NKS_R_2011_96	01/2011	02/2012
SADE	NKS_R_2011_97	01/2011	03/2012
RASTEP	NKS_R_2010_87	06/2011	09/2012
AIAS	NKS_R_2011_98	01/2012	05/2013
DECOSE	NKS_R_2012_100	01/2012	unfinished
DIGREL	NKS_R_2010_86	01/2012	02/2013
ENPOOL VTT	NKS_R_2011_90	01/2012	04/2013
ENPOOL LUT	NKS_R_2011_90	01/2012	03/2013

ENPOOL KTH	NKS_R_2011_90	01/2012	05/2013
MoReMO	NKS_R_2011_95	01/2012	03/2013
Nordic-Gen4	NKS_R_2012_103	01/2012	11/2012
POOLFIRE	NKS_R_2011_96	01/2012	02/2013
RASTEP	NKS_R_2010_87	01/2012	unfinished
SADE	NKS_R_2011_97	01/2012	03/2013

Attachments

A1. Status report Decom-sem

Institute for Energy Technology

Note

To: Kaisu Leino
Programme Manager NKS-R

From: Niels-Kristian Mark (Institutt for energiteknikk, Halden),
Project manager for Decom-sem, Decommissioning seminar 2013, NKS_R_2013_106

Copy:

Date: 2013-05-06

Status report for
Decom-sem, Decommissioning seminar 2013, NKS_R_2013_106

This is the status of the preparations for the Decom-sem:

1) The contract between IFE and NKS was signed 11th February 2013.
2) IFE invoiced 7th February NKS for the first 50% of the total budget. That is DKK 100.000,-.
3) The committee responsible for arranging the seminar consists of:
   - Niels-Kristian Mark (project manager), IFE.
   - Anders Appelgren, ndcon (Studsvik):
   - Anne Sørensen, Dansk Dekommissionering.
   - Eurajoki Tapani, Fortum.
   - Naeem Syed, NRPA.
4) The date and place for the seminar has been settled: Wednesday-Thursday 6-7th November in Halden.
5) IFE has made an overall programme for the seminar meaning that the following has been decided: The location for the seminar, lunch and dinner. The locations have been reserved and a number of rooms booked in advance at the hotel.
6) IFE, DD, Fortum and NRPA will now start working the programme, invitation, dead-lines etc. and start announcing the seminar. This should be completed in May.

IFE, P.O. Box 173, NO-1751 Halden, Norway Page 1 of 1

A2. Status report DECOSE

VTT progress in 2013 on the Deliverables:

1. COOLOCE experiments with cone on a cylindrical base (Task 1.c).

Modification of the conical test bed for the cone on a cylindrical base configuration with half of the radius of the conical bed has been started.
Pre-test simulations of the case to estimate the required heating power has been started.

2. COOLOCE experiment in cylindrical geometry with open side wall and a cake simulant (Task 2).

The experiment with the cylindrical debris bed with open sidewall and a cake simulant at 1-7 bar pressure have been done.

3. Continuation of feasibility studies for advanced instrumentation (Task 6).

Feasibility study is ongoing.

4. Code–to–code comparison and development of recommendations and best practice guidelines for analysis of debris bed coolability and validation against produced experimental data (Task 7).

The modelling work has not yet been started, except for the pre-test simulations.

5. Application of MC3D and TEXAS-V to analysis of steam explosion in a BWR containment (Task 8).

Training and learning with MC3D code is on-going. SERENA2 BWR reactor exercise with MC3D version 3.5 has been started while waiting to receive the 3.7 version during this year.
After this the work will be concentrated on comparison of the BWR calculations with the previous and the newer version.

6. Reporting of the COOLOCE experiments.

Reporting on the tests with cylindrical bed has been started.

7. Delivery of relevant experimental data to the simulation partners.

Not started yet.

KTH progress in 2013 on the Deliverables:

1. Evaluation of the effect of heater geometry and cake simulants on the DHF. Comparison of data from POMECO-HT and COOLOCE. POMECO-FL tests for effective particle diameter (Task 5, 2).

The dryout heat flux experiment with Zirconium Silicate beads is performed to study the uncertainty associated with the heaters geometry. In this way, the tests with two types of particles received from VTT are carried out.

2. DECOSIM code development. Code–to–code comparison and development of recommendations and best practice guidelines for analysis of debris bed coolability and validation against the experimental results produced in Tasks 5, 1.c, 2 and 3.

Validation of the DECOSIM code has been continued against existing COOLOCE data. The dryout powers for cylindrical (with impermeable walls) and conical debris beds were calculated and shown to be in reasonably good agreement with the experimental data. Simulations of cylindrical debris bed with permeable walls are under way. Validation to be continued as new data will become available from COOLOCE, POMECO-HT and POMECO-FL facilities.

3. Investigation of particulate debris spreading (Task 4.a).

Exploratory tests in PDS-C facility (which stands for particulate debris spreading – closures) have been carried out with stainless steel particles and zirconia-silica beads. A mock-up of the COOLOCE heaters and thermocouples has been manufactured. The tests with COOLOCE mock-up and zirconia-silica beads are ongoing to clarify the significance of the influence of heaters and TCs on particulate debris spreading rate. A model for particulate debris spreading using experimentally obtained closures for the particles flux Qp as a function of the gas flow rate through the bed Qg and local slope angle of the bed θ has been developed. Both, the explicit and implicit methods of solving of the model are available now.

4. DEFOR-A confirmatory series of tests with melt simulant material (Task 2).
Several DEFOR-A tests with melt simulant materials have been performed. Melt release through a plate with lower melting temperature material immersed under water was investigated in order to assess ablation of the hole. Experimental results obtained with lead plate suggest that no radial ablation of the nozzle is not observed, even if the plate itself is ablated in vertical direction by the melt. Further investigation will be carried out with different plate materials.

5. Application of MC3D and TEXAS-V to analysis of steam explosion in a BWR containment (Task 8).
Initially, the steam explosion calculations in the flooded drywell of Nordic BWR were carried out to check the loads on the side walls. The conditions were considered according to the SERENA II BWR reactor case exercise.
The calculations to study the loads due to steam explosion on containment walls in Swedish BWR (modified geometry) are under progress. The present study also involves the extensive sensitivity analysis to see the effect of different parameters on the loadings.

6. Reporting of the POMECO-FL, POMECO-HT and PDS experiments and code development results.
Reporting has been started.

7. Delivery of relevant experimental data to the simulation partners.
Not started yet.

A3. Status report DIGREL

Task	Status
WGRISK activity (task group) focusing on the development of best practice guidelines on failure modes taxonomy for reliability assessment of digital I&C systems for PSA	Task Group meeting in Paris March 18-19 Status reported to OECD/NEA WGRISK Paris March 20-22, 2013 Taxonomy report updated One paper written to PSA Castle meeting 2013 (April 10–12 2013) Abstract submitted to ANS PSA 2013 conference (accepted) 30%
Development of the generic digital I&C system example and associated demonstration PSA-model	Model slightly updated One paper written to PSA Castle meeting 2013 (April 10–12 2013) 15%
Finnish-Swedish-German collaboration specifically on software modelling and quantification	Kick-off meeting in Stockholm January 8, 2013 Working report outlined Outline of the method developed 25%
Nordic end user workshop (Fall 2013)	0%
Interim report (public NKS report) (tentatively the work will be reported in 2013 by two reports - overall DIGREL report - software reliability report	0%

A4. Status report DPSA

STATUS REPORT OF NKS-DPSA
May 08, 2013

Work at Royal Institute of Technology (KTH)

Pavel Kudinov, Viet-Anh Phung, Kaspar Kööp, Sebastian Raub, Sergey Galushin, Yuri Vorobyev.

Deliverable 1: Results of feasibility study on connection between conventional PSA, DSA and DPSA methods
Approaches to identification of failure domain using DPSA tools and post processing of DPSA analysis data for characterization of failure domain is ongoing.
Task completion: 25 %

Deliverable 2: Mapping, information collection and identification of areas of certain interest based on existing PSA
Mapping of PSA-L1 scenarios into groups of early/late vessel failure at high/low pressure is ongoing. Identification of scenarios sensitive to timing of events in analysis of Nordic type BWR severe accidents for (i) in-vessel stage, (ii) vessel failure modes, and (iii) ex-vessel accident progression analysis is ongoing.
Task completion: 40 %

Deliverable 3: State of the art review of the probabilistic, deterministic and combined DPSA analysis
Review of the state of the art DPSA approaches is ongoing.
Task completion: 50 %

Deliverable 4: Results of analysis of core relocation scenarios taking into account timing of PSA Level 1 events and possible recovery actions on the melt conditions in the lower head
Analysis of core relocation process taking into account the influence of timing in vessel depressurization is ongoing with MELCOR code. Coupling of MELCOR with Genetic Algorithm GA-DPSA tool is ongoing.
Task completion: 30 %

Work at VTT

Jan-Erick Holmberg, Silvonen Taneli.

Deliverable 1: Results of feasibility study on connection between conventional PSA, DSA and DPSA methods
Feasibility of different approaches to data exchange between PSA and DPSA tools is under investigation.
Task completion: 15 %

Deliverable 2: Mapping, information collection and identification of areas of certain interest based on existing PSA
Materials for summary of current PSA-2 modeling approaches have been collected. Compilation of data relevant to Nordic type BWR design for (i) in-vessel stage, (ii) vessel failure modes, and (iii) ex-vessel accident progression analysis is ongoing.

Task completion: 50 %

Deliverable 3: State of the art review of the probabilistic, deterministic and combined DPSA analysis
Review of the state of the art PSA approaches and the needs for coupling with DPSA tools is ongoing.
Task completion: 15 %

Deliverable 4: Results of analysis of core relocation scenarios taking into account timing of PSA Level 1 events and possible recovery actions on the melt conditions in the lower head
Reference scenarios to be addressed with MELCOR and SPSA are under selection and consideration.
Task completion: 15 %

Work at Scandpower

Yvonne Adolfsson,

Deliverable 1: Results of feasibility study on connection between conventional PSA, DSA and DPSA methods
Feasibility of different approaches to data exchange between DSA and DPSA tools is under investigation.
Task completion: 15 %

Deliverable 2: Mapping, information collection and identification of areas of certain interest based on existing PSA
Work on summary of current PSA-2 modeling approaches for a reference Nordic type BWR design for (i) in-vessel stage, (ii) vessel failure modes, and (iii) ex-vessel accident progression analysis is ongoing.
Task completion: 20 %

Deliverable 3: State of the art review of the probabilistic, deterministic and combined DPSA analysis
Review of the state of the art DSA approaches and the needs for coupling with DPSA tools is ongoing.
Task completion: 20 %

Deliverable 4: Results of analysis of core relocation scenarios taking into account timing of PSA Level 1 events and possible recovery actions on the melt conditions in the lower head
Possibility of using MAAP code for analysis of core relocation scenarios is under investigation. A meeting with utilities to get a permission for using MAAP results is to be arranged.
Task completion: 5 %

A5. Status report ENPOOL

STATUS of ENPOOL-NKS ACTIVITIES, 5 April 2013

Work at Lappeenranta University of Technology (LUT), Markku Puustinen

Deliverable 1: Execution of an experiment series on mixing
Facility preparations for the tests are under way. The test series will be started when a detailed test plan has been agreed with KTH.

Deliverable 2: Reporting of the mixing experiments
No progress.

Deliverable 3: Execution of the experiment series on DCC
The PIV measurement system is being tested with laser-induced fluorescence (LIF) particles and special filters. The selection and procurement process of three high speed cameras is under way.

Deliverable 4: Reporting of the DCC experiments
No progress.

Deliverable 5: Delivery of relevant experiment data to the simulation partners.
No progress.

Work at VTT, Timo Pättikangas, Jarto Niemi, Antti Timperi and Michael Chauhan, VTT

Deliverable 1: CFD simulation of chugging in a PPOOLEX experiment with detailed temperature measurements
The direct-contact condensation model for chugging has been modified. Test simulation has been performed.

Deliverable 2: Fluid-Structure Interaction calculation of a PPOOLEX experiment
Modelling of the PPOOLEX experiment with the acoustic-structural FEM model has been just started. Different values for the pool damping have been tested and the pool dynamic behaviour has been briefly compared with the experiment.

Deliverable 3: FEM calculation on the statistics of the structural response of BWR containment
The subtask is to be started in July, when the responsible person returns from his vacation.

Deliverable 4: Report on the CFD and FEM calculations
To be written in December.

Work at Royal Institute of Technology (KTH), Hua Li, Walter Villanueva and Pavel Kudinov

Deliverable 1: Further development of the Effective Heat Source and Effective Momentum Source models.
The development of the analytical model for prediction of amplitude and frequency of water level oscillation inside the blowdown pipe during chugging is ongoing.

Deliverable 2: Validation of the models against latest available PPOOLEX data
Lumped modeling validation against 3 of the tests, MIX-01, MIX-02, and MIX-06 has been done as well as the validation with 2D wetwell against MIX-01. Validation against the rest of the tests are ongoing.

Deliverable 3: Pre- and Post-test simulations of the new series PPOOLEX tests
Preparations for pre-test calculations are ongoing.

Deliverable 4: Report on the model development and validation
No progress.

A6. Status report Exam HRA

Project Objective

The overall project objective is to provide guidance for a ”state of the art” Human Reliability Analysis for purposes of PSA to ensure that plant specific properties are properly taken into consideration in the analysis. This will also provide means to improve plant features based on HRA and PSA results.

Project funding

This project is partly funded by NKS and partly by Swedish, Finnish and Swiss utilities and the Swedish regulator SSM.

Time schedule/milestones

The ongoing phase of work was initiated in Oct 2012 and work is planned for 20 month.

Project tasks and reporting in the pipeline

This phase (3) of the project shall maintain and extend the assessments of existing HRA application and continue the analysis to provide interpretation of important plant features and identify good operational practices. The following case or task reports have been defined:

1. Reassessment of Manual Restoration of Residual Heat Removal System during full power operation.
2. Update of case report on Manual Depressurization of containment
3. Case report on Heavy load drop.
4. Case report on HRA methods or treatment of actions without procedures.
5. HRA method for Hazards.
6. Case report on Category B HRA – Initiator HRA.
7. HRA application guide.
8. Updated Aspect report (updated version of the Phase 2 summary report taking into account new aspects from phase 3.)
9. Update of the evaluation guide.

The following candidate case reports have been discussed and defined, but we have not yet decided if we shall initiate them.

10. Candidate case report on Makeup water to reactor vessel during outage (C12), also spent fuel pool as applicable, we needs more discussion with VRD/Ringhals
11. Candidate case report on Circulation Pump maintenance (C13), ready to start case study on this.
12. Candidate case on RCPB, still unclear if possible or interesting to do. Can the RCPB case be better defined or different? Check if we shall do depressurization case instead!

Progress reporting is made in the form of working group minutes, 2 WG meetings have been carried out so far, Forsmark, Nov 2012 and Mühleberg Feb 2013. In addition has a number of phone conferences, with minutes, been carried out. The minutes cover, work achieved, work in progress, work scheduled, critical items and action plans and are summarized here as work in the pipeline.

Deliverables

The results will be documented in a summary report supported by separate case and task reports as listed above. Two project seminars will be arranged for dissemination of results and project evaluation. The first seminar, fall 2013, will focus on status reporting and the development regarding guidance on scope of HRA applications, including the decision if to continue with Phase 3b. The second seminar, fall 2014, will focus on the guidance on methods and the choice of methods for HRA applications.

A7. Status report HUMAX

Project: Maximizing Human Performance in Maintenance (HUMAX)

Project Group: Pia Oedewald (VTT), Luigi Macchi (VTT), Nadezhda Gotcheva (VTT), Elina Pietikäinen (VTT), Christer Axelsson (RAB), and Ann Britt Skjerve (IFE, co-ordinator).

Milestones:

No.	Activities	Duration (planned)	Status
1	Literature review	January-Mach 2013	Complete draft
2	Case studies	March-October 2013	Initiated
3	Survey	August-October 2013	
4	Data analysis	August-November 2013	
5	Dissemination seminars	November 2013	
6	Final report	January 2014	

Overall status:

Overall, the project progresses according to plan, as far as I can judge. The literature review have been performed and discussed, and work on the three cases studies has been initiated (see further below).

The project work was formally initiated with a video-based kick-off meeting on February 27, 2013. During the meeting, common ground was established and an activity plan for the spring of 2013 was generated. On April 15, a joint work session was organized at Ringhals. The main purpose of the session was to obtain a shared understanding of the theoretical basis for the study and to coordinate the activities on three cases studies.

Status on the activities:

Ad 1) Literature review
A literature review has been carried out and documented in *complete draft* format. The scope of the review was to provide project members with a summarised presentation of the main assumptions and characteristics of the human performance programme movement.

Ad 2) Case studies
The project comprises three case studies. Data will be collected from interviews, observations, and possibly questionnaire surveys.

- **The Ringhals case:** Two draft interview guides have been completed. The plan is to initiate data collection (interviews) before the summer vacation. In all, we plan to interview 15-10 persons.
- **The TVO case:** A meeting has been scheduled with TVO on 20th May to plan the execution of the case study in more detail. The actual data gathering is planned to take place after the summer vacation.
- **The Loviisa case:** Meetings with the plant have been organised to specify the scope of a case study and select interviewees. According to the discussions the data collection will be started in May and nearly 30 persons will be interviewed during spring and summer.

A8. Status report L3PSA

Project funding
This project is partly funded by NKS and partly by Nordic and Finnish utilities and the Swedish regulator SSM. The work is being performed by Scandpower in cooperation with ES-konsult (Sweden), Risk Pilot (Sweden) and VTT (Finland). The Finnish participation funded also by the SAFIR program.

As of today work orders has been received from NKS, RAB and OKG and we have been told that work orders are in the process of being sent from SSM and FKA.

So - much of the funding is in place, but not all.

Project setup:
Since we are several organizations that are working in the project a project set-up meeting was held March 8 where we discussed which organization that will take lead in the different tasks. The decision was then made to split the lead for the different tasks according the following table:

Task	**Leading org.**
Task 0 – Industry Survey and Involvement	ES-konsult
Task 1 – Appropriate Risk Metrics	Risk Pilot
Task 2 – Regulation, guides and standards	Scandpower
Task 4 – Pilot application and tools	VTT
Task 3 – Guidance document	*Future task*
Project management	Scandpower

During this setup meeting it was also decided that a draft Project Plan and a draft Questionnaire should be developed that can be communicated with the funding members (project stakeholders). It was also decided that we shall arrange a separate meeting with the funding members where they are tasked to give their input on the project plan for the different tasks. How that work has progressed is described below.

Project Plan & Task 0 Questionnaire
Since the meeting 8 March each organization has made a first attempt to describe how the work will be performed within each task. Today, 3 April, a second project meeting between Scandpower, ES-konsult, Risk Pilot and VTT did take place where we discussed the project plan and set up a deadline for the development of this. The time schedule that we have agreed upon is as follows:

Week 15 – All organizations should have their tasks described in draft format
Week 16 – All organizations are given the opportunity to comment on the other tasks
Week 17 – A first draft version of the project plan to be completed
Week 18 – The first draft of the project plan to be distributed to the funding members (the "stakeholders")

When this first stakeholder meeting, or reference group meeting (see below), has taken place the project plan will be updated and finalized as much as possible. We anticipate that the project plan will be a somewhat living document meaning that the content of each project task may change some during the progress but the final objective should still be kept.

Involvement of "stakeholders/reference group"

Already from the beginning of the project it has been clear that several of the funding members wants to be actively involved in the project and it is therefore necessary to invite them as early as possible to give their input/position on what the project should focus on from an industry perspective.

A WebEx meeting will therefore be performed with Swedish and Finnish stakeholders where the draft project plan will be presented and the stakeholders will be asked to give their comments to the plan. Also during this meeting a draft of a questionnaire that will be used for Task 0 – Industry Survey – will be presented and again, the stakeholders will be asked to provide their comments and inputs.

A message has been sent to the stakeholders that the project group suggest this meeting to be held on either May 6, 7 or 20. We have also asked the stakeholders to carefully consider who should participate from their side in such a meeting and during the project itself, i.e. what skills/disciplines do they think is important to have represented from their side in the project.

A9. Status report POOLFIRE

Status of the POOLFIRE project and achievements during period December 2012-May 2013.

The following achievements can be reported between December 2012 and May 2013.

The second year report was delivered at the end of January [1] as an update of the first year report [2]. The report was recently also approved by the management board of the PRISME OECD project [3]. This means that it now can be published in the public domain. A publication was made by Lund University on the simulations performed in the second year report, which was approved for publication in Fire Safety Journal. The publication will be part of the PhD work of Jonathan Wahlqvist, PhD student at Lund University.

During the spring of this year the university of Lund performed a number of fire tests in order to investigate the fire behaviour of di-electrical fluids. Cone calorimeter tests with ISO 5660 and ad hoc tests have performed in order to determine values as input for the modelling of these types of fluids when they burn as pool fires. Both traditional mineral oil as well as esters and silicon oils have been used. A master student from Belgium within the joined Erasmus Mundus programme from Gent, Edinburg and Lund performed the tests and work. The work will be published as master thesis at the end of May. The tests have also lead to cooperation with ESS (European Spallation Source) facility. Although that the poolfire project will not cover all aspects of fire with di-electrical fluids it will show how applicable the models might be even for fluids with high fire point.

The University of Lund now does modelling of the test campaign performed during the summer of 2012 with the new pyrolysis model developed by VTT. Also new tests from the OECD PRISME 2 project will be used for the final validations as well as the real scale fire information from Heysham (England) resulted from the visit by Ringhals and OKG to the facility.

The project is running as planned and no delays occurred.

References

1. Patrick van Hees, Jonathan Wahlqvist, Simo Hostikka[1], Topi Sikanen[1], Bjarne Husted[2], Tommy Magnusson[3], Fredrik Jörud[4], Prediction and validation of pool fire development in enclosures by means of CFD (Poolfire) Report – Year 2, LTH Report 3169, Lund 2013.

2. Patrick van Hees, Jonathan Wahlqvist, Simo Hostikka[1], Topi Sikanen[1], Bjarne Husted[2], Tommy Magnusson[3], Fredrik Jörud[4], Prediction and validation of pool fire development in enclosures by means of CFD (Poolfire) Report – Year 1, LTH Report 3163, Lund 2012.

3. http://www.nea.fr/jointproj/prisme.html (downloaded 2011-12-15)

A10. Status report SADE

Status report for the "Safety culture in design and implementation of technological and organisational solutions - improving resilience of the sociotechnical system throughout the life-cycle" (SADE) NKS_R_2011_97 Project – May 2013

Work status

The main objective of **SADE** project for 2013 is to test and evaluate the results of Phase I and Phase II. The testing and evaluation will be based on in depth analysis of selected design projects as case studies conducted both in Finland and Sweden. By the analysis of the case studies the project will develop a deeper understanding about how the challenges identified in phase I and II manifested from the designers' perspective, as well as about how they were recognised, addressed and overcome.

The following activities were planned for the year 2013:

1. Selection of relevant case studies in Finland and Sweden to be analysed on the basis of the results of phase I and phase II.
2. Interviews and workshops with designers involved in the selected cases to test and validate the relevance of the identified challenges and the model of human and organisational factors affecting the design process.
3. Internal workshops with the research parties were initial findings are discussed, data is analysed and common view is formulated
4. Drawing conclusions and writing the final report of the third phase of the SADE project.

During the first reporting period of 2013 the following activities were performed:

1. Power companies have been contacted in Sweden and Finland to gain access to the case studies. At the present moment, only one Finnish power companied authorised the case study.
2. Three individual interviews and one group interview at the power company has been conducted. A first interview with a STUK representative.
3. The transcription of the interviews and their translation into English is currently in progress
4. Regular monthly meetings have been held within the project team

Potential difficulties and delays

Potential difficulties and/or delays in achieving the project's objectives are:

- Delay in conducting the case studies due to difficulties in gain access and authorisation by the power companies.