

From: Tone Madsen
Sent: 10 Nov 2014 13:16:20 +0100
To: Yvonne Korup;Bent Horn Andersen;Ian Henning Clausen;Nina Hanne Holst;Tina Schmidt;Peter Moltesen;Karsten Borg Jensen;Lisbet Poll Hansen;Louise Baad Rasmussen
Cc: Sanne Kjær
Subject: Vs: Materiale til møde tirsdag kl 12.30-15 (MIM Id nr.: 1419097)

Kære alle

Hermed materiale fra DTU mhp mødet i morgen. De har ikke skrevet så meget, men har tilsyneladende valgt at fremlægge mundtligt i morgen.

Se dagsorden nedenfor. Vær gerne obs på at alle relevante fra NST/MST har fået indkaldelsen.

Vi ses i morgen. Mvh Tone

Til: Tone Madsen (tomad@mim.dk)
Cc: Sidsel Marie Nielsen (sa@kt.dtu.dk), Mads H Odgaard (maod@adm.dtu.dk), jem@adm.dtu.dk (jem@adm.dtu.dk)
Fra: Ole Høyberg (ohoy@adm.dtu.dk)
Titel: Materiale til møde tirsdag kl 12.30-15
Sendt 10-11-2014 13:01:56
:

Kære Tone

Vedhæftet er udkast til tilbud på på videnskabelig udredning af international viden om skifergas relateret til en dansk kontekst. Vedhæftet er desuden CV'er på 4 af de centrale forskere der vil bidrage til opgaven.

Herunder er udkast til dagsorden og et bud på ca. tider for de enkelte emner.

Udkast til dagsorden

12.30-12.45:	Tilbuddet fra DTU – introduktion og overblik – Sidsel Marie Nielsen
12.45-13.30:	Arbejdspakke 1-3/v Sidsel Marie Nielsen, Poul L. Bjerg og Ida Lykke Fabricius
13.30-14:00:	Arbejdspakke 4-7 /v Ida Lykke Fabricius og Poul L. Bjerg
14.00-14.30	Arbejdspakke 7-8/v Ida Lykke Fabricius og Igor Kozine
14.30-15.00	Opsamling og afklarende spørgsmål

Ring hvis du har spørgsmål (2826 9424)

Bedste hilsner

Ole

Ole Høyberg
Specialkonsulent
Afdeling for Innovation og Sektorudvikling

Danmarks Tekniske Universitet
Anker Engelundsvej 1,
Bygning 101 A



2800 Kgs. Lyngby

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NOTAT (UDKAST)

Tilbud på videnskabelig udredning af international viden om skifergas relateret til en dansk kontekst

10. november 2014

Miljøministeriet har bedt Danmarks Tekniske Universitet, DTU, udarbejde en videnskabelig udredning af international viden om skifergas relateret til en dansk kontekst.

DTU vil som leadpartner gennemføre en videnskabelig udredning, hvori eksisterende viden om efterforskning og indvinding af skifergas sættes i relation til specifikke forhold i Danmark, herunder særligt den danske geologi, hvor det er relevant i forhold til efterforskning og indvinding af skifergas.

På baggrund af den fremsendte projektbeskrivelse beskrives herunder helt overordnet de delelementer DTU anser som nødvendige for at løse opgaven. Den metode der vil anvendes vil bestå af følgende elementer:

Gennemgang af og et overblik over eksisterende videnskabelig litteratur og internationale udredninger med et særligt fokus på de miljømæssige effekter ved skifergasrelaterede aktiviteter med henblik på 1) en vurdering af, hvorvidt denne viden kan anvendes i en dansk kontekst og 2) hvor der vurderes at være behov for yderligere viden set i forhold til de særlige forhold for skifergasrelaterede aktiviteter i Danmark.

Udredningens primære fokus er at belyse de mulige miljømæssige problemstillinger fra efterforskning og indvinding af skifergas i Danmark. Herunder mulige påvirkninger af jord, grundvand (drikkevand) og overfladevand, udledning til luften, spildevand, affald (herunder naturligt forekommende uorganiske-, organiske- og radioaktive stoffer), jordskælv, transport-udfordringer, landskabelige forhold og støj.

Udredningen vil inddrage international viden om, hvordan mulige negative miljøpåvirkninger kan imødegås. Udredningen vil beskrive relevante afværgeforanstaltninger, herunder internationalt anerkendte best practice-løsninger.

DTU har en lang række førende forskere inden for området der vil udføre en detaljeret og dækkende videnskabelig udredning. Bilag 1 giver et overblik over, hvilke områder DTU anbefaler belyses og de ressourcer DTU vil involvere i opgaveløsningen. DTU vil, i det omfang der er behov for det, inddrage eksterne eksperter eksempelvis fra DCE, GEUS og om nødvendigt internationale eksperter.

Organisering

DTU har det overordnede ansvar for projektet. DTU nedsætter en intern styregruppe bestående af:

- Koncerndirektør Niels Axel Nielsen (formand)
- Institutdirektør, professor Michael H. Faber (DTU Byg)
- Institutdirektør, professor Kim Dam-Johansen (DTU Kemiteknik)
- Institutdirektør, professor Thomas H. Christensen (DTU Miljø)
- Kontorchef Jan E. Molzen (sekretær)

Projektgruppe

- Professor Poul L. Bjerg, DTU Miljø
- Professor Ida L. Fabricius, DTU Byg
- Seniorforsker Igor Kozine, DTU Man Eng.
- Post.doc., ph.d., Sidsel Marie Nielsen, DTU Kemiteknik (faglig koordinator)
- Koncerndirektør Niels Axel Nielsen (deltager efter behov)

Projektet gennemføres via følgende otte arbejdsplaner (med ansvarlig i parentes). Bilag 1 uddyber hver arbejdsplan, herunder yderligere deltagende forskere samt tidsforbrug.

Arbejdsplaner

1. Samlet fremstilling af miljøimpact og afværgeforanstaltninger ved efterforskning og indvinding af skifergas (post. doc. Sidsel Marie Nielsen, DTU Kemiteknik)
2. Frakturering - kemikalier og forurening af jord, grundvand, søer og vandløb (professor Poul L. Bjerg, DTU Miljø)
3. Landskab og trafik (professor Ida L. Fabricius, DTU Byg)
4. Støj, vibrationer og lys (lektor Toke Rammer Nielsen, DTU Byg)
5. Radioaktive stoffer (seniorforsker Per Roos, DTU Nutech)
6. Metan og andre klimagasser (lektor Charlotte Scheutz, DTU Miljø)
7. Jordskælv (professor Ida L. Fabricius, DTU Byg)
8. Analyse af risici forbundet med efterforskning og indvinding af skifergas (seniorforsker Igor Kozine, DTU Man Eng)

Sekretariat

- Post.doc. Sidsel Marie Nielsen, DTU Kemiteknik (sekretariatsleder/faglig koordinator)
- Specialkonsulent Ole Høyberg, DTU
- Specialkonsulent Mads Odgaard, DTU

Følgegruppe

Der nedsættes en følgegruppe jf. opdraget fra Miljøministeriet.

Den videre proces

På mødet tirsdag d. 11. november vil fire ledende forskere fra DTU på området deltage, med henblik på en teknisk gennemgang af de opstillede delelementer i de enkelte arbejdsplaner som miljøministeriets projektbeskrivelse opstiller. Ud over de aspekter der er beskrevet i projektbeskrivelsen, er

det DTU's vurdering, at der kunne være behov for også at belyse emner som miljøpåvirkninger og risici ved den tekniske udføring af borerne, samt rystelser og støj ved borer og frakturering.

DTU afsætter som ønsket ressourcer til rådgivning efter rapporten afleveres. Der er dog behov for at definere såvel omfang som over hvor lang tid denne rådgivning kan gives inden for denne opgave. Såfremt der ønskes rådgivning af længerevarende karakter bør der indledes en dialog om en specifik aftale for dette.

Bilag 1

	Ressource-person	Emne/ekspertise	Timer
1. Samlet fremstilling af miljøimpact og afværgeforanstaltninger ved efterforskning og indvinding af skifergas: Post. doc. Sidsel Marie Nielsen, DTU Kemiteknik. Denne arbejdsplan belyser de forskellige trin i et skifergas projekt og udarbejdes i tæt dialog med de øvrige arbejdsplaner, der hver især fokuserer på konkrete miljømæssige problemstillinger			
			700
DTU Kemiteknik	Post. doc. Sidsel Marie Nielsen	Olie, reservoir modellering, mikrobiologi, processteknik og projektledelse.	
DTU Miljø	Lektor Steffen Foss Hansen	Har arbejdet med skifergas ud fra en risikovurderingssynsvinkel	
2. Frakturering – kemikalier og forurening af jord, grundvand, søer og vandløb: WP leder Poul L. Bjerg, DTU MILJØ (i samarbejde med BYG, GEUS og DCE)			
			1100
DTU Miljø	Professor Poul L. Bjerg	Transport og skæbne af miljøfremmede stoffer, grundvandskvalitet og frakturering	
DTU Miljø	Res. Ass. YY	Review af litteratur omkring emnet for WP2	
DTU Miljø	Professor Hans-Jørgen Albrecht-sen	Drikkevandskvalitet og rensning	
DTU Miljø	Hans-Christian Holten Lützhøj	Miljøkemi, vurdering af kemiske stoffers påvirkning af overfladevand	
DTU Miljø	Lektor Henrik Andersen	Rensning og håndtering af spildevand med fracking fluids	
DTU Miljø	Lektor Peter Kjeldsen	Håndtering og deponering af restprodukter fra boreaktiviteter	
DTU Miljø	Professor Anders Baun	Miljøkemi	

DTU Miljø	Instituddirektør Thomas H. Christensen	Affaldshåndtering, Allround ekspertise	
GEUS, Ekstern	Flemming Larsen	Saltvand, geokemiske ændringer	
Ekstern, DCE	NN(afventer afklaring)	Fracking fluids, miljøpåvirkning af overfladevand	
DTU Byg	Professor Ida Lykke Fabricius	Generel viden om lerskifer-egenskaber.	
DTU Byg	Post doc Morten Kanne Sørensen	Vurdere egenskaber og spændingsforhold for danske skiferaflejringer med henblik på frakturering	
GEUS	Seniorforsker Niels Schovsbo	Lerskiferens regionale egenskaber -samarbejde med BYG	
3. Landskab og trafik: WP leder professor Ida Lykke Fabricius, DTU BYG (i samarbejde med MAN ENG)			
			300
DTU Byg	Lektor Lotte Bjerregaard Jensen	Konsekvenserne for landskabet generelt og mulighederne for at reducere de visuelle påvirkninger i både efterforskningsfase og produktionsfase undersøges.	
		Konsekvenserne for landskabet generelt og mulighederne for at reducere de visuelle påvirkninger i både efterforskningsfase og produktionsfase undersøges.	
DTU Transport	Post doc. NN/ Thomas Sick Nielsen	Konsekvenser af øget lastbilkørsel i området analyseres.	
4. Støj, vibrationer og lys: WP leder Toke Rammer Nielsen, DTU Byg			
			240

DTU Byg	Lektor Toke Rammer Nielsen	Effekten af støj og kunstlys på omgivelserne undersøges.	
DTU Fotonik	NN (afventer afklaring)	(Afventer afklaring)	
DTU Ørsted	Post. Doc NN/Cheol-Ho Jeong	(Afventer afklaring)	
5. Radioaktive stoffer: WP leder seniorforsker Per Roos, DTU NUTECH			
			80
DTU Nutech	Seniorforsker Per Roos	Radioaktivitet og skifergas	
6. Metan og andre klimagasser: WP leder lektor Charlotte Scheutz, DTU Miljø			
			150
DTU Miljø	Lektor Charlotte Scheutz	Metanudledning og målemetoder, til kvantificering af klimaeffekter	
DTU Miljø	Instituddirektør Thomas H. Christensen	All round ekspertise	
Picarro Inc., USA	Chris W. Rella, Picarro Inc., Santa Clara, USA	Metanudledning fra skifergasaktiviteter i USA	
DTU Vind	Sektionsleder Hans Jørgensen	Spredningsmodeller for metangassers bevægelser i at-mosfæren	
7. Jordskælv: WP leder professor Ida Lykke Fabricius, DTU BYG (i samarbejde med GEUS)			
			150
DTU Byg	Professor Ida Lykke Fabricius	Vurdere egenskaber og spændingsforhold for danske skiferaflejringer med henblik på frakturering	
8. Analyser af risici forbundet med efterforskning og indvinding af skifergas: WP leder seniorforsker Igor Kozine, MAN ENG. Denne WP har samme samlede funktion som WP1, her med fokus på en overordnet ramme for risikovurdering			
			450
DTU Man Eng	Seniorforsker Igor Kozine	Kortlægning af risici forbundet med alle	

		aktiviteter efterforskning og indvinding af skifergas	
DTU Man Eng	Seniorforsker Frank Markert	Uheld scenarier i drift fasen	
	Vid. Ass. Linda Nielsen	Risiko vurdering. Laver litteratur studie i eksisterende risiko analyse for skifergas indvinding	
	Post. doc. Micolaj Owsianiak	Ekspert i livscyklus vurdering	
	Seniorforsker Henrik Saxe		
	Professor Michael Hauschild		
	Lektor Alexis Laurent		
DTU Miljø	Lektor Steffen Foss Hansen	Erfaring med overførsel af risikobilleder fra udlandet til Danmark på fx. nanoområdet. Arbejder med samme emne for skifergas	
DTU Miljø	Professor Anders Baun	Betydelig erfaring med overførsel af risikobilleder fra udlandet til Danmark på fx. nanoområdet	
DTU Byg	Instituddirektør Michael Havbro Faber	Allround ekspertise	
9. Sekretariatsbetjening			
			400
DTU Rådgivning & Netværk, AIS	Specialkonsulent Ole Høyberg og specialkonsulent Mads H. Odgaard		
10. Rådgivning efter aflevering af rapporten			
			100
Relevante DTU institutter	Involverede forskere efter behov	Forskningsfaglig rådgivning ved henvendelse	

		delser til miljømini- steriet	
I alt			3600

CV for Poul L. Bjerg (*1961)



Positions and degrees

2002- Professor, DTU Environment
 2000-2001 Sabbatical at CSIRO, Land and Water, Perth, Australia
 1996 Associate professor, Department of Environmental Science and Engineering (IMT), Technical University of Denmark
 1992 Post Doc, IMT, Technical University of Denmark
 1992 PhD, IMT, Technical University of Denmark
 1987 MSc in Environmental Engineering, Technical University of Denmark

Research area

The research field is risk assessment and remediation technologies for contaminated soil, groundwater and surface water. This involves more recently use of life cycle assessment tools and focus on holistic management of contaminated sites and water resources. Leader or participant in several research projects under different programmes (FP6 and FP7, The Danish Agency for Science Technology and Innovation, Strategic Environmental Research Programme 1996/Pesticides Significant experience with collaboration projects with leading consulting companies and administrative bodies (Danish EPA, Danish Regions/former counties).

ISI Journal publications

>90 ISI publications, books= none, patents=none; > 3200 citations, H-index=29 (Web of Science)

Distinctions and awards

2012: Academy of Technical Sciences, Soil and groundwater foundation, Poul Harremoés Award
 2011: Ejnar og Aase Danielsens Foundation: Environmental prize
 1993: Direktør Peter Gorm Petersen's Award for the Ph.D. thesis

Projects, selected

2014- Project leader, GEOCON – Advancing GEOlogical, geophysical and CONTaminant monitoring technologies for contaminated site investigation. The Danish Council for Strategic Research under the Programme commission on sustainable energy and environment.
 2013- Capital Region of Denmark, Collaboration contract on risk assessment and remediation of chalk aquifers. Project in collaboration with Mette Broholm and Philip Binning.
 2012- Project leader, Risk assessment of contaminated sites towards surface water, Technology development projects, Danish EPA and Region of Southern Denmark.
 2008-2012 Project leader, REMTEC, Innovative Remediation and assessment Technologies for contaminated soil and groundwater. The Danish Agency for Science Technology and Innovation under the Programme commission on sustainable energy and environment

Leadership experience and boards/committees, selected

2011- Head of Water Resources Engineering Section at DTU Environment
 2011- Head of Research committee at DTU Environment
 2009- Member of organising committee for AQUACONSOIL
 2005-2008 Member of the Editor-in-chief group “Journal of Contaminant Hydrology”
 2004-2008 Chairman of Academy of Technical Sciences, Soil and Groundwater Foundation
 2004- Member of the organising committee for Groundwater Quality conference series
 2001-2005 Vice head of Institute of Environment & Resources

Supervision of PhD students

Supervisor/co-supervisor of 17 completed PhDs. Ongoing 2014:

- Anne Sonne (from 2013.): Risk assessment of stream water: linking mass discharge from contaminated sites, in-stream fate and water health.
- Nanna Isbak Thomsen (2010-): Quantifying contaminant discharge from real sites to groundwater and surface water and related uncertainties.
- Bentje Brauns (from 2011-): Occurrence and degradation of contaminants at the groundwater surface water interface.

CV Ida Lykke Fabricius,

DTU Byg, Brovej bygning 118, 2800 Kgs Lyngby

Private address: Bjørnsonsvej 11, 2500 Valby

Education.

Copenhagen University: M.Sc. Geology 1981.

Technical University of Denmark: Ph.D. Technical Geology 1988.

Technical University of Denmark: dr. techn. Technical Geology 2009.

Employment.

Mærsk Oil and Gas AS 1981-1985, Development geologist.

Technical University of Denmark, from 1985, associate professor from 1989, professor MSO from 2011.

Leaves of absence.

Maternity leaves:

May-August 1977

February-July 1981

September-November 1983

Rewards.

Copenhagen University gold medal 1981.

Direktør Gorm-Petersens Mindelegat 1989.

Management experience.

Head of department, Department of Geology and Geotechnical Engineering, DTU 1989-1992.

Coordinator for Hydrocarbon and Mineral Resources research group, E&R DTU 2001-2008.

Coordinator of Geophysics Research Group, DTU Environment 2008-2010.

Head of Geotechnics and Geology Section, DTU Byg from 2012.

Project management .

HeHo Heat storage in Hot Aquifers. DSF Grant 10-093934. 01.03.2011 – 31.12.2015. (project manager).

Smart water – Advanced waterflooding of Danish oil and gas reservoirs, EUDP j.no.64011-0009

Mærsk Oil, DONG Energy 01.07.2011 – 31.12.2015 (project coordinator).

Supervision.

15 completed and 4 current PhD. projects, 75 completed and 2 current master projects.

Focus of Research.

Reservoir engineering: Geothermics, Petroleum, CO₂ storage.

Petrophysics and diagenesis of sedimentary rocks

Rock physics and rock mechanics

International relations.

Research.

Coauthoring papers with researchers from:

Chalmers University of Technology, Colorado School of Mines, Curtin University, Ohio State University, Stanford University, Technical University of Tallinn, Texas A&M University,

University of Maine, University of Miami, Vilnius University, Alfred Wegener Institute for Polar and Marine Research, Danish Geotechnical Institute, Geological Survey of Denmark and Greenland, Scripps Institution of Oceanography, Denerco Oil, DONGEnergy, Hess Corporation, Mærsk Oil and Gas AS, Ødegaard A/S, Vattenfall.
Participation in Ocean Drilling Program (ODP Leg 130 1990 and Leg 165 1995-96).

Ph.D. committees outside DTU.

Peter Lock (Imperial College) 2001
Arnout Colpaert, (Tromsø) 2/3 2007
Reidar Korsnes (Stavanger) 23/3 2007
Thushan Chandrasiri Ekneligoda (KTH, Stockholm) 7/12 2007
Delphine Croize (Oslo) 30/9 2010
Charlotte Faust Andersen (Bergen) 4/2 2011
Morten Kolstø (NTNU) 7/3 2013

Reviewer for:

Computers and Geoscience, Geology, Geophysical Prospecting, Geophysics, Marine and Petroleum geology, Petroleum Geoscience, Journal of Petroleum Science and Engineering Journal of Sedimentary Research Rosa, The Open Geology Journal, Tectonophysics
NSF OCEAN DRILLING PROGRAM, USA, Petromax, Norway, QatarNRF
Council for Earth and Life Sciences, NL

Guest researcher and invited presentations abroad.

University of Stavanger: "Burial Diagenesis of Ontong Java Plateau chalk", 24/4 1997.
Stanford University, Guest (15/6 -17/8 2000).
Stanford University: "Calk Properties" 16/8 2000.
CSIC, Barcelona: "Diagenesis of chalk sediments from Ontong Java Plateau" 28/1 2004.
University of Miami (25/10 2006-25/1 2007, sponsored by FTP)
University of Miami.: "Sonic att. in carbonates: A perspective for permeability prediction?" 15/10 2007.
Stanford University, Guest (21/10-4/11 2007, sponsored by Stanford University)
University of Stavanger: "A discussion of water weakening" 10/4 2008.
University of Miami.: "Water weakening of elastic moduli of carbonates related to texture and permeability" 6/10 2008.
NTNU: "Velocity of elastic waves in carbonate rocks. High frequency versus low frequency" 20/4 2009.
Mærsk Olie og Gas AS, Houston: "Chalk, Composition, diagenesis and physical properties" 29/10 2009.
University of Houston: "Permeability Prediction in Chalks" 2/11 2009.
Colorado School of Mines: "Chalk" 4/11 2009.
ICCR Technical Programme Melia Tryp Belder Hotel Las Palmas, Mallorca 7-8th December, 2011. 9:30: SAB Paper: Ida Fabricius (Technical University Denmark): Permeability prediction from velocity of elastic waves
ICCR 2/7 2012: "Biot's coefficient: a basic parameter for sedimentary rocks". University of Edinburgh.
106rd Monthly Meeting of SPWLA Brazil Chapter "Petrophysics of Chalk", Rio de Janeiro 16/4 2013
Joint Chalk research meeting Reims "Burial stress and elastic strain of carbonate rocks " 22/10 2014.

Publications, Ida Lykke Fabricius (Lind 1977-97)

Pear reviewed papers

- Lind, I. & Makovicky, E. 1983: "Phase relations in the system Cu-Sb-S at 200°C, 10⁸ Pa by hydrothermal synthesis. Microprobe analysis of tetrahedrite - a warning." *N. Jb. Miner. Abh.* **145**, 134-156.
- Leg 130 Shipboard Scientific Party (incl. I. Lind) 1990: "Reading the Ocean's Diary." *Nature* **346**, 111-112.
- Kroenke, L., Berger, W., Janecek, T., Backman, J., Bassinot, F., Corfield, R., Delaney, M.L., Hagen, R., Jansen, E., Krissek, L., Lange, C., Leckie, M., Lind, I.L., Lyle, M., Mahoney, J.J., Marsters, J., Mayer, L., Mosher, D.C., Musgrave, R., Prentice, M., Resig, J.M., Schmidt, H., Stax, R., Storey, M., Takayama, T., Takahashi, K., Tarduno, J.A., Wilkens, R., Wu, G., 1990: "ODP returns to Ontong Java Plateau." *Geotimes* **35**, 15-17.
- Lind, I., 1991: "Microprobe aided mapping of areal element concentration and microporosity in chalk." *Carbonates and Evaporites* **6**, 45-51.
- Lind, I., Nykjær, O., Priisholm, S., Springer, N. 1994: "Permeability of stylolite-bearing chalk." *Journal of Petroleum Technology* **46**, 986-993.
- Lind, I. & Schiøler, P. 1994: "Dinoflagellate cyst concentration as an independent reference for monitoring mineral mobilization in stylolites." *Sedimentary Geology* **92**, 53-65.
- Lind, I. & Grøn, P., 1996: "Porosity variation in chalk." *Zbl. Geol. Paläont.*, **1994**, 763-772.
- Madsen, L., Grahl-Madsen, L., Grøn, C., Lind, I., Engell, J., 1996: "Adsorption of polar aromatic hydrocarbons on synthetic calcite". *Org. Geochem.*, **24**, 1151-1155.
- ODP Leg 165 scientific party (incl. Ida Lind), 1996: "Deep-Sea cores from the Caribbean reveal history of volcanism, tectonics, and oceanic change (progress report)." *EOS*, **77**, p. 291.
- Borre, M., Lind, I., & Mortensen, J. 1997: "Specific surface as a measure of Burial Diagenesis of Chalk." *Zbl. Geol. Paläont. Teil 1* **1995**, 1071-1078.
- Berger, W.H. and Lind, I.L. 1997: "Abundance of color bands in Neogene carbonate sediments on Ontong Java Plateau: a proxy for sedimentation rate?" *Marine Geology* **144**, 1-8.
- Madsen, L. & Lind, I. 1998: "Adsorption of carboxylic acids on reservoir minerals from organic and aqueous phase." *SPE Reservoir Evaluation & Engineering* **1**, 47-51.
- Mortensen, J., Engstrøm, F., & Lind, I., 1998: "The relation among porosity, permeability, and specific surface of chalk from the Gorm field, Danish North Sea" *SPE 31062, SPE Reservoir Evaluation & Engineering* **1**, 245-251.
- Madsen, L., Grøn, C., Lind, I., & Engell, J. 1998: "Adsorption of benzoic acid on synthetic calcite dispersed in cyclohexane as a function of temperature." *Journal of Colloid and Interface Science* **205**, 53-64.
- Borre, M. & Fabricius (Lind), I. L., 1998: "Chemical and mechanical processes during burial diagenesis of chalk. An interpretation based on specific surface data of deep-sea sediments" *Sedimentology* **45**, 755-770.
- Henriksen, A., Fabricius, I., Theilgaard, A, Borre, M., Zandbergen, J., & Korsbech, U. 1999: "Core density scanning and mechanical properties of limestone in the Copenhagen area" *Quarterly Journal of Engineering Geology* **32**, 107-117.
- Solymar, M. & Fabricius, I.L. 1999: "Image Analysis and Estimation of Porosity and

- Permeability of Arnager Greensand, Upper Cretaceous, Denmark” *Phys. Chem. Earth (A)* **24** 587-591.
- Fabricius, I. 2000: “Aspects of the Chalk of the North Sea Area”. *Zbl. Geol. Paläont. Teil 1.* **1999**, 409-417.
- Clausen, L. & Fabricius, I., 2000: “BET Measurements: Outgassing of Minerals”. *Journal of Colloid and Interface Science* **227**, 7-15.
- Madsen, L., Lindhardt, B., Rosenberg, P., Clausen, L. & Fabricius, I. 2000: “Pesticide sorption by low organic carbon sediments: A screening for seven herbicides.” *Journal of Environmental Quality* **29**, 1488-1500.
- Clausen, L., Fabricius, I. & Madsen, L. 2001: “Adsorption of Pesticides onto Quartz, Calcite, Kaolinite and Alumina.” *Journal of Environmental Quality* **30**, 846-857.
- Clausen, L. & Fabricius, I. 2001: “Atrazine, Isoproturon, Mecoprop, 2,4-D, and bentazone Adsorption onto Iron oxides.” *Journal of Environmental Quality* **30**, 858-869.
- Fabricius, I.L., 2001: “Compaction of microfossil and clay- rich chalk sediments”. *Physics and Chemistry of the Earth* **26**, 59-62.
- Gommesen, L. & Fabricius, I.L., 2001: “Dynamic and static elastic moduli of North Sea and deep sea chalk . *Physics and Chemistry of the Earth* **26**, 63-68.
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Lind, I. 1988: "Stylolite Formation.", 200pp.

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***Numerous peer read abstracts and extended abstracts for conferences.
Several confidential and public technical reports***

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Position: Senior Researcher, Technical University of Denmark; Department of Management Engineering; Section for Safety and Risk Management

Education: PhD in Systems Science (22 November, 1989, Moscow Institute of Physics and Engineering (technical university), Russia. Ph.D. thesis' title "Decision making on shutting off steam generators for fast breeder reactors in case of leakages"); Master in Systems Science (21 February, 1983, Moscow Institute of Physics and Engineering).

Employment:

January 2007 until now – Senior Researcher, Technical University of Denmark, Department of Management Engineering, Risk Research Group

July 1999 – January 2007 – Senior Scientist at Risø National Laboratory, Systems Analysis Department, section "Risk, Reliability and Human Factors" (from 1 January 2007 Risø National Laboratory was merged with Technical University of Denmark)

August 1998 - June 1999 – visiting senior scholar at the State University of New York at Binghamton. Supported by the Fulbright Foundation of the USA. Did study under the title of "Risk-Related Decision Making Based on Imprecise Statistical Reasoning".

1996-1998 - Associate Professor at the Institute of Nuclear Power Engineering, Obninsk, Russia

1994-1996 - guest researcher at Risø National Laboratory, Denmark

1989-1994 - Scientist - Associate Professor - Senior Scientist, Institute of Nuclear Power Engineering, Obninsk, Russia

1985-1989 – Ph.D. student, Moscow Institute of Physics and Engineering, Russia

1983-1985 - trainee scientist, Institute of Nuclear Power Engineering, Obninsk, Russia

Awards/Academic achievements:

- Award of the J. William Fulbright Foreign Scholarship Board and the United States Information Agency in the recognition of I. Kozine's participation in the Fulbright Research Program, 1999
- NATO award as Host Institute Project Director, CBP.NR.NREV 982410 (hosting Prof. V. Krymsky)
- Member of the editorial board of the International Journal of General Systems
- Member of the editorial board of the International Journal of Risk, Decision and Policy (journal is not published any longer)

- Representative of the Danish authorities at the Technical Working of the European Commission on Risk/Hazard Assessment Data.
- Member of the Society for Imprecise Probability: Theories and Applications
- Diploma of Docent (29 January, 1992) in recognition of achievements in educating students at university

Project management experience (last five years):

- Task leader in the EU SAFERELNET project (Safety and Reliability of Industrial Products, Systems and Structures. Thematic Network. Ended in 2006)
- Project coordinator of the Danish research contribution to OECD Halden Reactor Project since 2008 until now.
- Work package leader of the project financed by DSB (Danish train operator) on risk analysis of high speed trains IC4, 2012.
- Project coordinator of DTUs contribution to the Safe manning project financed by the Danish Maritime Fund. The project was completed in 2010.

Scientific focus areas: risk and reliability analysis, simulation of human performance, uncertainty analysis

International relations: large international network in the risk, reliability and uncertainty modelling domain. Large network in Russia, the USA and Europe, including Nordic countries.

Supervisor functions: 2 PhD students.

Publications: 15 peer reviewed journal articles, 2 book chapters, 32 papers in referred proceedings, 3 popular publications.

List of publications

Igor Kozine

2013-11-02

H-index: 5 (Scopus, excluding self-citations)

Starting from 2005

Peer-reviewed publications

Peer-reviewed journal articles

1. L. Utkin and I. Kozine, 2010. [On new cautious structural reliability models in the framework of imprecise probabilities](#). *Structural Safety*. vol: 32, pages: 411-416, Elsevier BV*
2. I. Kozine and V. Krymsky, 2009. Bounded Densities and Their Derivatives : Extension to Other Domains. *Journal of Statistical Theory and Practice*, vol: 3, issue: 1, pages: 25-38, Grace Scientific Publishing.*
3. I. Kozine and V. Krymsky, 2009. [Computing interval-valued statistical characteristics: What is the stumbling block for reliability applications?](#) *Intern. Journal of General Systems*, vol: 38, issue: 5, pages: 547-565, Taylor & Francis Ltd.*
4. I. Kozine, 2007. [Simulation of human performance in time-pressured scenarios](#). Proc. IMechE Part O: *J. Risk and Reliability*, vol: 221, pages: 141-151
5. I. Kozine and L. Utkin, 2005. Constructing imprecise probability distributions. *Int. J. General Syst.* 35, 1-8*
6. I. Kozine and L. Utkin, 2005. Computing System Reliability Given Interval-Valued Characteristics of the Components. *Reliable Computing*, 11: 19–34*

Peer-reviewed book chapters

1. K. Lauridsen, E. Hollo and I. Kozine, 2010. [Application of safety and reliability approaches in the power sector: Inside-sectoral overview](#). Part of: *Safety and Reliability of Industrial Products, Systems and Structures* (ISBN: 978-0-415-66392-2) , pages: 417-431 pages: 459, Taylor & Francis, London
2. I. Kozine and V. Krymsky, 2009. [Bounded Densities and Their Derivatives: Extension to Other Domains](#). Part of: *Imprecision in Statistical Theory and Practice* (ISBN: 978-0-9823998-0-4), pages: 29-42, Grace Scientific Publishing, Greensboro, NC, USA
3. I. Kozine, 2008. [Uncertainty modeling with imprecise statistical reasoning and the precautionary principle in decision making](#). Part of: *Real-Time and Deliberative Decision Making* (ISBN: 978-1-4020-9024-0) , pages: 225-238, 2008, Springer Verlag*
4. I. Kozine, 2006. On imprecise statistical reasoning. In: *The way through science and philosophy: Essays in honour of Stig Andur Pedersen*. Andersen, H.B.; Christiansen, F.V.; Jørgensen, K.F.; Hendricks, V.F. (eds.), (College Publishers, London, 2006) (Tributes Series, 4) p. 301-316*

Peer-reviewed conference articles

1. I. Kozine, 2010. [Discrete event simulation versus conventional system reliability analysis approaches](#) . ESREL'2010. Conference paper publ. in proceedings: *Reliability, Risk and*

Safety, Back to the Future (ISBN: 978-0-415-60427-7) , pp. 778-784, Taylor & Francis, London

2. L. Utkin and I. Kozine, 2010. [On new cautious structural reliability models in the framework of imprecise probabilities](#). The 10th International Conference on Structural Safety and Reliability (ICOSSAR'09) - 10, 2009, Osaka, Japan (Invited conference contribution). (ISBN: 978-0-415-47557-0) , pages: 1261-1267, Taylor & Francis, London
3. I. Kozine, 2009. Discrete event simulation as a versatile analysis tool for safety-critical systems. From the everyday to the extraordinary, SRA-Europe Conference (ISBN:) , pages: 1-78, 2009, Universitetsstryckeriet, Karlstad
4. I. Kozine, F. Market, A. Alapetite, 2009. "Discrete event simulation in support to hydrogen supply reliability". In the proceedings of ICHS'2009, 3rd International Conference on Hydrogen Safety, Ajaccio, France
5. I. Kozine, 2007. [Updating probability intervals with the beta-Bernoulli model](#) . NATO advanced research workshop on computational models of risks to infrastructure, 2006, Primosten. Part of: Computational models of risks to infrastructure (ISBN: 978-1-58603-766-6) , pages: 181-187, IOS Press, Amsterdam
6. I. Kozine, 2007. Simulation of human multitask performance. NATO advanced research workshop on computational models of risks to infrastructure, 2006, Primosten. Part of: Computational models of risks to infrastructure (ISBN: 978-1-58603-766-6) , pages: 89-97, IOS Press, Amsterdam
7. I. Kozine and V. Krymsky, 2007. [Enhancement of natural extension](#). International symposium on imprecise probability: Theories and applications (ISIPTA '07), 2007, Prague (CZ). Part of: Proceedings (ISBN: 978-80-86742-20-5) , pages: 253-262, 2007, Action M Agency, Prague
8. I. Kozine , 2006. Simulation of human performance in a discrete event environment. In: Safety and reliability for managing risk. Proceedings. Vol. 1. European safety and reliability conference (ESREL 2006), Estoril (PT),. Soares, C.G.; Zio, E. (eds.), (Taylor and Francis, London) p. 355-362

Other publications

1. I. Kozine, 2007. Book review: Joseph Y. Halpern, Reasoning about uncertainty. *Studia Logica* **85** , 431-432

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Scientific focus areas and projects

Modeling of transport in porous media
Microbial enhanced oil recovery, experiments and simulations
Enzyme enhanced oil recovery
Petroleum engineering
Microbiology and biochemistry
Fermentation technology
Population balance modeling of the coating and agglomeration process
Modeling of chromatography
Project management

Education

- 2014 Educational program in communicology, module 1, basic level, Denmark.
<http://www.kommunikologi.no/communicology.html>
- 2011 Course: Project Management for Researchers, DTU (Implement).
- 2010 **Ph.D. degree**, Technical University of Denmark (29 October 2010).
Title: Microbial Enhanced Oil Recovery – Advanced Reservoir Simulation.
- 2009 Research stay at Mork Family Department of Chemical Engineering and Materials Science, University of Southern California, Los Angeles, California, USA (Feb-May).
- 2009 Basic course on *Teaching and Learning*, DTU.
- 2006 **M.Sc.**, Chemical Engineering, DTU.

Relevant employment

- 2010 – **Project manager and Post Doc** on the project: "BioRec - Biotechnology in Oil Recovery".
Partners are Maersk Oil, DONG E&P, RUC, DTI, DTU, Novozymes and InnovationsFonden.
Post doc part: Modeling of microbial enhanced oil recovery.
Supervision of two PhD students on experimental work on enzyme and microbial EOR.
- 2014 **Acting Center Coordinator** for CERE, DTU (Feb-Jul, ¾ time).
Management of administrative staff. Planning and coordination within CERE.
Communication. Representation of CERE outside Denmark. Economy planning and overview.
- 2006-2010 **Ph.D. student**, DTU Chemical Engineering.
- 2004-2005 **Teaching assistant**, DTU Chemical Engineering and DTU Compute.

Teaching experience

- 2008, 2009 Teaching assistant with assignment formulation (part of Ph.D. study), DTU
Chemical Engineering Model Analysis (M.Sc. level)
- 2006 Teaching assistant (part of Ph.D. study), DTU
Recovery and purification of biological products (M.Sc. level)
- 2005 Teaching assistant, DTU
Introduction to MatLab (B.Sc. level)
- 2004, 2005 Teaching assistant, DTU
Mathematical models for chemical and biochemical systems (B.Sc. level)

Leave of absence

- 2007-2008 Maternity leave (10 months)
- 2012 Maternity leave (9 months)

Languages

Danish (Native language, fluent written and spoken)
English (Fluent written and spoken)
Basic knowledge of German, Norwegian and Swedish.

Computer skills

Microsoft Office package (document writing and presentations)
ADOBE Reader Pro, Photoshop and Illustrator (pictures)
LaTeX (document writing and presentations)
Fortran (coding, different versions and compilers)
MatLab (coding, graphs)

List of publications

PhD Theses (1)

* **Nielsen, Sidsel Marie** (2010) Microbial Enhanced Oil Recovery - Advanced Reservoir Simulation. Ph.D. Thesis. Technical University of Denmark (DTU).

Peer reviewed journal publications (3)

* **Nielsen, Sidsel Marie**; Nesterov, Igor; Shapiro, Alexander (2014) Simulations of Microbial-Enhanced Oil Recovery: Adsorption and Filtration. Transport in Porous Media, vol .102, p. 227-259.

* Halim, Amalia Yunita; Shapiro, Alexander; Eliasson Lantz, Anna; **Nielsen, Sidsel Marie** (2014) Experimental Study of Bacterial Penetration into Chalk Rock: Mechanisms and Effect on Permeability. *Transport in Porous Media*, vol. 101 (1), p. 1-15.

* **Nielsen, S.M.**, Shapiro, A.A, Michelsen, M.L., and Stenby, E.H., (2010) 1D simulations for microbial enhanced oil recovery with metabolite partitioning. *Transport in Porous Media*, vol. 85, p. 785-802.

Conference publications (3)

* **Nielsen, S.M.**; Nesterov, I., Shapiro, A.A. (2014) Microbial Enhanced Oil Recovery - A Mathematical Study of the Potential of Spore-forming Bacteria. Paper presented at ECMOR conference, Catania, Italy, 8-11 Sep 2014, 17 pages.

Yuan, Hao; **Nielsen, Sidsel Marie**; Shapiro, Alexander; Bedrikovetsky, P. (2012) A New Comprehensive Approach for Predicting Injectivity Decline during Waterflooding. SPE-154509 paper presented at 74th EAGE Annual Conference and Exhibition incorporating SPE Europec 2012, 2012, Copenhagen, 21 pages.

Nielsen, S.M., Jessen, K., Shapiro, A.A., Michelsen, M.L., and Stenby, E.H. (2010) Microbial enhanced oil recovery: 3D simulation with gravity effects. Paper SPE-131048 presented at the EUROPEC/EAGE Conference and Exhibition, Barcelona, Spain, 14-17 June 2010.