

Nordic Nuclear Forum for Generation IV Reactors Nordic-Gen4

1. Topic of research

1.1 Background

A Nordic Nuclear Materials Forum for research on Generation IV nuclear power reactors, GenIV, (NOMAGE4) was established in 2009 to spread the knowledge of nuclear materials for GenIV within the Nordic countries, to exchange information and to gather the partners in a Nordic network. The network exchanges information of different research teams and creates possibilities to carry out more ambitious and extensive research than would be possible for the individual teams. The aim of the network is to create excellent conditions for a stronger Nordic contribution to the worlds' development of the nuclear power reactors of the future, GenIV [1]. In 2012 the name of the network was changed into Nordic-Gen4.

It is also important to stress that materials (structural materials or fuel cladding) presently being developed for GenIV can also find applications in Gen III reactors. Material improvements for Gen III are thus also implicitly included in the network activity.

The following organizations have participated in NORDIC-GEN4 (see www.nordic-gen4.org):

- NKS – Nordic Nuclear Safety Research
- Institute for Energy Technology in Norway, IFE
- GEN4FIN
- JRC IET
- NRG
- Research Centre Rez (CVR)
- DTU Nutech – Center for Nuclear Technologies, Risø Campus
- Swedish Centre for Nuclear Technology, SKC
- GE-Hitachi Nuclear Energy
- Studsvik Nuclear AB
- Vattenfall
- EON
- Westinghouse
- Sandvik
- Royal Institute of Technology, KTH
- Chalmers University of Technology
- Uppsala University
- GE-Hitachi Nuclear Energy
- Outokumpu
- Thor Energy, Norway
- University of Oslo
- Norwegian University of Science and Technology

The members of GEN4FIN (see <http://virtual.vtt.fi/virtual/gen4fin/members.htm>) are given below:

- VTT*
- Fortum*
- Fennovoima*
- TVO*
- Aalto University
- Lappeenranta University of Technology
- Ministry of Employment and the Economy
- Prizztech Oy
- STUK – Radiation and Nuclear Safety
- Tekes – The Finnish Funding Agency for Technology and Innovation

*: Financing GEN4FIN

The research topics among the members include the following aspects:

- Fuels, cladding and structural materials for GenIV or material improvements for Gen III.
- Novel structural materials: materials performance, manufacturing technologies and Non Destructive Examination (NDE) of reactor components.
- Safety issues related to new fuel processing, handling, transportation and storage (waste management)

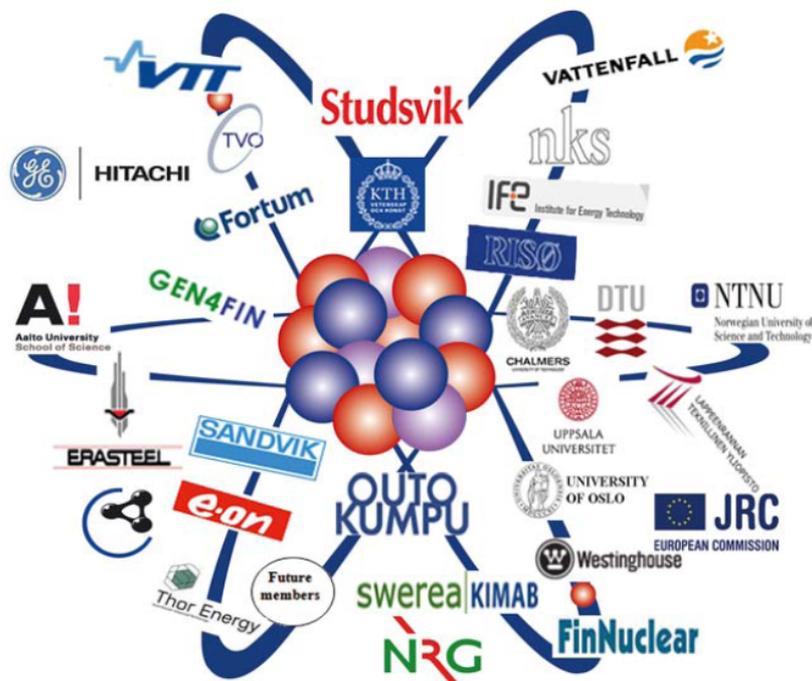


Figure 1. The Nordic-Gen4 network.

Potential cladding and structural materials for the different Gen-IV systems are presented in Table 1. There is a synergistic link between the materials integrity and nuclear safety for all nuclear reactors. The operation conditions in new generation reactors will be more demanding and thus knowledge of materials behaviour and integrity under operation are critical. To evaluate and choose proper materials to be used for GenIV reactors, it is important to know the boundary limits for use of the materials under these specific operation conditions. Safety analysis is based on technological assessment where the materials integrity has a decisive role [1, 2].

Table 1.

Potential cladding and structural materials for the different GenIV systems [4-6].

System	Materials		
	Cladding	Core regions	Out of core regions
Gas-Cooled Fast Reactor System (GFR)	Ceramics Matrices of SiC, ZrC & TiN, ODS (Oxide Dispersion-Strengthened)	Ceramics Carbides SiC, ZrC Nitrides ZrN, TiN Oxides MgO ZrYO ₂ Zr ₃ Si ₂ ODS	Coated or non coated ferritic-martensitic or austenitic steels Nickel based super alloys ODS
Lead-Cooled Fast Reactor System (LFR)	Austenitic, ferritic-martensitic steel Coated cladding e.g. FeAl		
Molten Salt Reactor System (MSR)	-		
Sodium-Cooled Fast Reactor System (SFR)	ODS (Metallic fuel) Ferritic-Martensitic steels (MOX-fuel)	Graphite Nickel-based alloys Ceramics Advanced austenitic steels	
Supercritical –Water-Cooled System (SCWR)	Austenitic, Ferritic-Martensitic steels ODS		Ferritic- Martensitic steels
Very-High-Temperature Reactor System (VHTR)	ZrC	Graphite Ceramics	Ni-Cr-W super alloys High temperature metall alloys

1.2 Seminars

The Nordic Gen4 seminars are very important for information sharing, competence build-up and for finding collaboration partners as well as to investigate the financing possibilities to make the network sustainable. In the present proposal, the continuation of the seminar on a regular basis is assumed. The seminars will be organized by network members from Sweden, Finland, Norway and Denmark every second year.

It is also important that young researchers will be actively involved in building the network. Spreading the knowledge, inspiring and training the young generation is crucial. Young generation nuclear societies are invited to the yearly seminar focusing on the latest research on Gen-IV in the Nordic countries and in the world. Universities from the Nordic countries involved in GenIV research are active members of the Nordic Gen4 network.

2. Network organisation

A schematic illustration of the activity organization for the Nordic Gen4 project is shown in Figure 2.

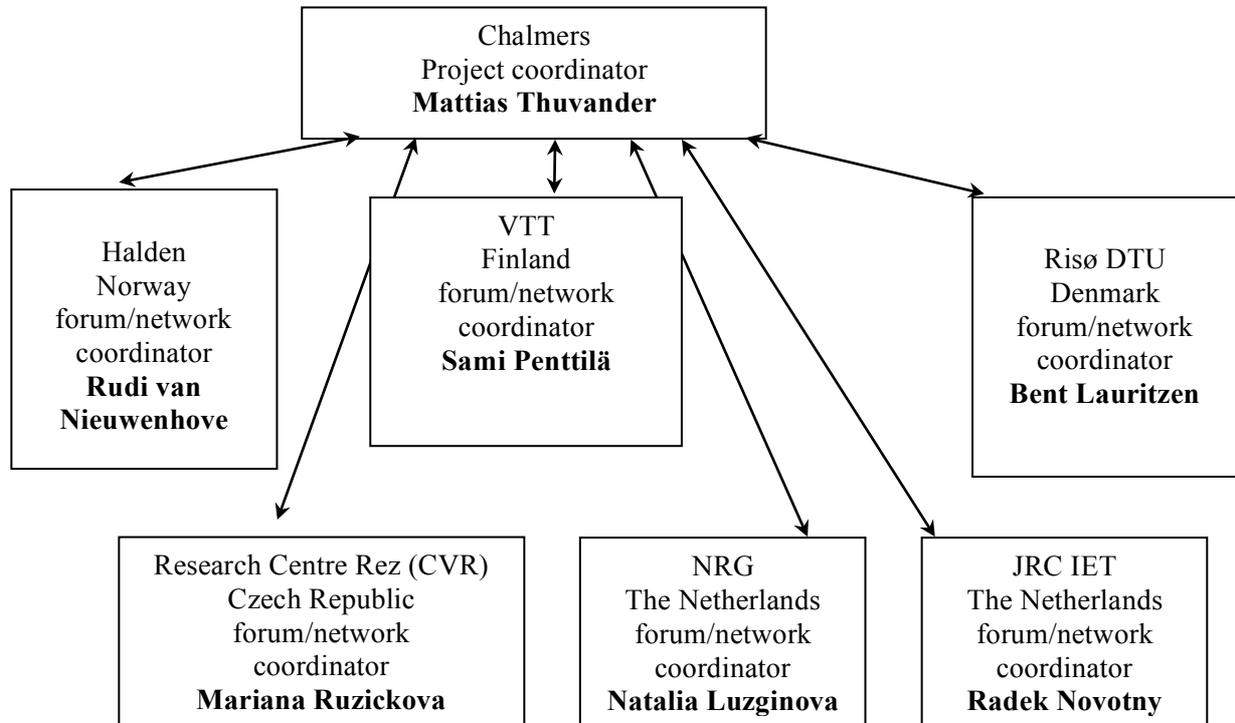


Figure 2. Schematic presentation of the activity organisation for the project Nordic Gen4.

Acknowledgements

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3. References

1. NKS project “NOMAGE4 - Nordic Nuclear Materials Forum for Generation IV Reactors”, <http://www.nks.org/>
2. David Bodansky, “*Nuclear Energy: Principles, Practices, and Prospects*”, Springer, 2004, ISBN 0387207783.
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<http://www.gen-4.org/PDFs/GenIVRoadmap.pdf>
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