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of State Corporation Rosatom

Innovative Technologies in Nuclear Modelling and Designing

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Oulu, Finland
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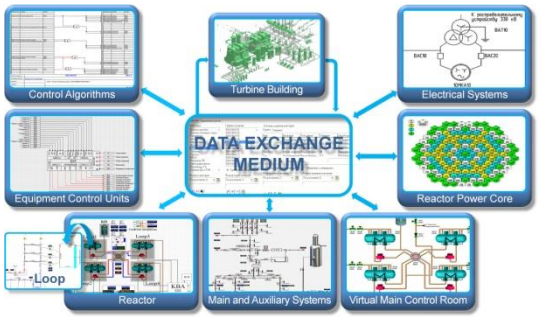
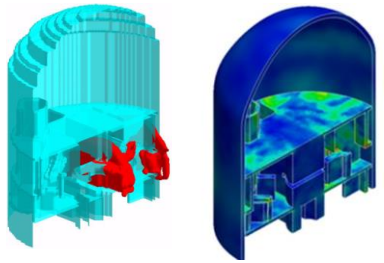
Outline

- JSC ATOMPROEKT. About us.
- Innovative Designing – How?
  - Virtual Power Unit
  - Supercomputer Technologies in Design





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JSC «ATOMPROEKT». Company history and projects

ATOMENERGOPROEKT
SAINT-PETERSBURG

LEADING INSTITUTE
VNIPIET

2013-2014

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Joint Stock Company
Scientific Research and Design
Institute for Energy
Technologies **ATOMPROEKT**

atomproekt.com/en

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Current projects

Nuclear power plants

Construction stage

- Beloyarsk NPP, Russia (unit 4, BN-800)
- Tianwan NPP, China (units 3-4, WWER-1000)
- Leningrad NPP, Russia (units 1-2, WWER-1200)
- Belarus NPP, Belarus (UNITS 1-2, WWER-1200)

Design stage

- Hanhikivi NPP, Finland (unit 1, WWER-1200E)
- Paks NPP, Hungary (unit 5-6, WWER-1200E)

Pre-design negotiations stage

- Ninhthuan -1 NPP, Vietnam
- El Dabaa NPP, Egypt

Nuclear power facilities

• Project of closed nuclear fuel cycle “Proryv” (“Breakthrough”)
• etc

Research reactors

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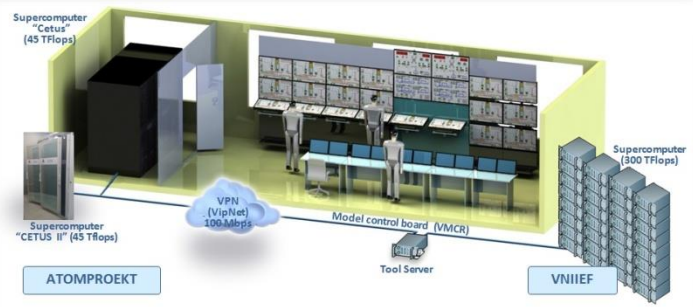
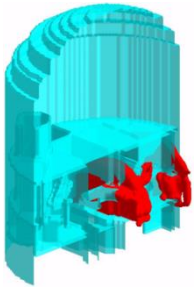
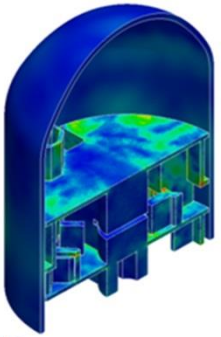
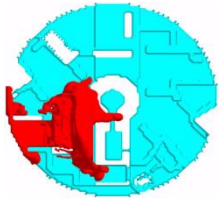
Application of Supercomputer technologies (SCT) for justifications of design decisions

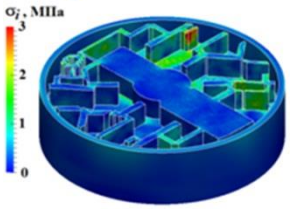


Development of Virtual Power Unit (VPU) for design supporting on life cycle stages

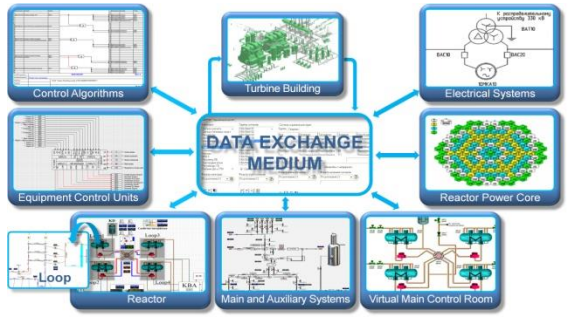








Innovative Designing based on Virtual NPP Technology



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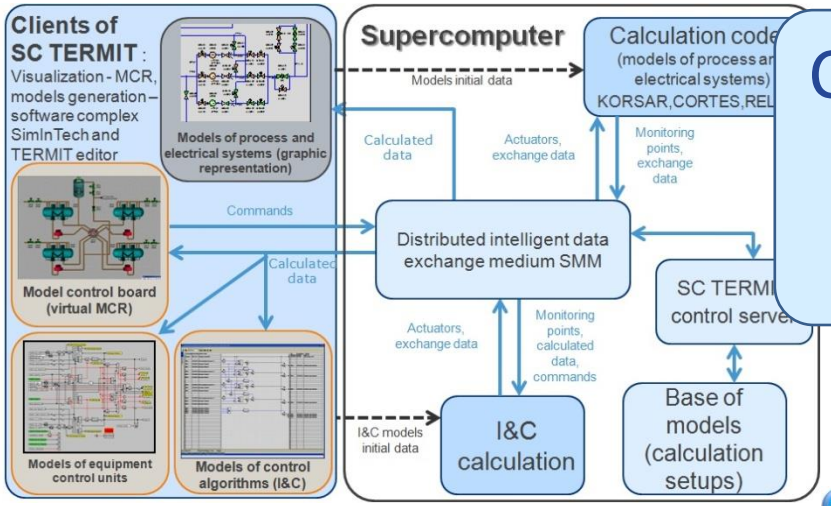
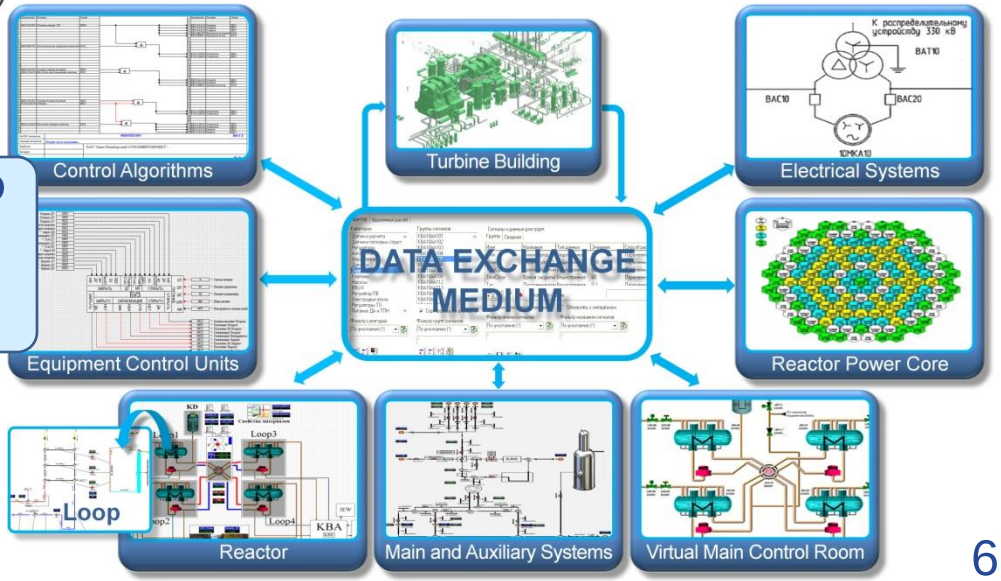
Complex Simulation Suite “Virtual Unit of NPP”

CSS “VEB”



Virtual Power Unit of NPP

VPU



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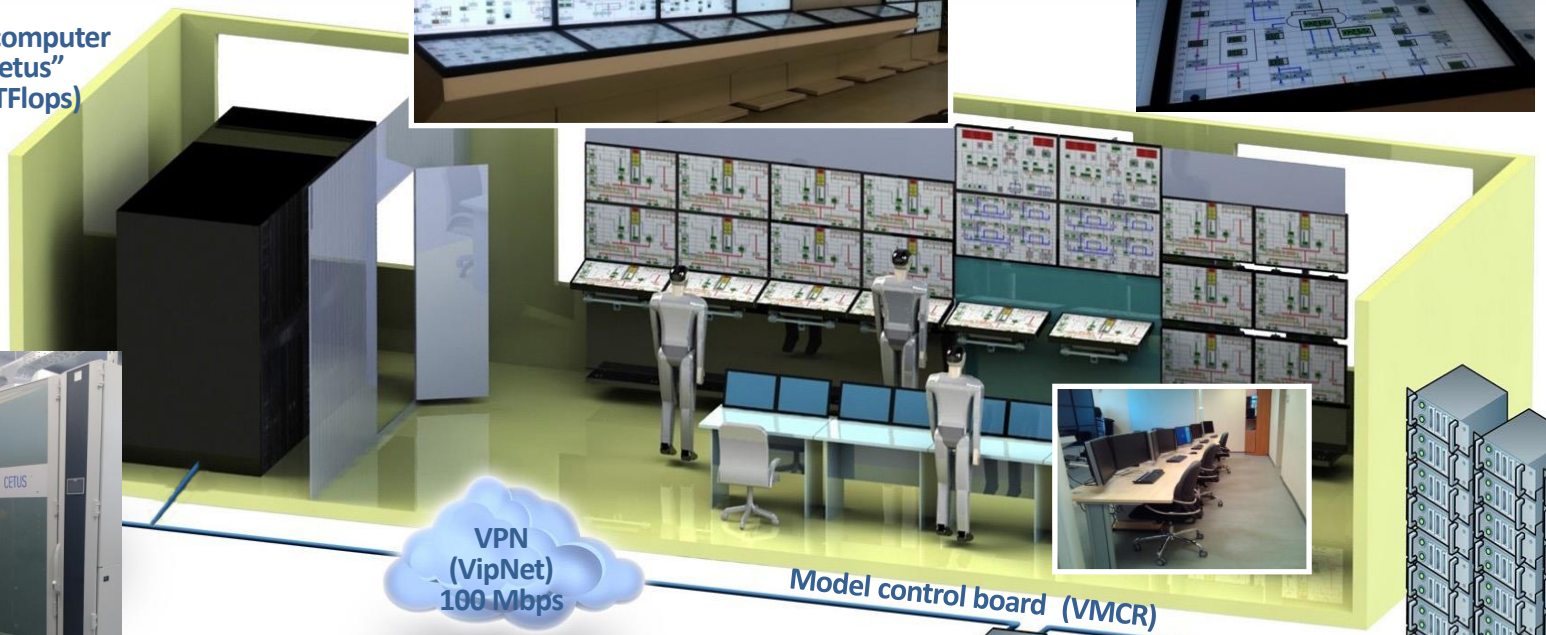
Supercomputer
"Cetus"
(38 TFlops)



Supercomputer
"CETUS II" (45 Tflops)

VPN
(VipNet)
100 Mbps

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Model control board (VMCR)

Tool Server

Supercomputer
(300 TFlops)

VNIIEF

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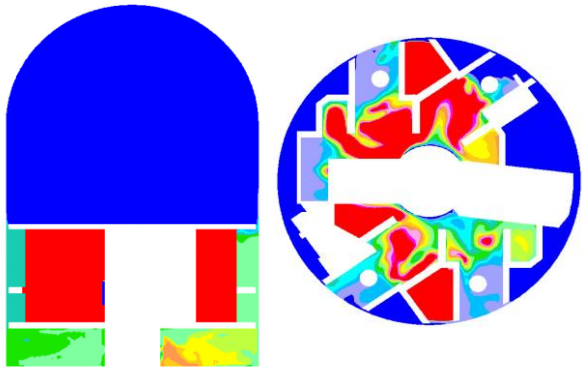
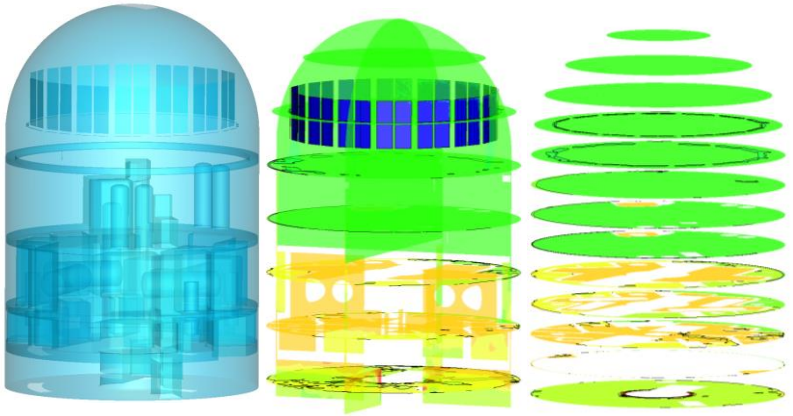
Application of CFD-codes for containment and cooling tower

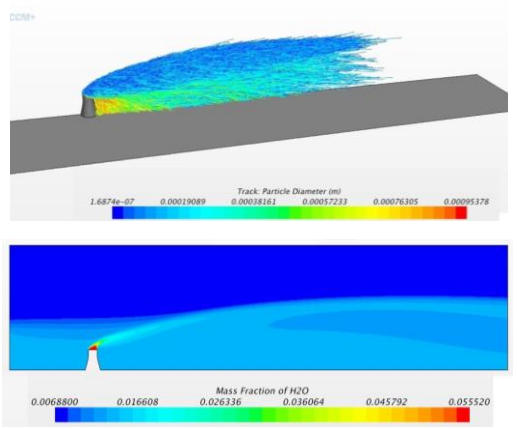
Justification of design solutions on the reactor compartment **ventilation systems** with complete 3D model (~3.5 million cells) of containment
3 months on 320 cores

Justification of the containment **passive heat removal system**, for example, at the ex-vessel stage of severe accident
(3 to 6 million cells)
3-6 months on 320 cores

Numerical simulation of drift deposition emitted from **cooling towers** to evaluate risk area
(10 million cells)
30 hours on 100 cores







STAR-CD, PGS-TK

STAR-CCM+

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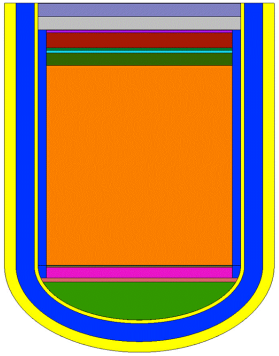
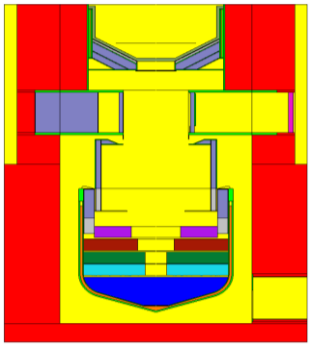
Nuclear and radiation safety calculations

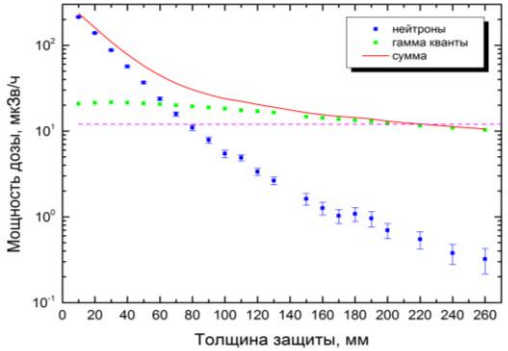
The dose rate in various areas during the reactor operations
50-100 hours on 240 cores

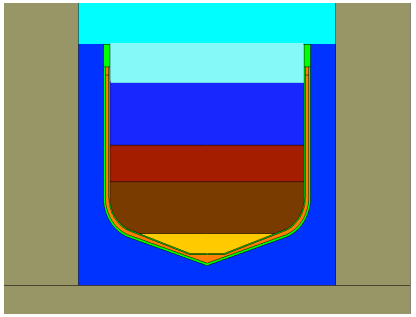
The radiation shields
50-100 hours on 240 cores

The criticality for all studies of severe accident includes large number of tasks ~30-100.
10 minutes on 240 cores.

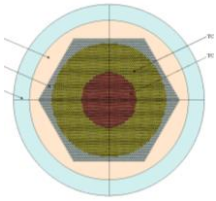


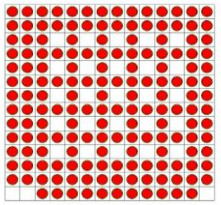


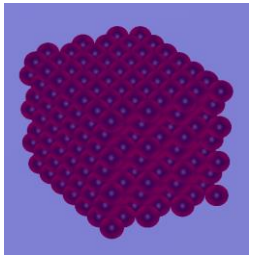




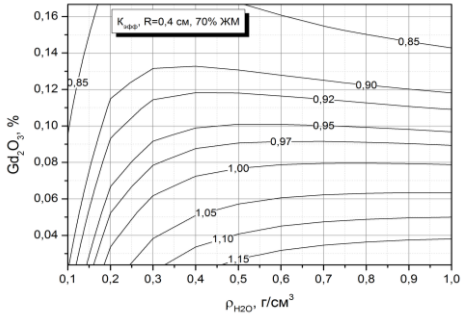
TDMCC code verification







TDMCC



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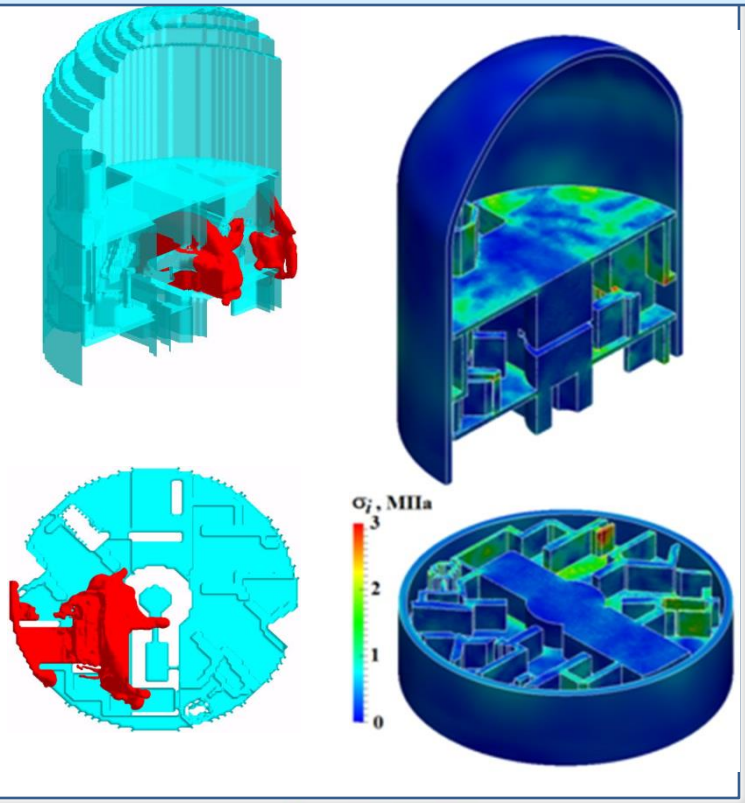
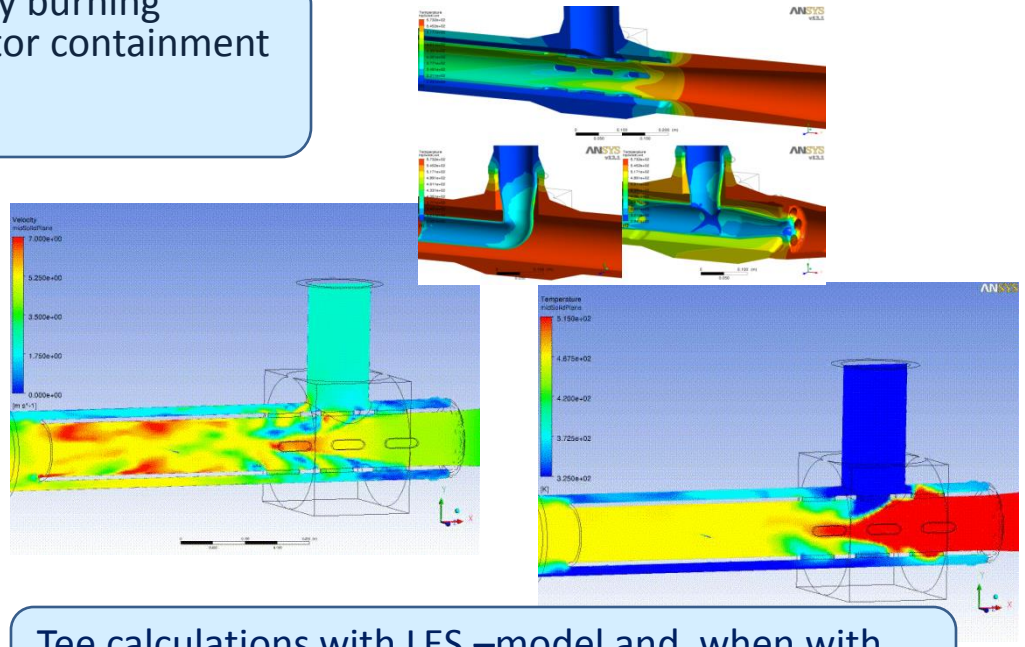
Coupled simulations

Calculation of loads on building structures caused by burning hydrogen-bearing mixtures generated inside a reactor containment under severe accidents (4.33 million nodes)
15 hours on 32 cores





Tee calculations with LES –model and when with temperature fluctuations (stress) on the inner and outer surface
2 months on 160 cores

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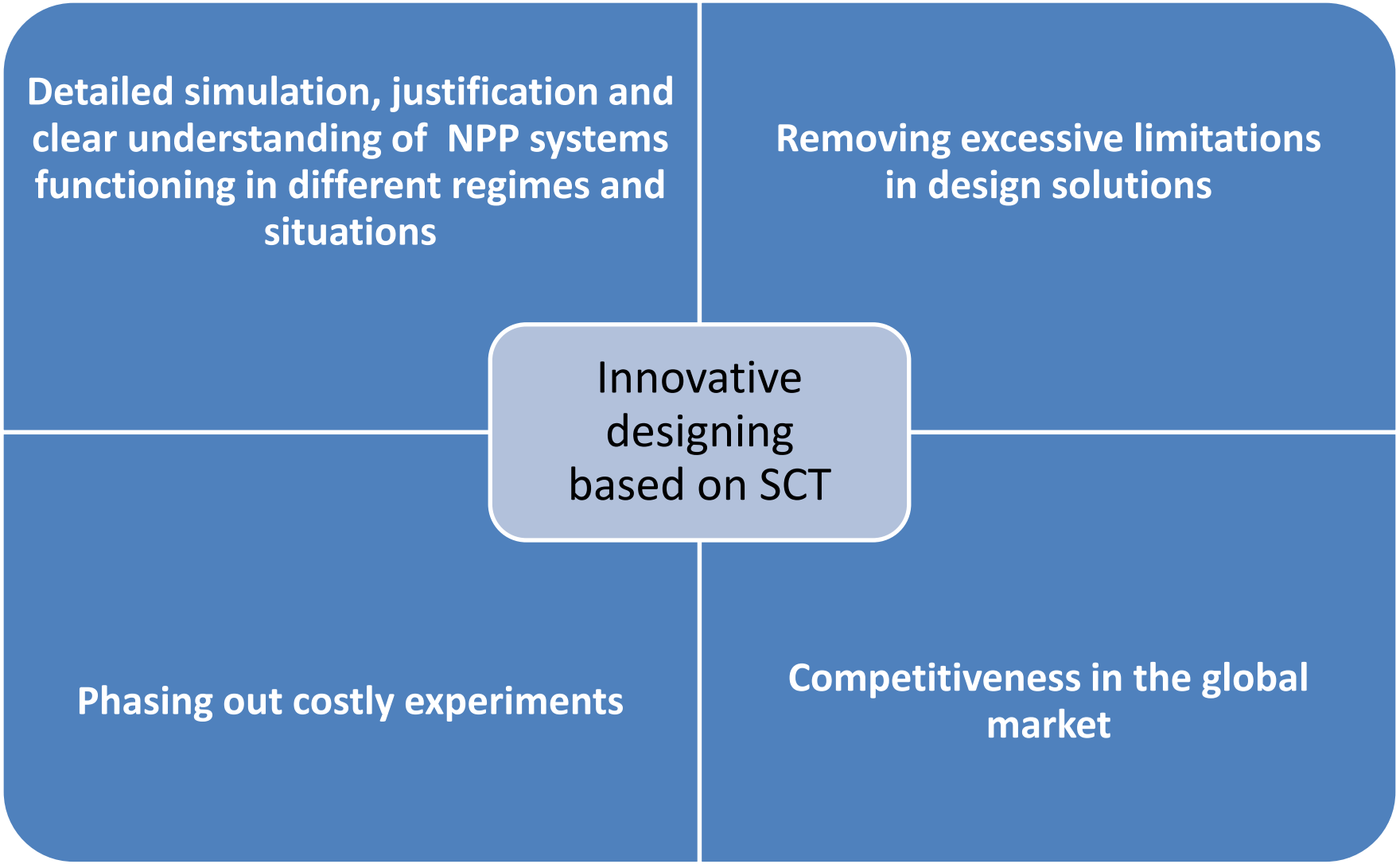

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Thank your for attention!

Questions?

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