

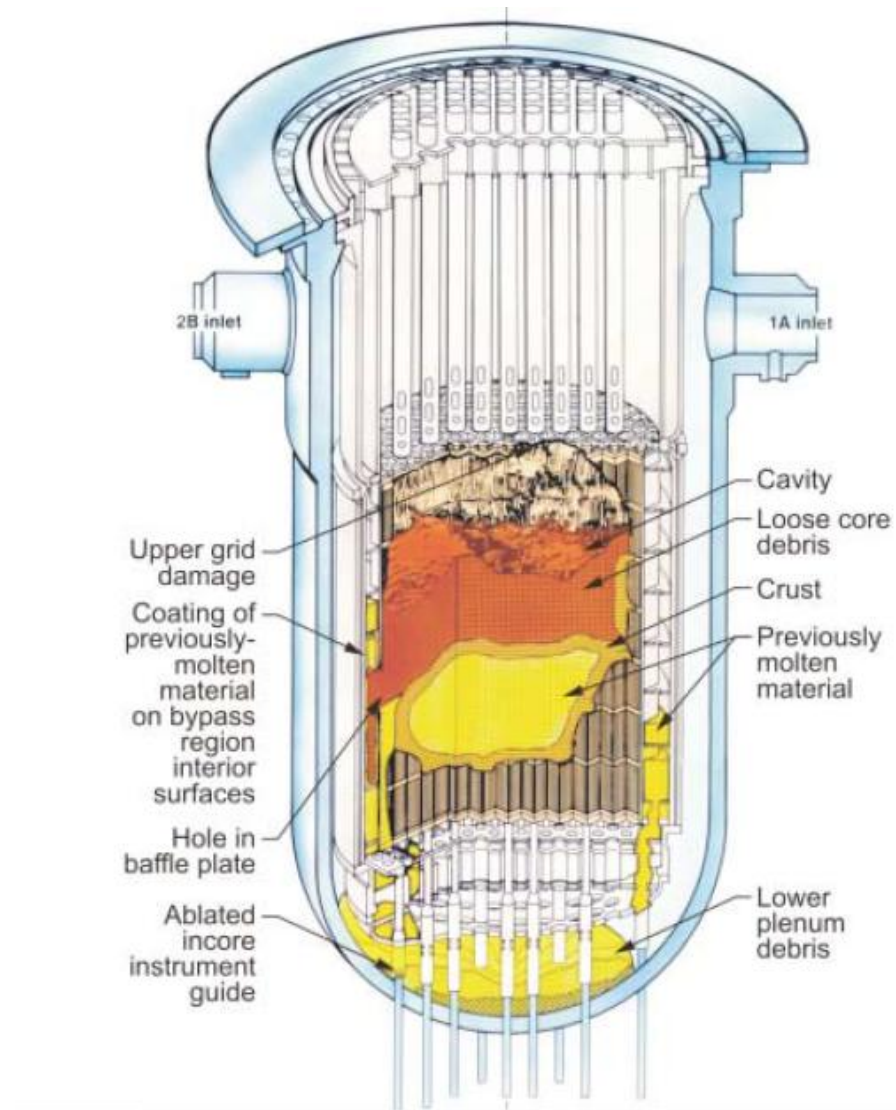


ÚJV Řež, a. s.

# Strategy for Severe Accidents – In Vessel Melt Retention

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NERS Conference

# First Severe Accident – Three Mile Island 1979



# History of Severe Accidents is Repeating

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- Chernobyl
- Fukushima
- Described Severe Accidents repeats with period of 10 to 12 years
- From the last Severe Accident at Fukushima we have 5 years
- As we cannot change the history, we have 5 to 7 years to find out , prove and justify fully qualified mitigation solution

# There are only two possible solutions

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- **We are not able to keep the melted Corium inside the reactor pressure vessel and we will have spread of Corium inside the reactor pit or cavity.**
- **Under all circumstances we are able to keep the Corium inside the RPV, with minimum probability that the RPV wall will be melted through**

# Key principles for ability to keep Corium inside the RPV

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- Ability to depressurise the primary circuit
- As soon as possible to flood the RPV cavity ( minutes)
- Generated steam to be removed from the cavity
- Flooding of the RPV cavity to be provided by passive means for first several hours if possible, than to assure continuous supply with cooling water with use of DG and pumps.
- To find most effective approach to remove the heat flux from the outer surface of the RPV.

# Is there already example for ability to keep Corium inside the RPV



- After extensive research and experimental work at the USA, first application of this strategy was applied on the WWER 440 at Loviisa/Finland
- After that US NRC confirmed this strategy for WEC AP 600 and AP 1000
- On nuclear power plants in operation this strategy is already applied or is intensively prepared on all remaining WWER 440, including NPP at Dukovany. Our goal is to prove this strategy application also on existing WWER 1000.



- Extensive research on application of this strategy on new design reactors is performed in China and Korea, even for reactors with 1400 MW
- Application of this strategy for nuclear power plants with power above 600 MW was for long time considered as not realistic option.
- Approach was significantly changed after approval of the European project HORIZON 2020 IVMR (In Vessel Melt Retention)
- ÚJV Rez is TASK 4 leader in this project, with goal to prove external RPV cooling for the WWER 1000.

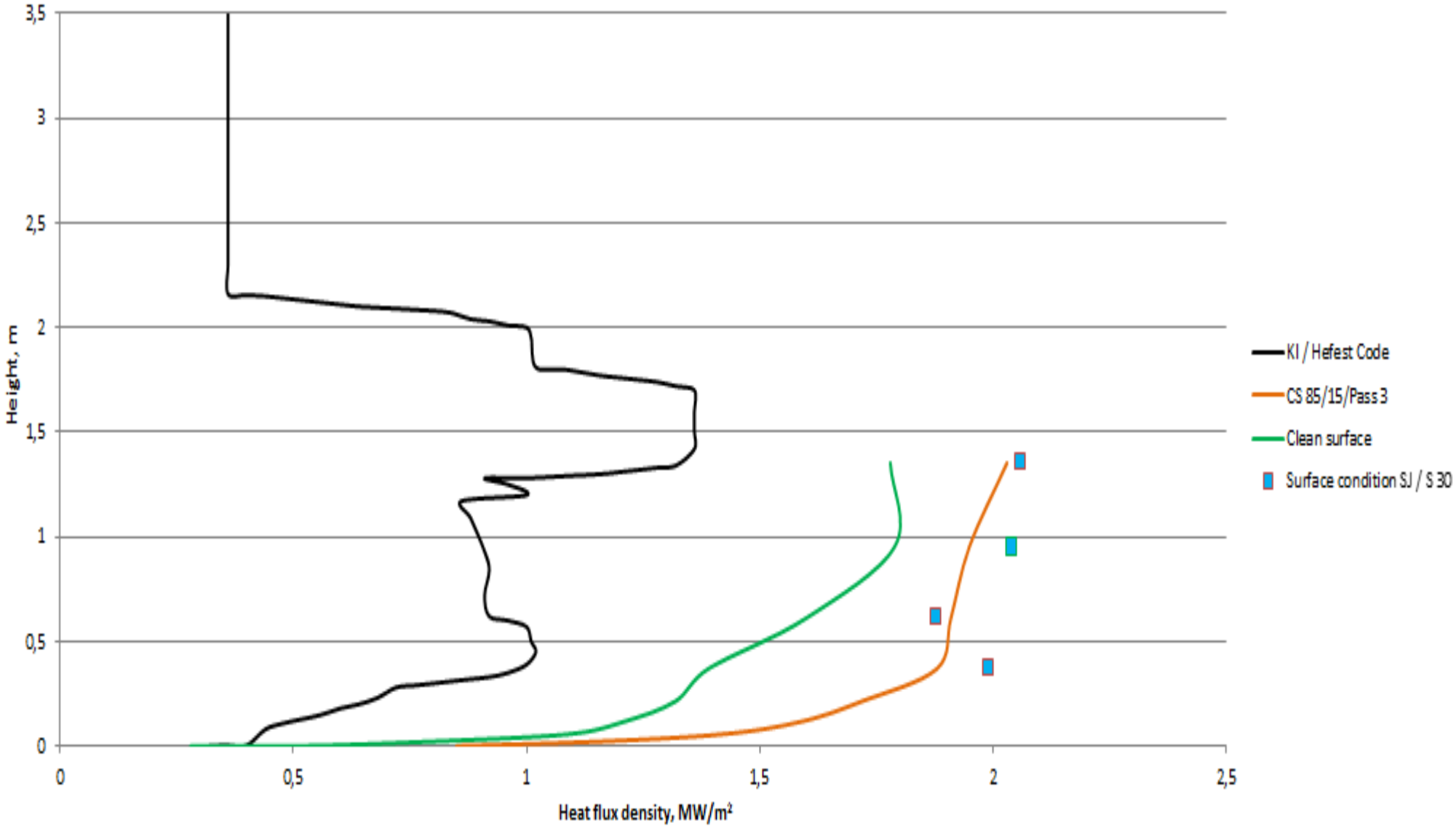
# Already confirmed results



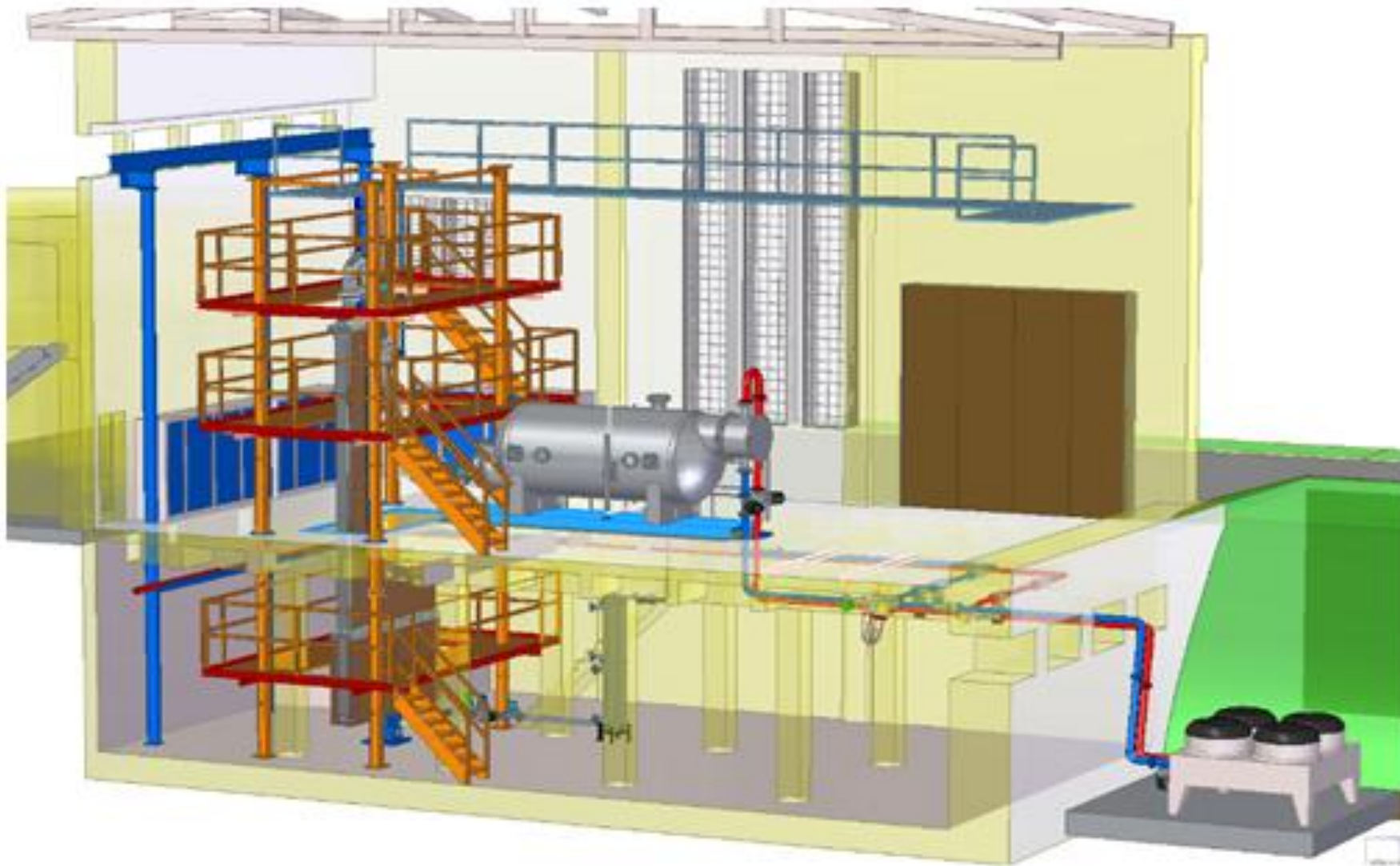
- **Project TACR Beta for the Czech Regulatory Body was finished in 9/2016**
- **Test facility was built as part of this project, which provides possibility of tests on samples in the cooling channel.**
- **Over 100 tests were performed with inclination from 0 to 90 degrees with different surface treatment, including the „cold spray“.**
- **We have learned very important knowledge for construction of the 2D cooling channel with full characterization of the WWER 1000 cavity**



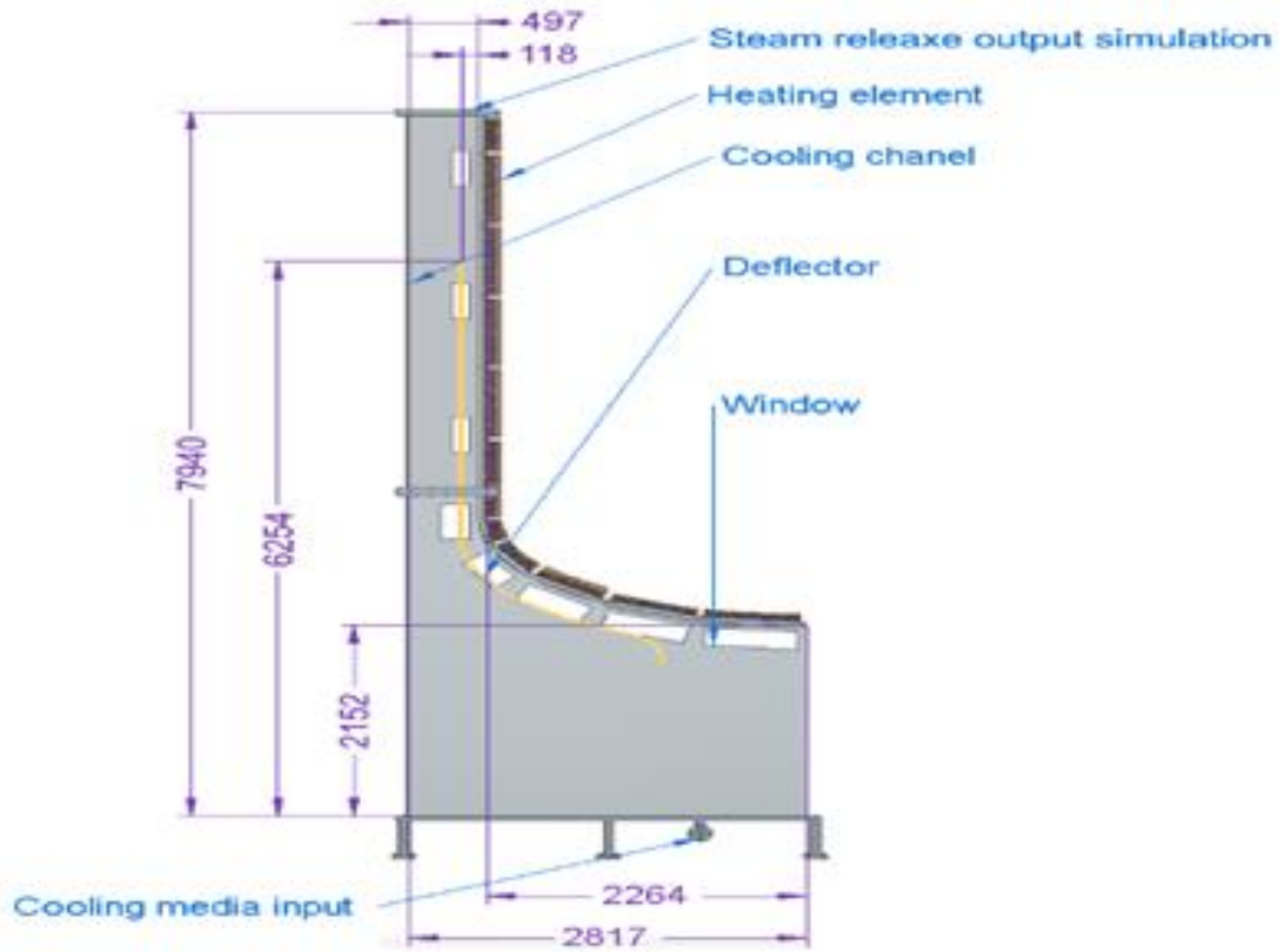
# Comparison of heat flux calculation with experimental results



# Large scale test facility to be build at UJV Rez



# Detail of the coling channel



- **Civil construction of the facility to be finished till 12/2016**
- **Full experimental facility to prepare for start of experiments till 3/2017**
- **Till 11/2017 first basic experiments to be finished**
- **Test matrix after 11/ 2017**
  - **experiments with clean surface**
  - **experiments with deflector**
  - **experiments with different surface state without and with deflector**
  - **simulation of different heat flux peaks positions and values**

- **At present is in general accepted that the In Vessel Melt Retention Strategy with use of the external cooling of the RPV is one of the most effective measures to prevent further propagation of the Severe Accident for water cooled reactors.**
- **Several NPPs in operation as well as new units under design and development has necessary systems installed**

- **Already performed analytical but first of all experimental research confirmed that the IVMR strategy even for higher power reactors , including the WWER 1000 is feasible**
- **Success of the large scale experimental programme under preparation at ÚJV Rez is necessary condition for justification this strategy for WWER 1000 Units**
- **We already have effective solution for the heat removal from the outside RPV surface,which significantly increases safety margin and assures minimum probability for the RPV melt through**
- **For described experimental and analytical work we have very strong international support**

# Many thanks



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- Thank you very much for invitation and your patience
  - I am ready to answer your questions