ISRM Commission on Underground Nuclear Power Plant (UNPP)

It was established in 2013 as a commission of the International Society for Rock Mechanics and Rock Engineering (ISRM)

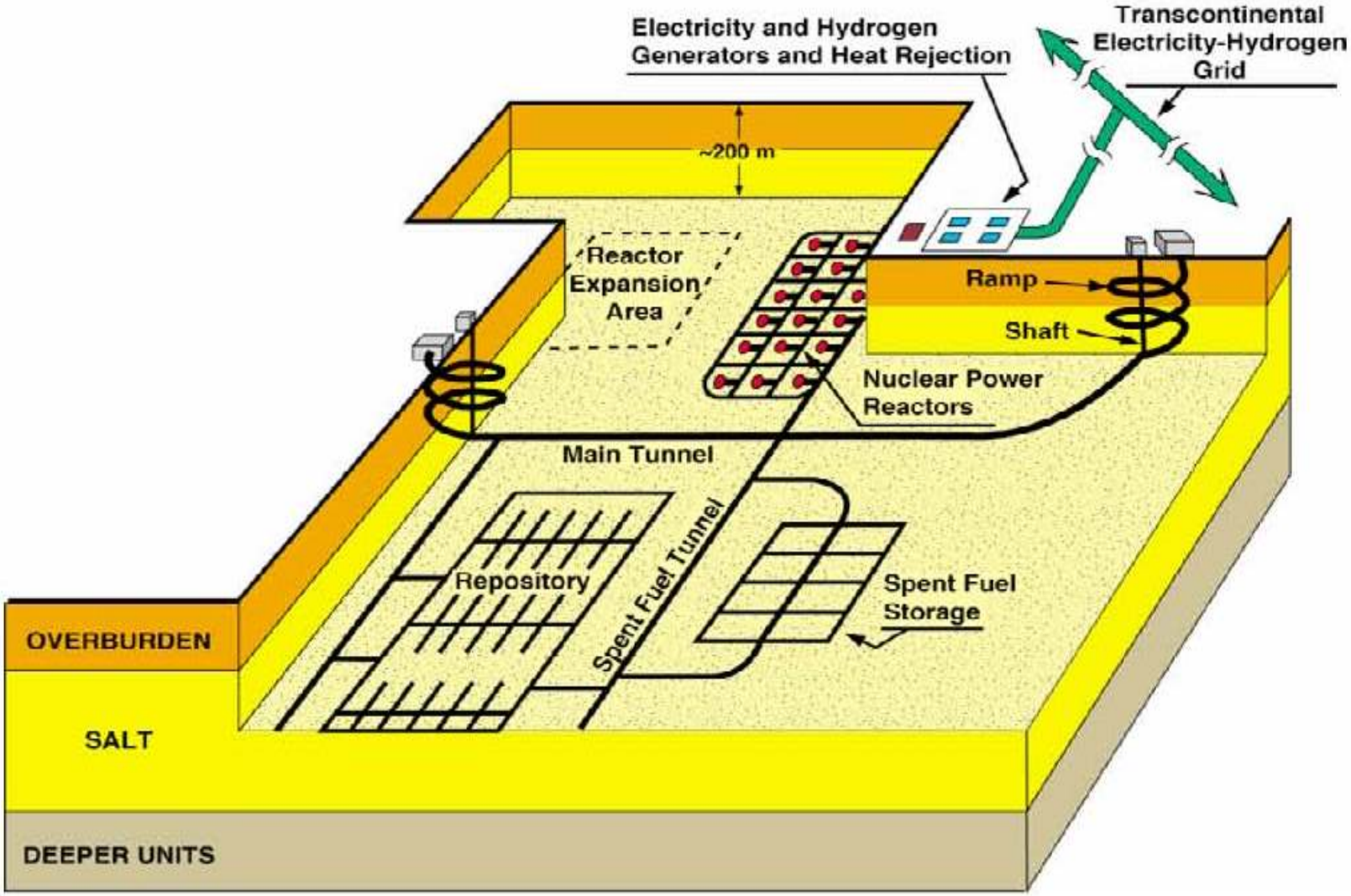
26 members from 13 countries

Commission Chair: Shunsuke Sakurai,

Past President of ISRM

Prof. Emeritus, Kobe University and Hiroshima Institute of Technology , Japan

Underground nuclear park



Outline abut Underground Nuclear Power Plants (UNPPs)

Purpose of the Commission

- Feasibility of nuclear power plants siting underground is studied.
- Considering the result of the feasibility study, the design and construction methodologies of underground nuclear power plants are discussed.
- As a final outcome of the Commission on UNPP, we are aiming at publishing a Guideline for the Design and Construction Methodologies of UNPPs, which will be hopefully published as one of the IAEA publications.

Current major results

- The ground vibrations due to earthquake drastically decrease with the depth. It was reported that the ground vibration underground in the depth of 30 m is approximately 1/10 of the ground surface vibration.
- In some countries there is a risk for large-sale destruction due to volcanic eruption. To eliminate such anxiety NPPs siting underground also have a great advantage.
- Even in a serious accident there will be no leakage of contaminated water from the cavern into the rock mass outside the cavern.

Back up Slides

A short history for the Commission on UNPPs

Pierre Duffaut & Shunsuke Sakurai (former ISRM President) met in Beijing (2011). Sakurai met other people concerned with the use of underground space in ACUUS held in Singapore, and Sakurai had a strong confidence to establish ISRM Commission on UNPP. Consequently, we apply to ISRM for establishing the Commission on UNPP (2012). The ISRM Board accepts the Commission (2013).

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Background of the commission
Why do we need UNPPs ?

- According to the lesson learned from the Fukushima Daiichi disaster, the most important issue is how to prevent the immediate scattering of radioactive materials right after the disaster.
- Concerning the safety of nuclear power plants, one of the urgent issues is to prevent the disasters due to earthquake, tsunami, and even human errors must be taken into account. Moreover, unpredictable cause including threat of terrorism currently becomes a crucial issue.
- Once a serious accident like the Fukushima occurred, we need tremendous amount of cost not only for decommissioning of the nuclear reactor, but also for decontaminating radioactive environmental destruction.
- In order to avoid any environment destructions due to various types of serious accidents of nuclear power plant, its underground sitting must be one of the potential options.

International platform for discussing the feasibility of UNPPs

Once a serious accident at an NPP occurs, large numbers of residents living around the plant are affected and are forced to evacuate. Moreover, a vast area around the plant is contaminated with radioactive materials.

In some cases, radioactive materials may be scattered across a national border. Therefore, the safety issue of NPPs must be discussed on an international basis, not just a domestic one.

Considering these circumstances, we decided to establish an international platform (ISRM Commission on UNPP) for discussing the feasibility of UNPPs from the various aspects of technical problems including costs and benefits.

Members of the ISRM Commission on UNPP (2015-prsent)

Nick Barton, Norway
Didier De Bruyn, Belgium
Pierre Duffaut, France
Charles Fairhurst, USA
Xia-Ting Feng, China
Sergei Gusak, Russia (2018-)
Il Soon Hwang, Korea (2018-)
Anatoliy Kozyrev, Russia
Jay Kunze, USA
C.F. Lee. Hong Kong
James Mahar, USA
Derek Martin, Canada
Nicolai Melnikov, Russia (2015-2018)
C. W. Myers, USA,
Matthew Pierce, USA
Shunsuke Sakurai, Japan (Commission Chair)
Norikazu Shimizu, Japan
Jae-Joon Song, Korea
Raymond Sterling, USA
Varun, USA
Philippe Vaskou, France
Joseph Wang, USA
Zhiguo Zhang, China
Jian Zhao, Australia
Yingxin Zhou, Singapore
Eda Quadros (ex officio), ISRM President
Seokwon Jeon (ex officio), ISRM VP Asia

(Current total number of the members is 26 from 13 different countries)

Earthquake and volcanic eruption for UNPP

The ground vibrations due to earthquake drastically decrease with the depth. It was reported that the ground vibration underground in the depth of 30 m is approximately 1/10 of the ground surface vibration.

This means that NPPs siting underground have a great advantage eve for the ground vibration due to earthquakes, resulting that cost for an earthquake resistance design can be reduced.

In some countries there is a risk for large-sale destruction due to volcanic eruption. To eliminate such anxiety NPPs siting underground also have a great advantage.

Leakage of water contaminated by radioactive substances

Some people worry about the leakage of water contaminated by radioactive substances when a meltdown or other serious accidents occur in an UNPP.

To overcome this problem, the cavern should be constructed so as to operate in such a way that the underground water pressure outside of the caverns is always higher than the inside pressure of the cavern. As a result, even in a serious accident there will be no leakage of contaminated water from the cavern into the rock mass outside the cavern.

In addition, even if contaminated water leaks from caverns, the water flow is generally very slow, because the permeability coefficients of rock masses are very small, allowing time to prevent radionuclide migration by using concrete injections to seal any permeable discontinuities.

This is entirely deferent from the case of geological disposal of high-level radioactive wastes, because there is no way to do an injection to prevent leaking water once the disposal are completed.

Thank you for your kind attention