QUICK BACKGROUND ON EU NUCLEAR POWER PLANT STRESS TESTS

September 2014, Joint Project

Key Stress Test results for the 4 units of the Paks nuclear power plant in Hungary:

√ ..... The original design was not fit to withstand **earthquakes** therefore many improvements in the past years were conducted to reach current seismic safety requirements. However, the Stress Tests revealed some weaknesses. Important buildings are not seismically resistant, like the fire brigade headquarters, which would be essential during accidents.

√ ..... The heat removal might fail in case of an earthquake, because components of the Essential Service Water System (ESWS), which is needed to remove the heat from the reactor, are not seismically qualified. The heat removal is a key issue, because it is needed to prevent the fuel from melting and the **development of a severe accident**.

√ ..... Without countermeasures, loss of all electrical power supply and heat removal triggered by an external hazard result in core damage after approx. 10 hours; boiling of the water in the spent fuel pools starts after 4 hours.

√ ..... The issue of earthquakes has been underestimated until now, but it still seems not to be taken seriously enough, because the deadlines are as far away as 2018 – while the plants are allowed to operate. The reactors at Paks showed to have very **little safety margins** (reserves), so they are not on the safe side: particularly soil liquefaction is a hazard. Soil liquefaction can cause an uneven settlement of the buildings. The Peer Review Team highlighted the importance of the planned measures. The analysis only to assess the existing situation of the buildings and the soil liquefaction phenomenon are to be performed by December 15, 2018. Any measures to fix the problem might need several more years; the plants are operated under this situation.

√ ..... According to Austrian experts it is unclear whether active faults in the site vicinity are adequately considered in the seismic hazard assessment which is of utmost importance for the reliability of the assessments. It could turn out that the current **protection against earthquakes** is utterly **insufficient**. An earthquake can occur any day!

√ ..... The Stress Tests also pointed out the serious problem with the machine room, which houses the safety important Essential Service Water (ESW) pumps: It is below the water level of the Danube. The penetrations of the machine room wall will have to be sealed – only until end of 2015.

√ ..... The measures to cope with a severe accident are not sufficient at Paks. The implementation of hardware measures had started before the Fukushima accident. However, as a result of the EU Stress Tests, the Severe Accident Management (SAM) hardware provisions are to be improved: Severe accident diesel generators will be installed, new water supply route to the spent fuel pools will be built etc.

Stress Tests - what is happening now?

At Hungary´s only nuclear power plant site Paks, currently four Soviet-type WWER-440/V-213 reactors are operating. The first grid connection of unit 1 was in 1982, unit 2, 3 and 4 followed in 1984 and 1986 and 1987, respectively. The original design lifetime was 30 years. The Hungarian Atomic Energy Authority (HAEA) has approved the lifetime extension program for all four reactors, and in December 2012 it approved a 20-year license extension for unit 1.

Concerning the main topics, the Hungarian National Action Plan lists 49 detailed actions. The implementation of measures is clearly scheduled with the specified timeframe to implement all the measures until the end of 2018.

A very dangerous fact was revealed: At Paks NPP a station black-out situation, i.e. when the plants lose all power-supply, this always is connected with the loss of Ultimate Heat Sink (UHS), which secures cooling of the core. Once UHS is unavailable, the heat removal via steam generator may be initiated - but without quick countermeasures the steam generator dries up within 4.5 hours; and core damage starts about 10 hours after the

loss of power – a severe nuclear accident is taking place. Without electrical power supply, also the circulation of the cooling water stops in the Spent Fuel Pool (SPF). Boiling could start after 4 hours already; damage to the cladding of the fuel assemblies may start after about 19 hours.

Several means providing alternate cooling and heat sink are necessary (increasing the amount of demineralized water, better supply mode for borated water to the containment etc.) and are to be implemented not earlier as December 2018.

The implementation of hardware measures for Severe Accident Management (SAM) had started before the Fukushima accident happened. As a reaction of the Stress Tests, further studies and measures are necessary to remedy deficiencies that the Stress Tests revealed. The topics to be resolved concern e.g. water supply to the spent fuel pools, multi-unit accidents, prevention of hydrogen explosion etc. Despite the fact that this is of high safety importance these measures are not pre-conditions for the approval of lifetime extension.

The most important SAM issue is the external cooling of the reactor pressure vessel (RPV) to prevent a major release in case of a core melting. This measure was only verified in the frame of limited experimental analyses. Thus, the Peer Review Team recommended considering a failure of reactor pressure vessel RPV failure. However, the National Action Plan did evaluate any measure to cope with consequences of RPV failure; the Hungarian regulator claims a failure of the external cooling of the RPV as being highly unlikely.

During the (slow) increase of pressure caused by steam produced during the external cooling of RPV, the unfiltered release of a big amount of radioactive substances through the stack could be necessary, because the Paks units are not equipped with a filtered containment venting system, and it is not intended to install such a system. HAEA requires the implementation of suitable measures to prevent over-pressurization of the containment to avoid the release of radioactive material to the environment; this should be realized with filtered venting or additional measures for internal containment cooling and is to be implemented by December 2018. Instead of a filtered venting system, which is installed in many reactors to filter radioactive substances before they are released during an accident into the environment, the operator is preparing the installation of an active containment cooling system. Currently it is not clear whether it can fulfil the necessary tasks.

The operator of the Paks plant interpreted the results for the public by saying: “The analysis showed that the results of the stress test do not require the implementation of any immediate intervention in the Paks NPP."[1] The nuclear regulator HAEA does not act as an objective source of information either: "The results of the stress test showed that the Paks NPP fulfils to the most rigorous European safety recommendations."[2]

Conclusions & Demands: The Stress Tests, which themselves are an exercise where the system is testing itself rather than being a truly independent and strict assessment, revealed that after years of continuous analyzing and improving those old reactors, many very serious issues went unnoticed. The safety culture of the Hungarian Nuclear Regulator HAEA cannot be seen as being sufficient, because the plants are not ordered for shut-down at least until those measures are implemented and confirmed as being sufficient. Which is hard to prove for this type of VVER, in particular when they are to be operated beyond their design life time. In addition, the power uprates which were performed during the last years accelerated the ageing process. Degradation effects of safety-related systems and components could significantly aggravate the development of an accident or even trigger a severe accident.

To remedy all design weaknesses (in particular wall thickness of the reactor building and location of the Spent Fuel Pool) of the outdated WWER 440/V213 reactor type is not possible. The combination of design weaknesses, ageing impacts and the seismic hazards revealed by the Stress Tests show that the Paks NPP life-time extension would pose an irresponsibly high nuclear risk. The four units at Paks should be shut-down immediately.

1 www.atomeromu.hu/sajtokozlemeny_20111102
2 becs.ensz.kormany.hu/az-orszagos-atomenergia-hivatal-sajtokozlemenye