FUTURIS 6: NUCLEAR RESEARCH

FRENCH SCRIPT

PRECOM

This nuclear reactor may lead the way to the power plant of the future. Irradiation studies at the nuclear core predict a safer, greener and cheaper atomic energy by the middle of the century. The first stage in research of a new generation of nuclear power plants - in this week's Futuris.

02:00 Generique Futuris

02:08 Petten reactor, Netherlands: Čerenkov effect, Jaap van der Laan set-up

At a depth of five meters, the bright blue glow of uranium decay illuminates the nuclear core of the European commission's joint research centre reactor in Petten, northern Holland.

02:24 SOT Jaap van der Laan / Program manager, NGR

"What you see down there is our major working horse, which is called High Flex Reactor. So downstairs there's fuel producing 45 MWth of power".

02:36 Animation: nuclear fission

In nuclear fission, atoms are split apart to form smaller atoms, releasing energy. Nuclear power plants use fission to produce electricity; in research reactors, such as the one in Petten, the chain reaction is being employed to conduct scientific studies.

02:51 SOT Jaap van der Laan / Program manager, NGR / Reactor close-ups

"A few of the tubes that you see coming up from the reactor are the experimental facilities, typically 5-6 meters long, and the tubing contains all the instrumentation, because we need to know temperatures and provide the right environment for the specimens to be representative for the reactor environment... This is one of the first generations of research reactors, built in the 1960s. But currently it is, I think, one of the five top facilities in the world."

03:25 Reactor building inside. Lift, airlock. Hot cells laboratory:
materials manipulation - graphite, steel, composite prototype

Jaap and his collegues position specimens of different materials (such as graphite, steel or innovative composites) inside the research reactor's core to let them degrade in the extreme environment for a given amount of time.

Irradiated examples are then transferred outside the reactor where they can be studied and tested in the so-called "hot cells" to check their behaviour and evaluate sustained damage.

Scientists need this knowledge to select a range of building materials for nuclear reactors of the future, which have to be much more efficient and clean than the ageing power plants currently in use today.

04:15 SOT Luigi Debarberis / Head of Nuclear Design Safety Unit, EC-JRC-IE

"The nuclear park in Europe is getting relatively old, and now there are big plans to extend their life, but this will only bring further another 10-15-20 years into life extension. Then - big choice is to be made. And, of course, one of the most interesting ideas is to replace not with the same type of concept, but with more advanced concept - like Generation IV."

04:36 Animation: Reactor generations

The first prototype of the fourth generation system is due in 2020, commercial operations expected to begin in 2040. Several competing technologies have been selected in order to form the basis of further research.

04:52 SOT Luigi Debarberis / Head of Nuclear Design Safety Unit, EC-JRC-IE

"They all have something in common: they are really an improvement compared to previous generation, and in particular they rely on the passive safety systems - so they rely less on human skills to manage potential safety events... They will also better use the resources, which is another point which should be mentioned. The reactors of today are in a sense not really sustainable for very long time - they burn uranium in a simple way, and only uranium. What you need is a reactor that can breed its own fuel, and can make reserve of it available for much longer span of time."

05:28 Archives: uranium mining/power plant/nuclear waste

Natural uranium reserves are limited, and their rapid exhaustion is unavoidable if nuclear reactors continue, as they do today, to use only a tiny fraction of the energy potential of uranium turning the rest into huge amounts of radioactive waste. A fourth generation reactor aims to recycle its fuel until it is fully spent, which would make production of electricity hundreds to thousands times more effective.

05:54 SOT Luigi Debarberis / Head of Nuclear Design Safety Unit, EC-JRC-IE

"It can potentially do much more. Today we're only extracting electricity out of fuel capacity of generating power, and we waste some of the rest of the power into warming up water for rivers and seas. There is an attempt in the new generation to use better directly the heat generated by the power plant to do other applications - like gazifying coal or producing hydrogen which can be a vector towards moving cars without emitting CO2 to the atmosphere."

06:16 Split screen: hydrogen production, drinking water, oil extraction

Future reactors may be twice as hot as the ones in use today, which will allow the excess heat to power up secondary applications - such as producing clean hydrogen fuel by thermolysis, desalination of seawater or even melting and extraction of yet unreachable semi-solid oil in bitumen sands.

06:36 Road to Cadarache. Road sign "Warning: wild mutant animals".
Construction area. Trucks.

The research will gather momentum in the near future with the introduction of a new experimental reactor in Cadarache, in France.
When its construction is complete in 2014, scientists will be able to conduct dozens of irradiation experiments simultaneously.

06:56 SOT (Fr) Gilles Beignan / Deputy Head of Reactor Studies Department, CEA - on the move in FRENCH

"Here you have the construction site of the future the research reactor Jules Horowitz, which several years from now will become a major element in European nuclear research. It's a reactor which is meant to support the future generations of reactors - Gen. III and Gen. IV, which we expect to see around 2040. This reactor will succeed the existing european reactors, which are about 40 years old and will cease operations in ten years' time."

07:30 Construction site. Gilles enters the building to present the reactor model

Just like the Dutch research facility in Petten, the reactor in Cadarache will be provide everything necessary and yet more materials'
for study under intensive irradiation.

07:49 SOT (Fr) Gilles Beignan / Deputy Head of Reactor Studies Department, CEA

"So, this is the profile model of the Jules Horowitz reactor and its nuclear appendixes. Here, at the center of this pool, you have the reactor core, where about 20 experiments will be taking place simultaneously when the reactor becomes operational in 6-7 years... It has a relatively small core size: the reactor's core measures 60 cm in diameter and 60 cm in height... basically a washing machine... But this reactor is of very high density, it produces up to 100 MWth - a considerable amount of power. And since we want to conduct twenty experiments simultaneously in different parts of the core, we need all these tubes and cables going there. And this 100 MWth core needs cooling : it's a water circulation-cooled reactor, and through these huge tubes cold water is pumped in from below the core and hot water is pumped out at the top of the reactor... We want to measure some physical henomenons directly, which is impossible to do in a power plant reactor... This research reactor is named after Jules Horowitz to honor the pioneer of reactor physics at the CEA. He's the man who played an important role in the 1960-1970s - he managed to found a group of scientists who were capable of calculating and verifying the right dimensions of a nuclear reactor's core and the ways to monitor and control it. He died in 1995 and so the research reactor of the XXI century carries his name."

09:40 Future reactor Jules Horowitz - outside

Today's studies are just the beginning of the road to the technological breakthrough essential to keep nuclear industry sustainable, competitive and safe in a world where energy demands are continuing to rise.

09:54 Generique FIN