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News Clip, Small Modular Reactors

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Background: A few weeks ago we made our LinkedIn followers aware of a 16 MW wind turbine being installed offshore in China. It is allegedly the biggest of its type worldwide and definitely a contribution to the carbon-neutrality trend that is being pushed by politicians and mainstream media.

Now we are reading about a successful acceptance test of a small 125MW modular nuclear reactor, also in China. Due to the CO₂-free energy production of this type of plant we decided to look more in detail into this matter.

Introduction

People following the power generation industry can observe the race towards always higher-capacity equipment. We were surprised by the news a few weeks ago about the installation of a 16 MW wind turbine in an off-shore windfarm in China. Solar farms are being planned with panels that exceed already 500 W and combined cycle plants are already equipped with 450 MW gas turbines. 571 MW combustion engines from GE are already on the market. The aforementioned goes hand in hand with the zero-CO₂-emission commitment of many governments and the trend towards carbon neutrality.

A reverse trend – the reduction of size and capacity – can be noticed in the nuclear power industry: the announcement of a successfully completed acceptance test of a small modular reactor – again in China, what else is new – signals a new approach for this, still, controverted technology. From our perspective and in favor of a healthy country's energy production mix, this trend should be followed upon. Specially for Mexico, that has only one nuclear power plant in Laguna Verde with 1970-technology, the small modular reactor could be an interesting alternative in view of the aforementioned balanced energy matrix that would benefit the country.

The Linglong One ACP100

On July 13th and 14th several Chinese newspaper announced a successful factory acceptance test performed on the core module of a 125 MW small Modular reactor. In the wake of a demonstration project, the module will be delivered to the operating Changjiang Nuclear Power Plant in the south china Hainan province.

So far, Nuclear Power Projects involved the construction of high-capacity power blocks. In Germany the pressurized water reactors of Konvoi projects in the '80ies involved the use of one 1300 MW steam turbine manufactured by KWU/Siemens. The latest third generation pressurized-water-reactors from French Framatome / Areva have an output of 1600 MWe.

Most ventures of this size, involve tailor-made projects, iterative design changes during construction, lengthy construction times, complex local regulatory frameworks, bureaucratic safety approval processes, and, last

not least, incontrollable cost overruns. Thus alternative ways of developing this industry were on the table since of the early 2000.

The latest approach in the nuclear power sector is building smaller plants, in the range of 100 MW – 300 MW, for a more localized use. Following this new route, the Nuclear Power Institute of China (NPIC) is developing the 125 MW Linglong One ACP100.



The core module of the world's first commercial small modular reactor (SMR) project passed final acceptance of construction on July 13, 2023. Photo: China Central Television

The design was approved by IAEA (International Atomic Energy Agency) in 2016 and, as mentioned, the core module passed its final factory acceptance test. The Small Modular Reactor (SMR) is a pressurized water reactor (as opposed to the boiling water reactor), independently designed and developed by NPIC, and manufactured by First Heavy Industries.

The core module is the key component of the Linglong One and includes the main equipment of the primary circuit (radioactive) like the pressure vessel, the steam generators, main circulating pumps. The secondary circuit (conventional) will include most likely the steam generating and power transforming equipment. In



the next years the equipment will be installed at the Changjiang NPP as a demonstration project. It is estimated that the project will have a total construction time of five years.

The goal is producing energy for meeting the needs of more than 500.000 households. The vision behind these new SMRs includes industrial steam production, district heating & cooling, as well as seawater desalination.

Once the project passes its trial process, mass production of the core module can be developed. A less complex regulatory framework due to heightened safety features should also be taken into account. At present the concerns are still focused on the management of the radioactive waste.

We consider the Linglong One ACP100 project as a promising initial step for the future use of nuclear power contributing to lowering the carbon footprint, a circumstance everybody is talking about these days. Latin America lags heavily behind installed NPPs worldwide, while Europe, USA and Asia are the leaders (<https://www.iaea.org/newscenter/news/iaea-releases-2019-data-on-nuclear-power-plants-operating-experience>). In Latin America Brazil (Angra 1 y 2), Argentina (Atucha 1 y 2, Embalse del Río) have a certain “nuclear-power-generating” history, while Mexico has only one plant with two blocks (Laguna Verde 1 y 2). Even taking into account that it will take most probably another 5 years until we will have more experience and hard figures around the operation of SMRs, we would consider this technology as one to follow up on since of now.

Insurance Aspects

Due to the nature of the fuel for nuclear power plants, the insurance for the SMR represents a challenge also for the insurance industry. The fact that a possible accident can trigger a radioactive contamination with severe consequences to third parties, requires a special treatment on behalf of the insurance industry. The events in Three Mile Island, Chernobyl and Fukushima, showed the world that catastrophic scenarios are possible and that adequate indemnification schemes are needed to compensate for the damage caused, also in view of the future development of a technology that receives intense public and political headwinds after a nuclear accident.

The operation of a nuclear power plant has two main features that makes the insurance through a single carrier unfeasible. It is the combination of a very low-frequency, but high-severity catastrophic radioactive accident and the relative small number of nuclear plants operating worldwide, that does not allow for an adequate premium calculation due an insufficient statistical basis. It is impossible with the data at hand obtaining a worldwide balanced portfolio, also because the overall third party liability is extremely difficult to estimate.

The unsplitable liability (capacity requirements) for one single carrier – be it an insurance company or a reinsurer – led to the pooling for the coverage of nuclear risks, i.e. several insurance companies in a country jointly assume a fix share of a particular group of plants.

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With this pooling arrangements, the insurance carrier has certainty about its commitment, that is limited to its share in the pool. An accumulation risk through other channels is excluded. Reinsurer follow the same scheme through international pooling mechanisms.

Material damage following uncontrolled radioactive chain reactions, overheating of a core element, or accidental contamination is thus covered by the pool, as is the third party liability of the NPP operator.

With respect to the risk engineering, it should be noticed that the communication flow among the pool members is not restricted only to the policy wordings and coverages, but extends also to risk analysis, prevention and improvement. Highly specialized pool-engineers visit the NPPs and provide the basis for the risk assessment, underwriting and management. Recommendations are strictly followed up on and have their reflection on policy conditions. Fire and machinery breakdown are, in terms of frequency, the most sensitive exposures and thus the most looked-after aspects during the inspection and follow-up of recommendations.

If the Small Modular Reactor approach of the nuclear industry develops as we expect and a mass production of small reactors will be the trend, new challenges for the insurance industry lay ahead. Nevertheless, the nuclear pool's engineers have accumulated considerable international experience and we are confident that they will contribute in maintaining the high safety standards that characterizes this industry.

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