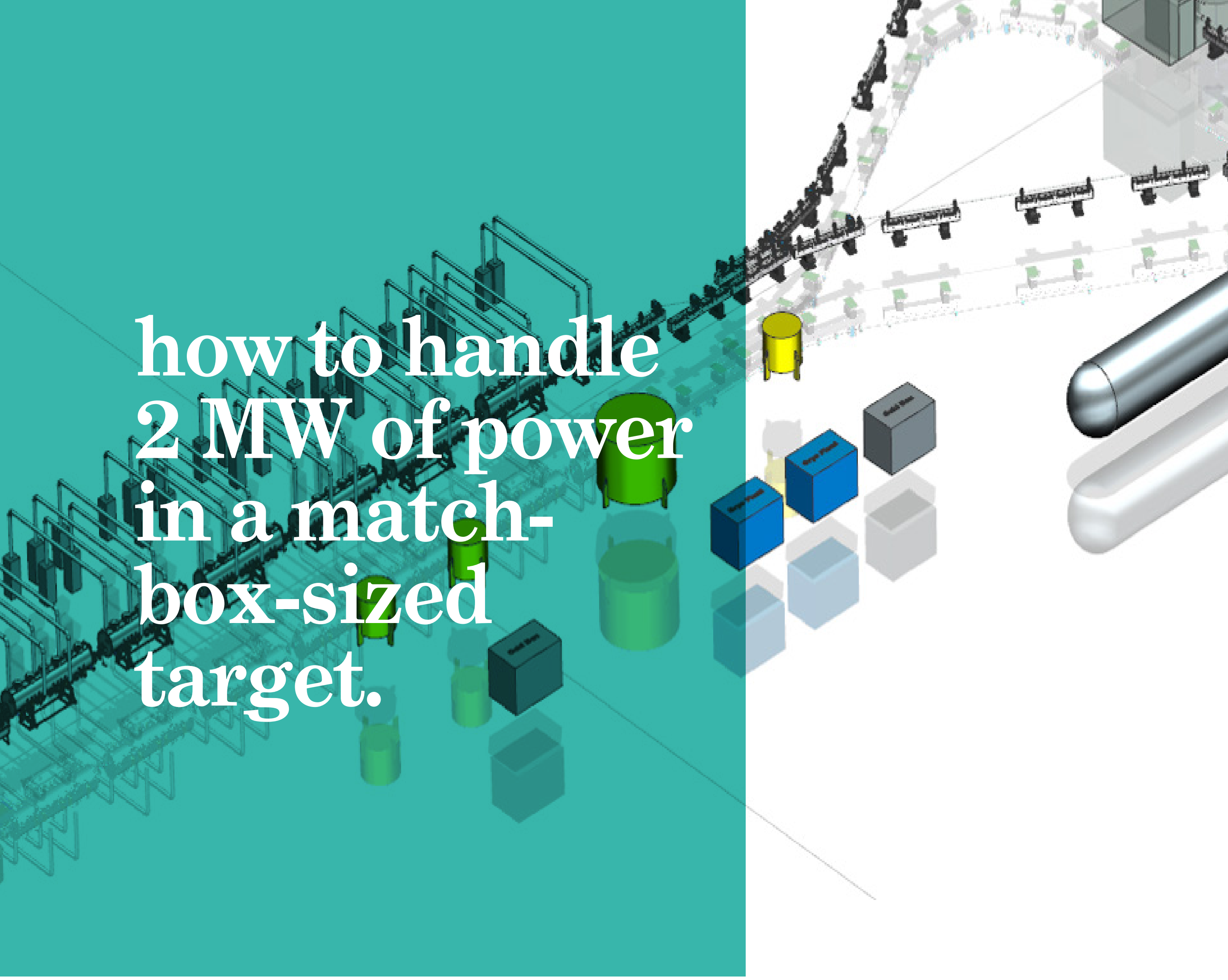

# how to handle 2 MW of power in a match-box-sized target.

Radioisotopes are widely used for medical diagnostics and treatment such as cancer care. In particular, the Mo-99/Tc-99m system is the most commonly used medical radioisotope in the world with tens of millions of diagnostic procedures annually. Unfortunately, the current production method relies on uranium fission and yields a lot of nuclear waste. In the framework of the SMART project, IRE develops a novel production facility for Mo-99 that relies on exposing a molybdenum target with high-energy electrons (the LightHouse Isotopes concept). The planned factory will supply a large part of the global Mo-99 demand without the need for a nuclear reactor and thus, almost without nuclear waste

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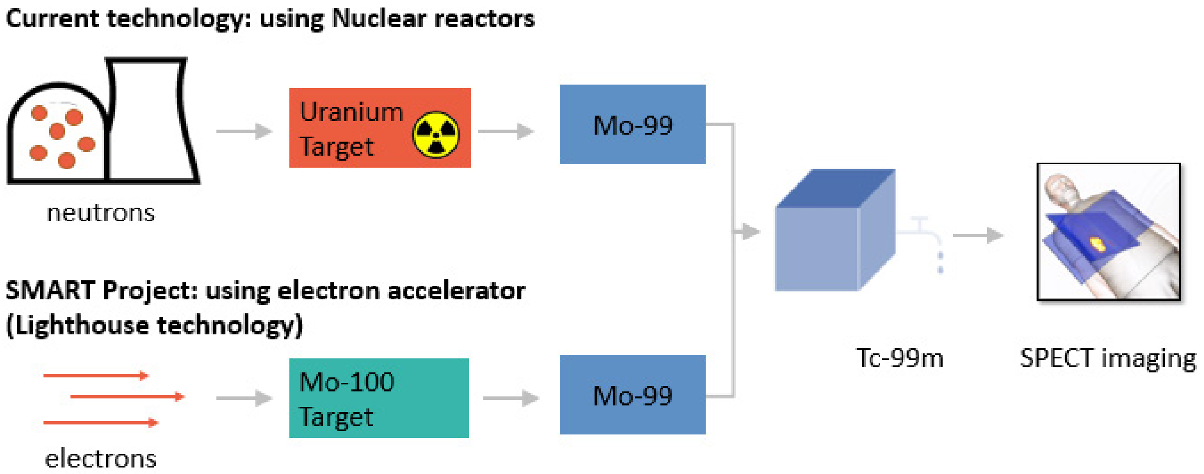
With the exposure module, DEMCON is developing the heart of this groundbreaking factory. It comprises 1) the target where the electron beam hits the molybdenum target and the Mo-99 isotope is produced under the generation of extreme heat, and 2) the systems to extract the activated target and replenish it with fresh molybdenum (Mo-100).

In 2021, we had a successful concept verification on a miniaturized version of the target. This demonstrator showed that the design of the target could withstand the heat , and that the cooling concept functions as desired!




Two key challenges in this project are cooling of the target and managing the intense radiation during exposure. The target is irradiated by a high-energy electron beam, resulting in extremely high power densities. We have to cool 2 megawatt (MW) of heat in a matchbox-sized target. Without cooling, the target would melt in 20 milliseconds. To ensure sufficient cooling, we use liquid sodium as the coolant. Liquid sodium, a metal with a melting point of around 100°C, has similar hydrodynamic properties as water. It has some disadvantages, such as its flammability and corrosivity, but has an extremely high thermal conductivity. Therefore, we extract heat very effectively from the target.

The intense radiation, on the other hand, causes all structural components to suffer from radiation damage. Materials swell and become brittle, causing components to detoriate quickly. Challenges include selecting suitable materials, experimentally quantify unknowns and designing a modular system, in which parts can be maintained relatively easily.

The contribution of DEMCON Multiphysics lies in the design and analysis of the cooling system, structural strength, radiative heat loads and shielding. Colleagues from DEMCON Advanced Mechatronics are responsible for the mechanical system design of the target, the system around it and the experimental setups. We are proud to have a pivotal role in this challenging and innovative project.

Our colleagues Johannes Jobst and Josée Kleibeuker explained how to handle 2 MW of power in an irradiation target that has the size of a matchbox in a public Tech-Talk. This part is key in the process of producing the medical radioisotope Mo-99 for cancer diagnostics, without the need for a nuclear reactor.

**WATCH HERE THE TECH-TALK**