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TItle of the project:

Floating Research and Purification Center for the Gulf of Gdańsk: Modern Form of Marine Architecture as a Response to Contemporary Environmental and Climate Challenges.

At the bottom of the Baltic Sea, particularly in the Gulf of Gdańsk, lie shipwrecks and large quantities of chemical weapons from World War II. Substances such as mustard gas, phosgene, and sarin, sealed in corroding containers, pose a serious threat to the environment and public health. These toxins can enter the food chain, contaminate seawater and sediments, and ultimately endanger the local economy, which depends heavily on fishing and tourism.

At the same time, coastal areas — including the Gulf of Gdańsk — are increasingly affected by the consequences of climate change. The ongoing melting of glaciers and the thermal expansion of warmer ocean masses are causing a gradual rise in sea levels, which demands flexible, resilient engineering solutions.

In response to these challenges, an innovative Research and Purification Center has been designed, located 1.2 km off the coast of Sobieszewo Island in Gdańsk, at a depth of 12.5 meters. The facility is mounted on hydraulic piles anchored into the seabed, allowing the structure to adapt to fluctuating water levels and to be elevated by up to 5 meters. This feature protects the building from storm surges and future flooding events.

Each pile is equipped with hydraulic actuators made of steel with a diameter of 150 cm. Water pressure acts on the surface of a piston, which moves along the cylinder; this movement is transferred by a piston rod, lifting the entire structure. Additional stability is provided by a floating foundation, which operates based on buoyant force — making the facility semi-mobile and resilient to long-term sea-level changes.

The entire structure is engineered to withstand harsh marine conditions — walls and slabs are made of waterproof and fire-resistant materials, ensuring durability, safety, and long-term functionality in extreme coastal environments.

The multi-level facility is divided into five functional zones: a representative and administrative section, living quarters for the on-duty crew, a temporary storage area, and two specialized laboratories — one for chemical analytics and one for robotics and telemetry. The center’s mission is to identify and recover chemical weapons from the seabed using

advanced technologies, including autonomous underwater drones, sonar systems, laser scanners, and AI-based tools capable of recognizing shapes and detecting underwater anomalies. Simultaneously, the facility will conduct continuous water and sediment quality monitoring to assess contamination levels.

The center is designed to be entirely energy self-sufficient, powered by both wave and wind energy. The wave energy system operates through a mechanism of floating modules that rise and fall with the waves, moving pistons that transfer kinetic energy to a rotor, thereby generating electricity. This ensures a continuous energy supply without reliance on external sources.

The architecture of the structure — dynamic and austere — reflects the character of the surrounding seascape while symbolizing its mission: to support science, protect the environment, and adapt to an evolving climate.