TRISO FUEL MANAGEMENT DEPENDING ON THE CHOICE OF THE FUEL CYCLE RESEARCH CURRENTLY CONDUCTED AT INCT, WARSAW, POLAND

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Technical Meeting on Back End of the Fuel Cycle Considerations for Small Modular Reactors

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OUTLINE

- Nuclear Power Plans in Poland
- INCT in EU projects related to SNF and HLRW
- TRISO spent fuel management studies
- Radioactive Waste Management in Poland
- Conclusion

Nuclear Power Plans in Poland

- **Nuclear Power Plant**

Poland plans to have nuclear power from about 2033

- **High-temperature reactors**

The Polish government plans to build a cogeneration HTR of 200-350 MWt for process heat, and before this a 10 MWt experimental HTR at Swierk

- **Small modular reactors**

Poland has a number of energy-intensive industrial companies, among them, Synthos, KGHM, and PKN Orlen, planning modernization of plants to include new small reactors

INCT in EU projects related to SNF and HLRW

- Advanced fuels for Generation IV reactors: reprocessing and dissolution
- Actinide reCycling by SEParation and Transmutation
- Safety of ACtinide Separation proceSSes
- GEN IV Integrated Oxide fuels Recycling Strategies
- Characterization of conditioned nuclear waste for its safe disposal in Europe
- European Joint Programme on Radioactive Waste Management

The National Centre for Research and Development

Funded by the European Union

HTGR RESEARCH PROGRAM IN POLAND

- Strategic Program financed by the National Centre for Research and Development (NCBiR): "Social and economic development of Poland in the conditions of globalizing markets" (GOSPOSTRATEG): **"Preparation of legal, organizational and technical instruments for the implementation of HTGR reactors"**

Scientific consortium: Ministry of Climate and Environment, National Centre for Nuclear Research, Institute of Nuclear Chemistry and Technology

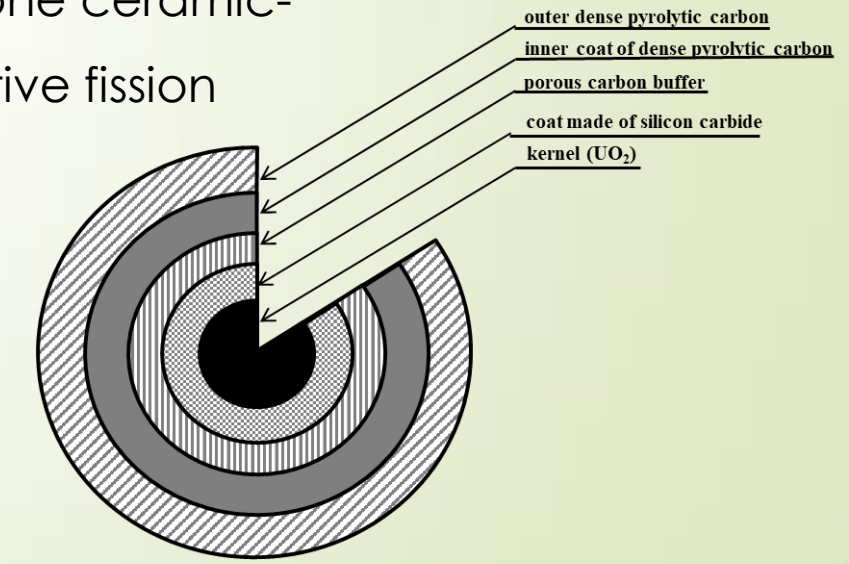
The support for the coordination of preparations for the practical use of HTR reactor in the Polish economy. There is planning the construction of the first HTR reactor with a capacity of approximately 150- 300 MWth before 2031.

- Horizon Europa GEMINI 4.0 - **GEMINI For Zero Emission**

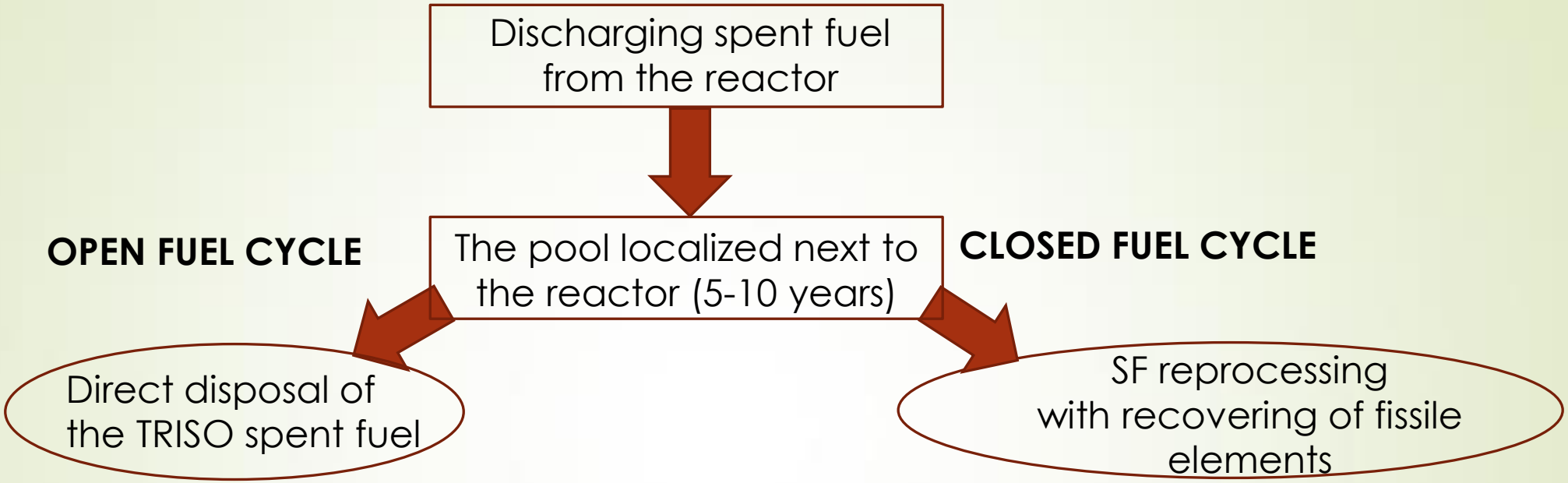
Launched in June 2022, GEMINI 4.0 aims to build a low-carbon future for industry based on the experience gained through the operation of HTR and knowledge of hydrogen production processes acquired in the previous H2020 project GEMINI+.

TRISO COATED FUEL PARTICLE

- HTGR technology is considered as a high advanced in terms of safety, economy and environmental impact
- The main advantage of the HTGRs is deep fuel burnout, as well as possibility of burning of the long-lived actinides and plutonium in the course of their operation
- TRISO particle is made up of carbon and oxygen fuel kernel. The kernel is surrounded by three layers of carbon- and one ceramic-based materials that prevent the release of radioactive fission products
- The structure of TRISO fuel make it resistant to incidents, such as thermal expansion, pressure of fission products and temperatures above 1600 °C



Options in TRISO spent fuel management

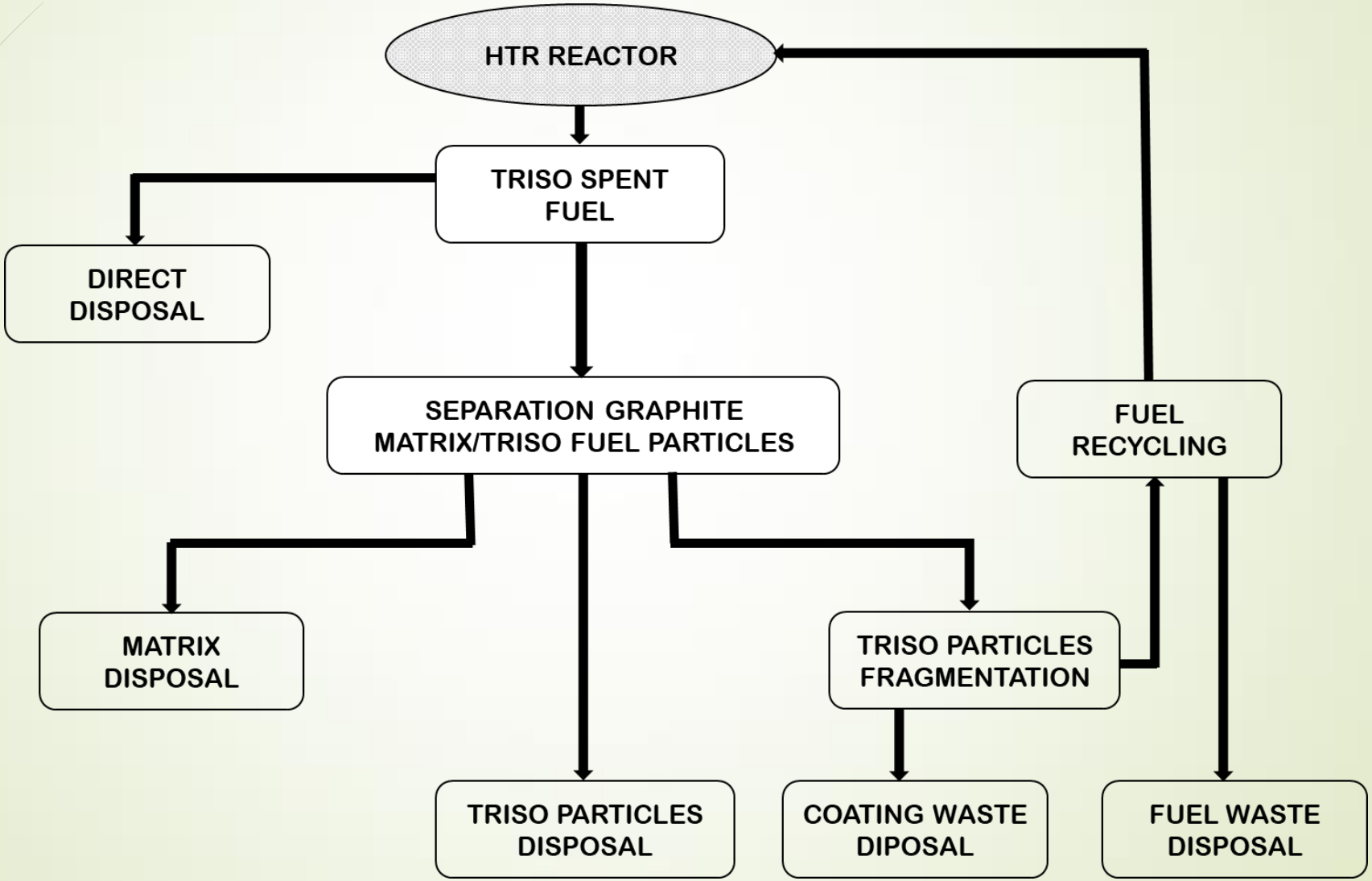


- analysis of possible techniques of preparing SF for disposal
- selection of end form for the disposal of spent fuel:

  the direct storage of entire graphite blocks or separation of the particles of spent fuel from the graphite block
- study on developing methods solidifying particles of spent fuel in vitreous and ceramic materials

- analysis of available techniques for separation of actinides from SF
- tests performed on model spent fuel
- removal of carbon coating from the kernel; separation of fissile components with the possibility of reuse them: hydrometallurgical methods for separation of U and Pu (e.g. PUREX or TRUEX processes); separation of minor actinides by solvent extraction

HTGR FUEL WASTE MANAGEMENT PATHWAYS



RADIOACTIVE WASTE MANAGEMENT IN POLAND - CURRENT SITUATION

- There is the only one radioactive waste repository in Poland, which accepts only low- and intermediate level, short-lived waste, and for temporary storage - long-lived waste
- The respository is operated by Radioactive Waste Management Plant (ZUOP)
- At present, there is only one MARIA research reactor in operation in Poland. The previous one, reactor EWA was shut down in 1995
- The spent fuel rods, after discharging them from the reactor, were temporarily stored in the water pool of the MARIA reactor which is placed in the National Centre for Nuclear Researches (NCBJ) and in the nuclear fuel (SNF) storage facilities operated by Radioactive Waste Management Plant
- Most of spent fuel from decomissioned EWA reactor and MARIA research reactor was returned to the Russia, the producer (The Global Threat Reduction Initiative (GTRI)

RADIOACTIVE WASTE MANAGEMENT IN POLAND – PLANNED STRATEGY

- The crucial objectives of the National Plan of the Radioactive Waste and Spent Fuel Management are selection of the location, construction and starting operation of a new near surface radioactive waste repository (NSRWR) for the short lived radioactive waste

- The Plan includes key tasks related to management of HLRW and SNF, among them preparation for the development of the **deep radioactive waste repository (DRWR)**

RADIOACTIVE WASTE MANAGEMENT IN POLAND – PLANNED STRATEGY

THE PRE-SELECTED LOCATIONS OF **DEEP RADIOACTIVE WASTE REPOSITORY** IN POLAND

1- Pogorzel -*clay deposit*
2- Krasnopol - *magmatic rock (granite)*
3-Tajno – *magmatic rock (granite)*
4- Kruszyniany - *magmatic rock (granite)*
5- Rydzewo - *magmatic rock (granite)*
6- Damasławek - *salt deposit*
7- Kłodawa - *salt deposit*
8- Łanięta - *salt deposit*
9- Jarocin - *clay deposit*

CONCLUSION

- At present, the temporary on-site storage of spent nuclear fuel from Polish nuclear reactors is recommended. Next, it can be transferred to the deep disposal facility, when it will be available or reprocessed. High-level waste from reprocessing will be disposed in this deep repository, too
- INCT is involved in European projects on radioactive waste management
- INCT has an experience in studies on the safe management of radioactive waste from fuel cycle
- The numerous studies concentrate on the development of the procedures suitable for the HTR waste management. It seems that improving the currently employed extraction methods of reprocessing the spent nuclear fuel will be possible to implement in the 4th generation of reactors.

Thank you!

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