Key objectives and results of the Gospostrateg-HTR project

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NATIONAL CENTRE FOR NUCLEAR RESEARCH ŚWIERK

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GOSPOSTRATEG-HTR (GoHTR)

GOSPOSTRATEG - strategic Polish program of scientific research and development (R&D) work "Social and economic development of Poland in the conditions of globalizing markets"

Title: Preparation of legal, organizational and technical instruments for the HTR implementation
(Gospostrateg1/385872/22/NCBR/2019)

Consortium:

Ministry of Climate and Environment

NCBJ

ichtj

www.gohtr.pl

Phase A: Research work. Preparation of testing procedures and instrumentation necessary for their implementation(1-18M).

Phase B: Implementation procedures into approvals, especially in terms of Polish Atomic Law(19-36M).

GOSPOSTRATEG-HTR

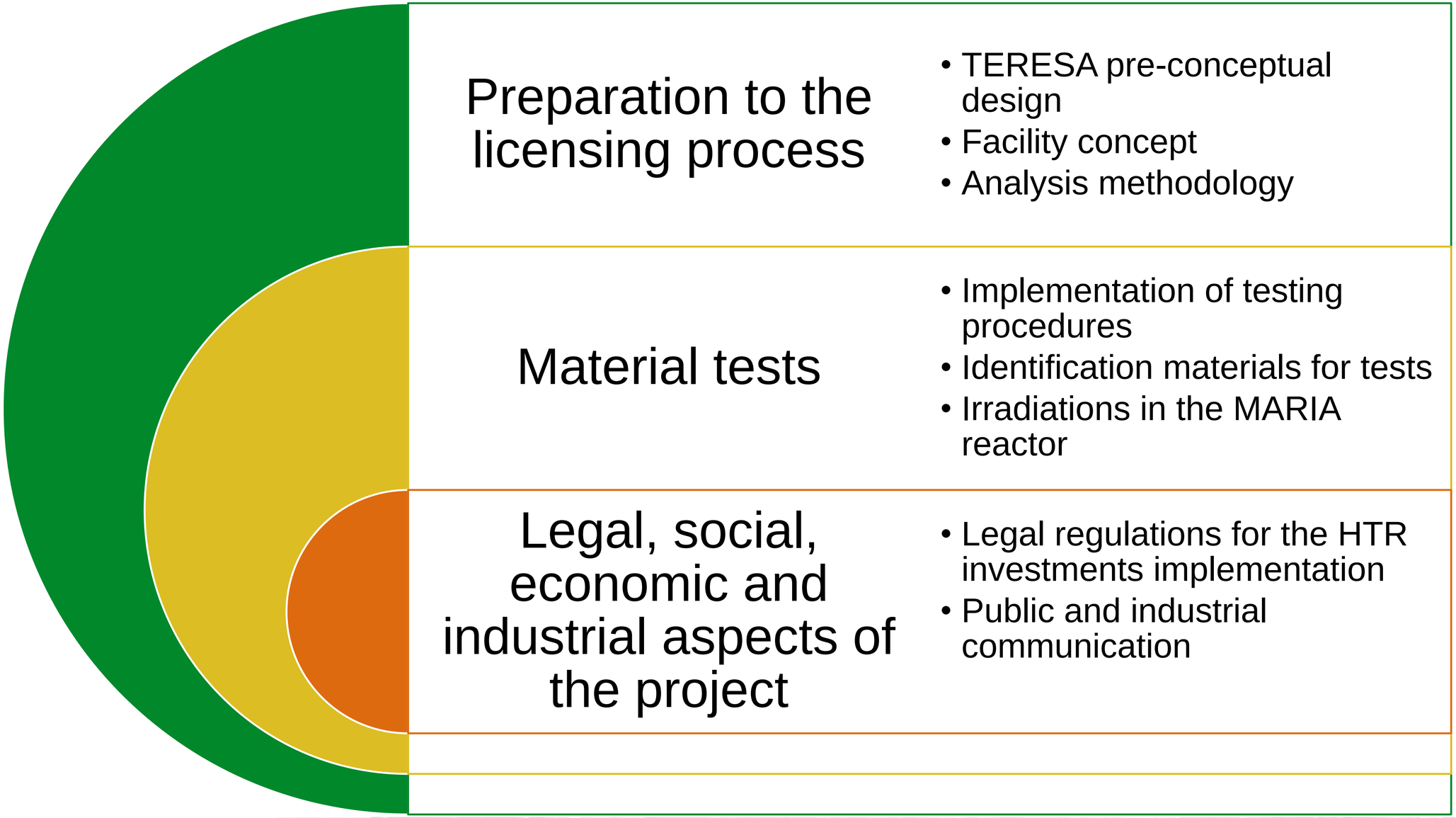
- Phase A
- (2019.02.01 – 2020.07.30)

1. Development of methods for diagnostics of structural materials in the HTR construction (NCBJ);
2. Development of methods for testing of structural materials in a nuclear reactor, and equipment for the execution of tests in the core(NCBJ);
3. Research and analysis of selected chemical aspects of the production and use of TRISO fuel in the HTR nuclear reactor(ICHTJ);
4. Comprehensive analysis of the necessary changes to the legal environment and the potential benefits of social, economic and industrial units for the Polish economy(ME, NCBJ).

- Phase B
- (2020.08.01 – 2022.03.31)

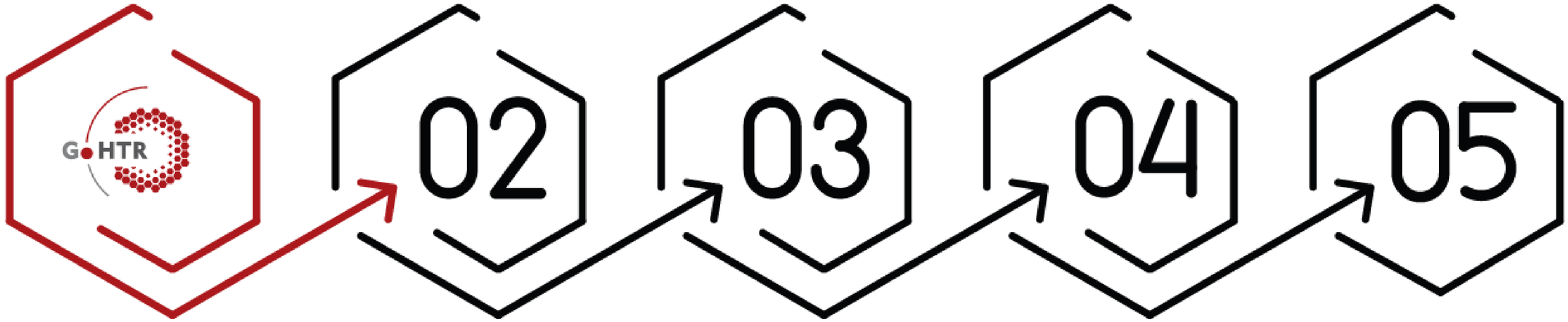
5. Preparation licensing process (certification) of HTGR reactors on the example of a research reactor(ME, NCBJ, ICHTJ);
6. Preparation draft of legal regulations for the HTR investments implementation; developing a strategy in the social, economic and industrial aspects of the project(ME, NCBJ, ICHTJ);
7. Piloting of test procedures for the use of construction materials for the HTR reactor design, including tests in the Maria reactor core (NCBJ);
8. Preparation of technical and economic assumptions for the construction of a fuel production unit for high-temperature reactors(ICHTJ).

GOSPOSTRATEG-HTR: Key objectives



Preparation to the licensing process	• TERESA pre-conceptual design • Facility concept • Analysis methodology
Material tests	• Implementation of testing procedures • Identification materials for tests • Irradiations in the MARIA reactor
Legal, social, economic and industrial aspects of the project	• Legal regulations for the HTR investments implementation • Public and industrial communication

GOSPOSTRATEG-HTR: TERESA pre-conceptual design



PRE-CONCEPTUAL DESIGN

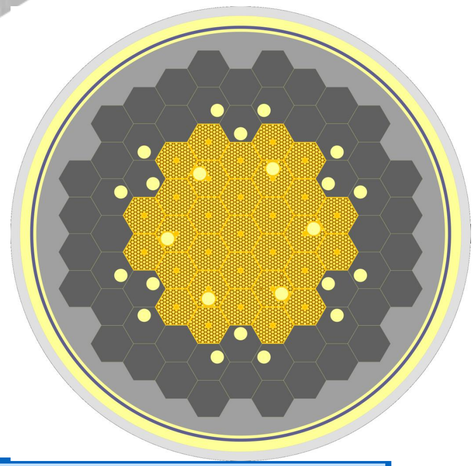
CONCEPTUAL DESIGN

PRELIMINARY DESIGN

BASIC DESIGN

EXECUTIVE TECHNICAL DESIGN

GOSPOSTRATEG-HTR



Pre-conceptual design of research HTR named TERESA

- Design based on GEMINI+ Project- down-size of HTR for Industrial application
- Safety analyses (T-H, neutronics, PSA, et. al.)
- Secondary circuit design
- System balance calculations

TERESA functions:

1. Research (e.g. passive heat removal tests, codes validation);
2. Experimental (technological appliances in micro scale - e.g. turbine);
3. Applicative (electricity and heat production for own NCBJ needs)

GOSPOSTRATEG-HTR: TERESA pre-conceptual design, main parameters

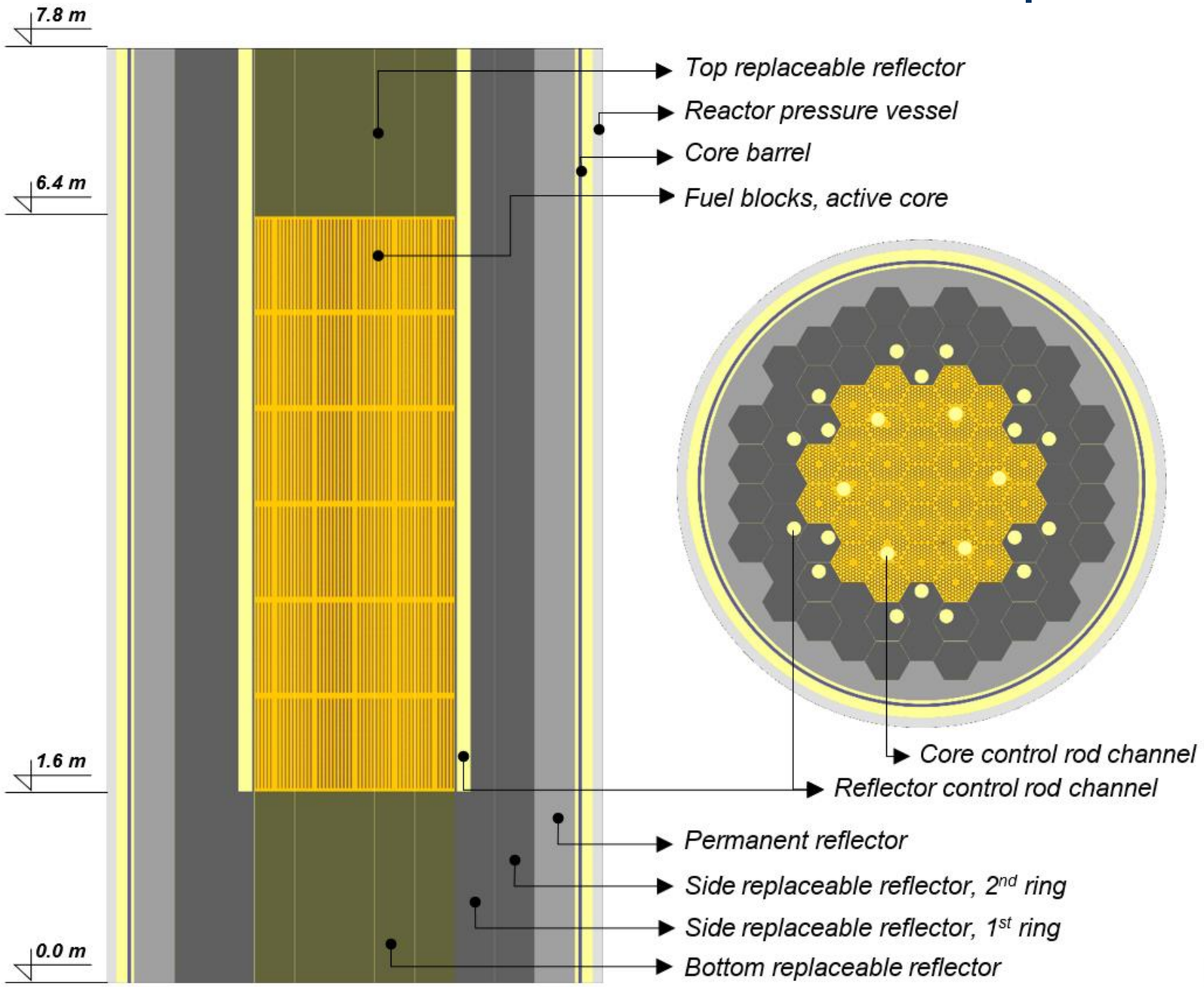
	Reactor name	
Parameter	**Gemini+**	**TeResa**
Thermal Power	180 MW	40 MW
Power density	5.8 MW/m^3	2.36 MW/m^3
Block type	FSV/SC-HTGR/HTR-Module (pin in block)	FSV/SC-HTGR/HTR-Module (pin in block)
RPV inlet temperature	~325ºC	325ºC
Core inlet temperature	335˚C	330˚C**
Core outlet temperature	750-1000˚C**	~800˚C**
Reactor outlet tempe-rature (inlet steam generator/IHX)	750˚C	750˚C*
Coolant pressure	6 MPa	6 MPa
Coolant flow	79 kg/s	18,14 kg/s
Bypass flow	8%	7%
Number of fuel blocks in a column	11	6
Number of columns of fuel blocks	31	31
Core height	11*80 cm = 8,8 m (11 fuel blocks in a column)	6*80 cm = 4,8 m (6 fuel blocks in a column)
Equivalent core diameter	2,12 m	2,12 m
Fuel	UO2/12%	UO2/12%
Burnup	60 MWd/kg	TBD
Burnup period	550 days	1250days (from MCB)
Refueling time	every 1.5 years	after assumed burnup

* from system heat balance, D2.10 Assessment of the flexibility of GEMINI+ System_Issue2
** from MELCOR & SPECTRA calculations

GOSPOSTRATEG-HTR: TERESA codes

CODE	PURPOSE/TYPE OF ANALYSES, CHARCTERISTIC
SERPENT2.1.32	neutronic core calculation, Monte Carlo code particle transport calculations using libraries of continuous energy spectrum
MVP/GMVP	neutronic core calculation, Monte Carlo code
MCB (AGH team)	neutronic core calculation, Monte Carlo code
MELCOR	thermal-hydraulic simulation, severe accidents and source term calculations
CATHARE	thermal-hydraulic simulation of multiphase flow dynamics
SEPHIRE	PSA/PRA- system reliability analysis, event and fault tree modeling
ANSYS Fluent	CFD analyses: ANSYS Design Modeller and ANSYS SpaceClaim- tools for creating 2D and 3D geometry; ANSYS Mesher - a tool for creating computational meshes; ANSYS Fluent - thermal-hydraulic analysis
PC-CREAM	ASSESSOR mode - calculation of effective doses MODELS mode - contains several mathematical models that predict the transfer of radionuclides through the environment and allow the estimation of activity concentration in various environmental media as a result of continuous releases
System Balance	NCBJ code for balancing the thermal system for the TeResa research reactor

GOSPOSTRATEG-HTR: TERESA* pre-conceptual core design



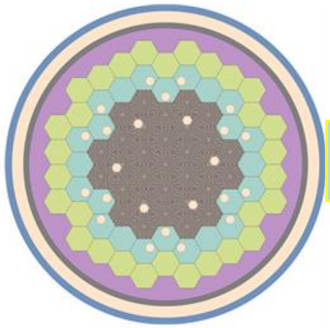
Neutronic

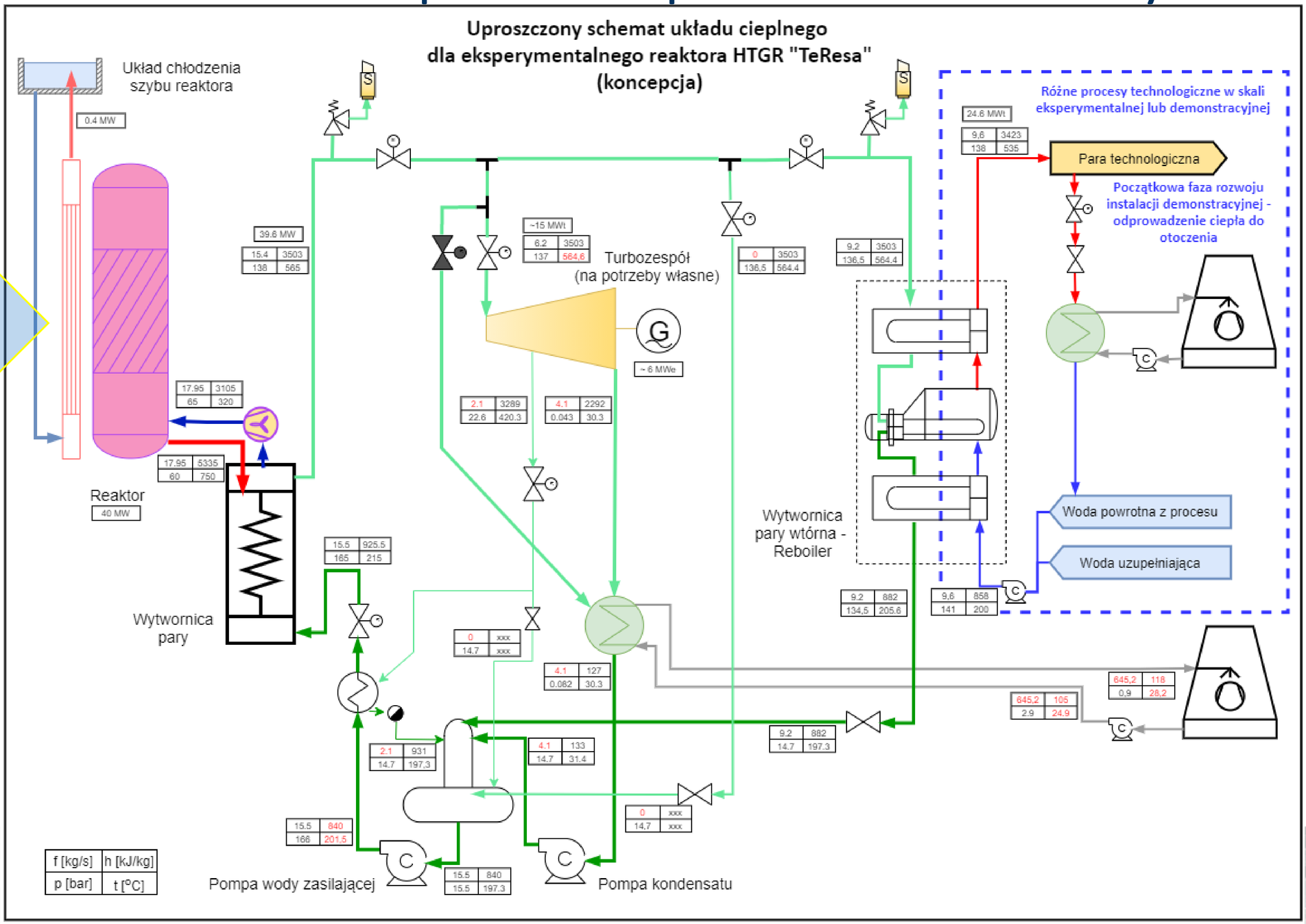
T-H

PSA

*based on the GEMINI+ concept

GOSPOSTRATEG-HTR: pre-conceptual TERESA facility





GoHTR

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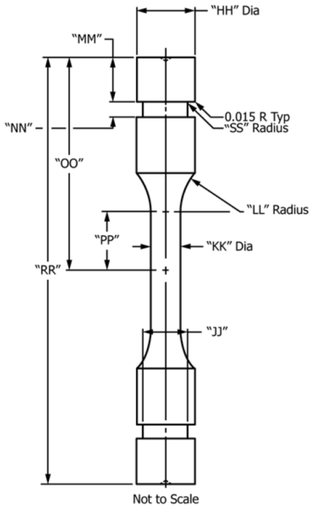
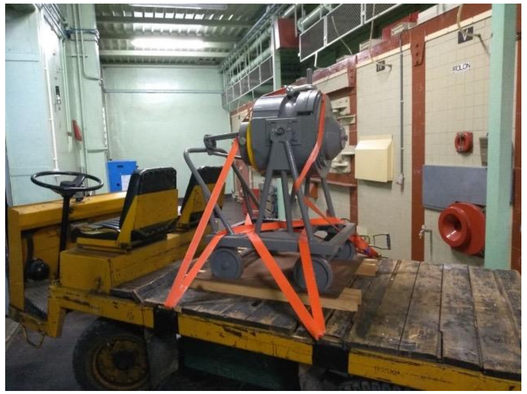
GOSPOSTRATEG-HTR *Material tests*

Identification and description of measurement procedures for testing and validation of HTR reactor construction materials

Irradiation System for High TemperAture Reactor (ISHTAR) design

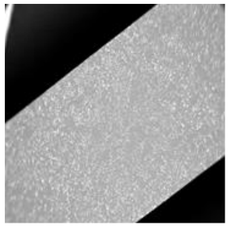
Materials: graphite (IG110, NBG-17, NCBJ facility), metal alloys (Hastelloy: X, N, B-3, C-273; Haynes 230)

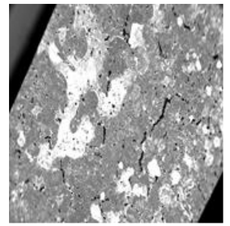




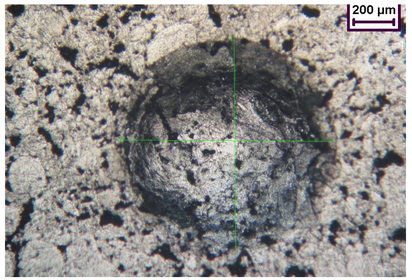
Equipment modernization

Implementation of testing procedures





Irradiations in the MARIA reactor

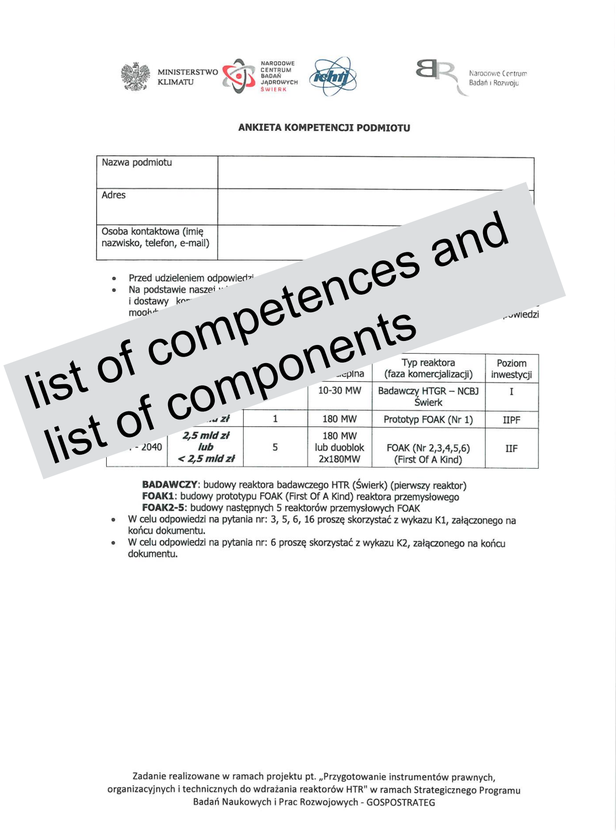


GOSPOSTRATEG-HTR Legal regulations for the HTR investments implementation

Procedure of changes in polish legal acts initiated by Ministry of Climate and Environment, started on 20-07-2021!

GOSPOSTRATEG-HTR Public and industrial communication

Survey of the Polish industry capabilities



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ANKIETA KOMPETENCJI PODMIOTU

Nazwa podmiotu	
Adres	
Osoba kontaktowa (imię nazwisko, telefon, e-mail)	

- Przed udzieleniem odpowied…
- Na podstawie naszej … i dostawy k… mo…

…owiedzi

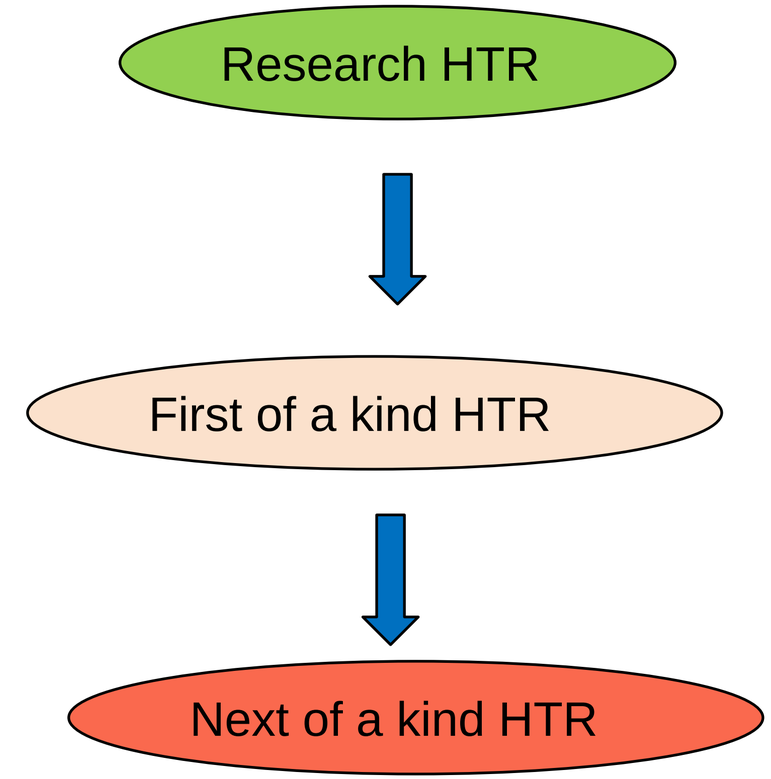
			…aptna	Typ reaktora (faza komercjalizacji)	Poziom inwestycji
			10-30 MW	Badawczy HTGR – NCBJ Świerk	I
	…d zł	1	180 MW	Prototyp FOAK (Nr 1)	IIPF
…- 2040	*2,5 mld zł lub < 2,5 mld zł*	5	180 MW lub duoblok 2x180MW	FOAK (Nr 2,3,4,5,6) (First Of A Kind)	IIF

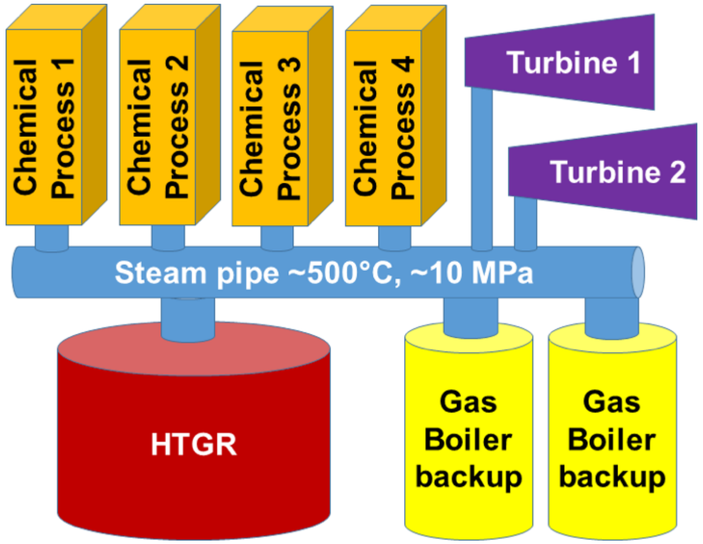
BADAWCZY: budowy reaktora badawczego HTR (Świerk) (pierwszy reaktor)
FOAK1: budowy prototypu FOAK (First Of A Kind) reaktora przemysłowego
FOAK2-5: budowy następnych 5 reaktorów przemysłowych FOAK

- W celu odpowiedzi na pytania nr: 3, 5, 6, 16 proszę skorzystać z wykazu K1, załączonego na końcu dokumentu.
- W celu odpowiedzi na pytania nr: 6 proszę skorzystać z wykazu K2, załączonego na końcu dokumentu.

Zadanie realizowane w ramach projektu pt. „Przygotowanie instrumentów prawnych, organizacyjnych i technicznych do wdrażania reaktorów HTR" w ramach Strategicznego Programu Badań Naukowych i Prac Rozwojowych - GOSPOSTRATEG

list of competences and list of components





GOSPOSTRATEG-HTR Public and industrial communication

Seminar for the Industry, 23.11.2021

Time	Description
9.00	Welcome: • Representative of the Ministry of Climate and Environment - Andrzej Sidło, • Director of National Center for Nuclear Research - prof. Krzysztof Kurek • President of the Polish Space Agency - prof. Grzegorz Wrochna.
9.20	High-temperature reactor - characteristics and applications– prof. Mariusz Dąbrowski, NCBJ
10.00	High-temperature reactor - components and required competences-– dr Agnieszka Boettcher, NCBJ
10.40	Introduction to the projects of the European Space Agency– Patrycja Karwowska, POLSA
11.20-11.30	Coffee break
11.30	Presentation of foreign companies: • Toshiba Energy Systems & Solutions Corporation - dr. Akito Nagata • Mitsubishi Heavy Industries - Kazumasa Suyama • USNC - Ziemowit Iwański
12.30	Presentation of the Polish company: • Energoprojekt SA- Olgierd Sikora, Piotr Łatecki
12.50	End of the Meeting

116 registrated participants!

– most of them from Industry

GOSPOSTRATEG-HTR Public and industrial communication

Series of expert lectures for the public

Reaktory wysokotemperaturowe (HTR) dla Polski
Wykłady eksperckie

24.11.2021 (środa), 17:00
Wacław Gudowski
Co to jest HTR i dlaczego potrzebujemy go w Polsce?
Ekonomia, przemysł, potencjalne zastosowania.

01.12.2021 (środa), 17:00
Piotr Darnowski
Zasada działania reaktora HTR.
Podstawy fizyki reaktorowej i aspekty bezpieczeństwa HTR.

08.12.2021 (środa), 17:00
Eleonora Skrzypek
Jak zbudowany jest reaktor HTR?
Podstawy techniczne.

Wykłady zostaną przeprowadzone w formie transmisji online, za pośrednictwem YouTube

Finansowanie:

Ministerstwo Klimatu i Środowiska
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P

+folders
+short movies on NCBJ YouTube
+games
+WNE Paris 2021

Reaktory wysokotemperaturowe - źródło ciepła dla przemysłu

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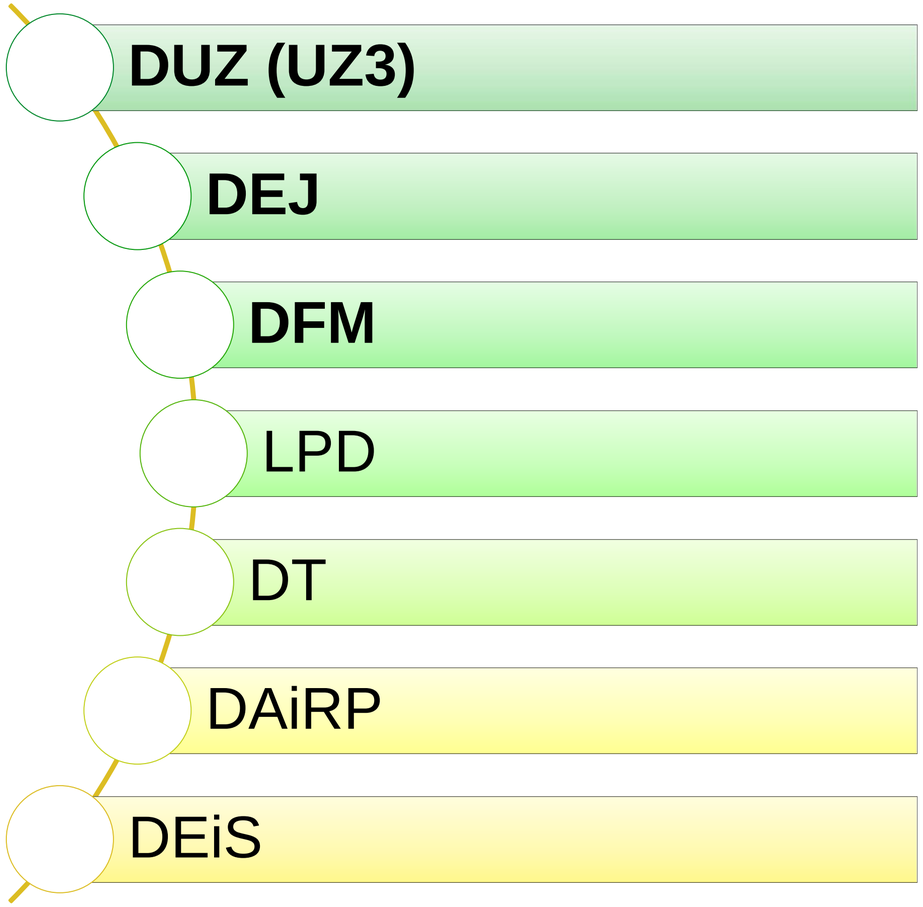
Research HTR

Reactor MARIA
30 MW, high n flux

www.ncbj.gov.pl

GOSPOSTRATEG-HTR in numbers

Budget	21 370 998.00 PLN
Czas realizacji	36+2 month
End of the project	31.03.2022r.
Number of employees	~110/month
The number of orders completed	~170
WP no. at NCBJ	6



GOSPOSTRATEG-HTR

ACKNOWLEDGEMENT

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Project management at NCBJ:

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dr inż. Agnieszka Celińska
Paweł Sęktas, MA
prof. Mariusz Dąbrowski
MSc. Małgorzata Frelek-Kozak
MSc. Marek Migdal

Thank you!

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