		Contractor: České vysoké učení technické v Praze, Fakulta jaderná a fyzikálně inženýrská
		ESA Contract No.: [redacted]
CONTRACT CHANGE NOTICE No. 1		DATE: 01/02/2024
TITLE OF AREA AFFECTED (WORK PACKAGE ETC): To analyse potential similarities and difference of selected NEP architecture and SMR (Small Modular Reactor).		WPD REF: WPD 1000, 4000, 5000 and 6000
		INITIATOR OF CHANGE: OHB CZ

DESCRIPTION OF CHANGE

While RocketRoll objectives focussed on the feasibility of NEP for various missions, this CCN shall investigate the similarities and differences with Small Modular Reactor (SMR) being developed for terrestrial applications. The increase of the scope and consequently of time of work is needed to **assess the common features between SMR and NEP**.

To reach this objective, following work package will be extended: State-of-the-Art (1000), Market Study (4000), Roadmap elaboration (5000) and Project management (6000). First, the SOTA will establish major design drivers and constraints specific to SMR development. These elements will be compared with NEP specific design drivers and constraints to highlight commonalities between the two systems. Then, the Roadmap shall be updated and highlight where technology maturation could benefit to both SMR and NEP. Finally, the mutual benefits of connecting SMR and NEP will be assessed from market and business perspectives (e.g., new value chain, new markets, etc.).

The optimal NEP design requires multiple advanced technologies that have not been qualified, yet. These include especially uranium carbide HALEU fuel, yttrium hydride moderator, and materials compatible with the high-temperature lithium coolant. The current investigated SMR concepts are largely based on a light-water technology and thus offer almost negligible synergies with the NEP vehicle design. But several SMR designs are based on sodium and are planned to operate in a fast neutron spectrum: APC-100, Natrium, or SEALER-55. These conditions enable to identify potential common technologies between the NEP vehicle and a non-classical SMR. Proposed approach to the task is to identify synergies between the NEP vehicle and SMR from a different perspective. To identify first the SMR designs with high-temperature liquid coolants and find the planned fuel types, materials, enrichment levels, and the coolant outlet temperature. Next, we shall adjust the reactor core with the fuel type compatible with the SMR development. We need to respect the anticipated lower coolant temperatures for the SMR designs and evaluate the impact on the NEP vehicle design.

In addition, the task shall investigate use of the Space NEP components in terrestrial market as a new integral part of the Market Study.

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Considering the need of component qualification, extension of the roadmap by high-level parts with the findings from the additional Market Analysis will be necessary.

With respect to the found commonalities between SMR design and NEP design a roadmap shall be updated and highlight where technology maturation could benefit to both SMR and NEP. Updates will be made to expected technology maturation impacts considering synergies/common SMR-NEP developments, highlighting the potential benefits and limitations.

Rational of the CCN

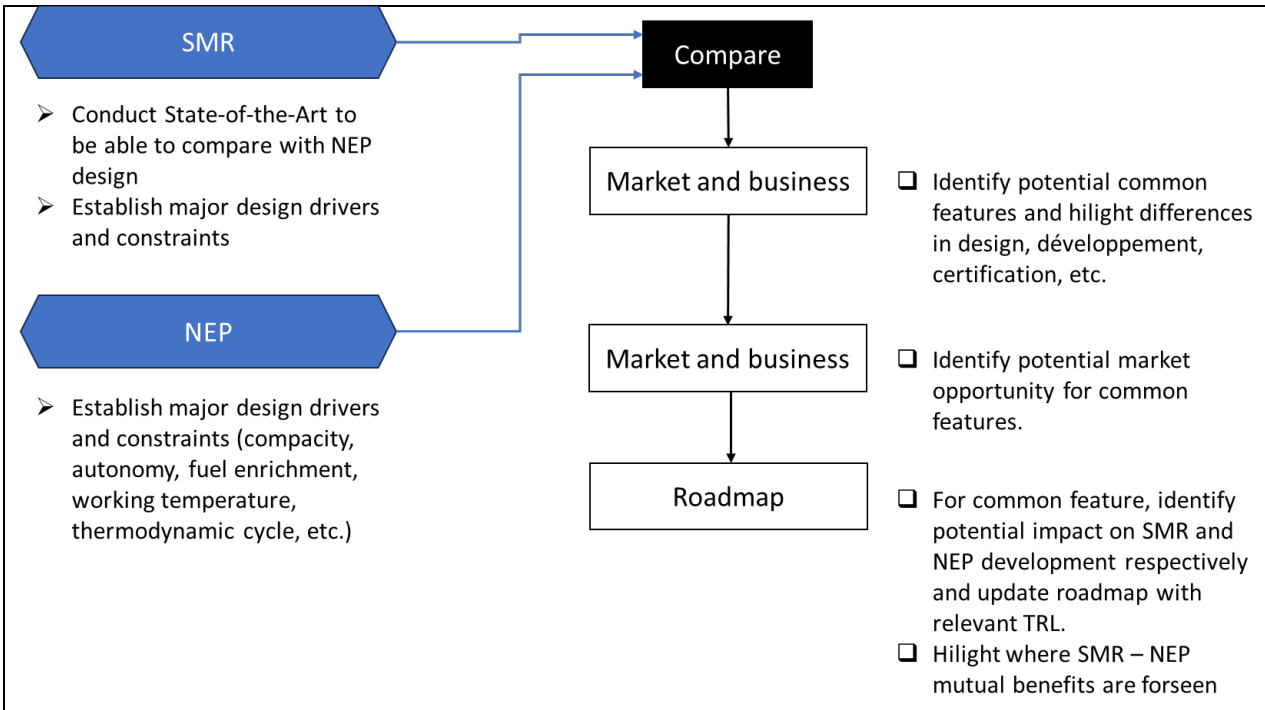
During RocketRoll study, potential architectures for NEP tug has been proposed to enable various in-space transportation scenarios (called "use-case"). While short-term technical feasibility was a major driver in the design process, it was highlighted that recurrent lack of experimental data in most sub-systems of NEP require specific technological maturation. Therefore, identifying synergies with relevant technologies being developed in other sectors is crucial to minimise cost, de-risk and accelerate the development.

Pushed by the growing demand low carbon and sovereign power generation, Small Modular Reactors (SMRs) are being extensively developed in Europe. *A priori* SMR and NEP have little in common, as power scale, safety requirement, autonomy is different. But compacity, scalability, fuel enrichment, etc. are potential synergies to be investigated.

This proposed analysis will lead to a schematic of the NEP vehicle design with imitations on existing SMR technologies to maximize synergies with the SMR development.

Approach and tasks

The general approach established to reach the added objective is shown below. The more detailed micro-objectives, input, activity description is provided in Annexe of the CCN.



Payment Milestone

Final Presentation (FP) in contract will become a Progress Meeting, so that actual Final Presentation will take place at the end of the CCN. An additional Payment Milestone (MS1 CCN1) will take place at the completion of the CCN and becomes the Final Settlement of the activity.

The payment MS1 CCN1 will be triggered upon acceptance of signed MoM of the Final Presentation (FP).

Milestone (MS) Description	**Schedule Date**	**Payments from ESA to (Prime) Contractor (in Euro)**	**Country (ISO code)**
Final Settlement MS1 CCN1: Upon the Agency's acceptance of all deliverable items due under the Contract and the Contractor's fulfilment of all other contractual obligations including submission of the signed Contract Closure Documentation.	30/06/2024	15.000,00	CZ
TOTAL		15.000,00	

Deliverables definition and content

In case work performed during the CCN lead to change of the NEP design, deliverables associated with Final Presentation and review (MRD, FR and EX) shall be updated for consistency and completeness.

The deliverables associated with the MS1 CCN1 are detailed in the table below:

Doc ID	Issue	Associated MS	Classification
TN1	1	MS1 CCN1	Class 2
FP	1	MS1 CCN1	Class 1

The Technical Note 1 (TN1) is technical document detailing key findings of the work performed in the frame of the CCN. The Final Presentation (FP) as per the contract become a standard progress meeting (i.e. PM5 according to planning). The actual FP shall take place at the completion of the CCN.

PRICE BREAKDOWN (Currency)/PRICE-LEVEL

15,000 (Fifteen Thousand) Euro

EFFECT ON OTHER CONTRACT PROVISIONS
NONE

START OF WORK 29/02/2024

END OF WORK 30/06/2024

CONTRACTOR'S PROJECT MANAGER:

DATE:

CONTRACTOR'S CONTRACTS OFFICER:

DATE: [redacted] 21.5.2024

[DISPOSITION RECORD OR OTHER AGREED CONDITION RECORDED WITH THE CCN APPROVAL]

OCZ TECHNICAL OFFICER:

DATE: [redacted]

OCZ CONTRACTS OFFICER:

DATE: [redacted]

ANNEX to the CCN

Detail of the additions to the Work Package Description (WPD):

WP title:	**NEP SMR technology synergies**			**WP ref:**	**WP 1400**
Project:	NEP RocketRoll			Phase:	N/A
Contractor:	CTU			Issue:	01
WP manager:	Dr. Jan FRÝBORT			Issue date:	14.02.2024
Start event:	FP	Planned date:	T0 + 11 M		
End event:	FP CCN	Planned date:	T0 + 14 M		

1. OBJECTIVES

- Assess the common features and differences between SMR (Small Modular Reactors) and NEP

2. INPUTS

- CCN
- FR: Final report

3. TASK DESCRIPTION

- Task 1: Conduct state of the art research in the field of SMR technologies
- Task 2: Establish major design drivers and constraints specific to SMR development
- Task 3: Establish major design drivers and constraints related to NEP (compacity, autonomy, fuel enrichment, working temperature, thermodynamic cycle, etc.)
- Task 4: Compare with NEP specific design drivers and constraints to highlight commonalities and differences between the two systems (design, development, certification)
- Task 5 – Highlight where technology maturation could benefit to both SMR and NEP and evaluate the impact on the NEP vehicle design

4. OUTPUTS

- TN1: SMR NEP Synergies
- FP: Final Presentation – input