# Zmluva o spolupráci pri riešení projektu

uzatvorená podľa § 269 ods. 2 zákona č. 513/1991 Zb. Obchodný zákonník v znení neskorších predpisov (ďalej len „zmluva“)

medzi:

Názov: **Ústav experimentálnej fyziky Slovenskej akadémie vied, verejná výskumná inštitúcia**
Sídlo: Watsonova 47, 040 01, Košice
IČO: 00 166 812
IČ DPH: SK 2021364752
Bankové spojenie: Štátna pokladnica
IBAN: SK15 8180 0000 0070 0070 1853
SWIFT: SPSRSKBA
Štatutárny orgán: doc. RNDr. Zuzana Gažová, DrSc., riaditeľka
Právna forma: verejná výskumná inštitúcia
Osoba zodpovedná za riešenie projektu: Ing. Ján Kubančák, PhD.

(ďalej aj ako „**UEF**“ alebo „**prijímateľ**“)

a

Názov: **Ústav jaderné fyziky AV ČR, v. v. i.**

Sídlo: Hlavní 130, Řež, 250 68 Husinec, Česko
IČO: 61389005
DIČ: CZ61389005
Bankové spojenie: Československá obchodní banka, a.s. (ČSOB)
IBAN: CZ21 0300 0000 0006 7195 8383
SWIFT: CEKOCZPP

Štatutárny orgán: Ing. Ondřej Svoboda, Ph.D., riaditeľ
Právna forma: verejná výskumná inštitúcia
Osoba zodpovedná za riešenie projektu: Ing. Ondřej Ploc, Ph.D.

(ďalej aj ako „**UJF**“ alebo „**subdodávateľ**“)

(ďalej každý jednotlivo aj ako „**zmluvná strana**“ a spoločne aj ako „**zmluvné strany**“)

## Článok I.
## Úvodné ustanovenia

1. **Ústav experimentálnej fyziky Slovenskej akadémie vied, v. v. i.** je prijímateľom finančných prostriedkov na riešenie projektu s názvom: „ *ESADOS (ESA Support for Aircrew DOsimetry Services)“* (ďalej len „projekt“), a to na základe zmluvy: ESA Contract No. 4000148223/25/NL/MH/yd uzatvorenej medzi Európskou vesmírnou

agentúrou (ďalej aj ako „ESA“ alebo „poskytovateľ“) a Ústavom experimentálnej fyziky Slovenskej akadémie vied, verejná výskumná inštitúcia dňa 14. 05. 2025.

2. Ústav jaderné fyziky AV ČR, v. v. i. je v zmysle zmluvy ESA Contract No. 4000148223/25/NL/MH/yd (ďalej aj „Zmluva s ESA“) subdodávateľom, ktorý má rovnaké práva a povinnosti vo vzťahu k riešenému projektu na základe tejto zmluvy ako prijímateľ na základe Zmluvy s ESA. UJF je povinný poskytnúť prijímateľovi všetku súčinnosť potrebnú za účelom splnenia povinností vyplývajúcich zo Zmluvy s ESA (príloha č. 1).
3. Zmluvné strany sa zaväzujú realizovať projekt v súlade s touto zmluvou ako aj s ustanoveniami obsiahnutými v nasledujúcich dokumentoch, zoradených podľa prednosti v prípade ich nesúladu:

   a) Zmluva s ESA (príloha č. 1)

   b) Návrh projektu s referenciou *„ESADOS (ESA Support for Aircrew DOsimetry Services)*“ (príloha č. 2)

   c) Zápisnica z tzv. „Negotiations meetingu“, ktorou sa ustanovujú modifikácie návrhu projektu (príloha č. 3)

## Článok II.
## Predmet zmluvy

1. Predmetom tejto zmluvy je úprava práv a povinností medzi prijímateľom a subdodávateľom pri riešení projektu, a to v súlade s podmienkami stanovenými Zmluvou s ESA.

## Článok III.
## Práva a povinnosti zmluvných strán

1. Subdodávateľ sa zaväzuje v súlade so Zmluvou s ESA vykonať pre prijímateľa všetky činnosti, ktoré Zmluva s ESA vyžaduje.

   Subdodávateľ vyhlasuje, že je odborne spôsobilý na vykonanie činností a má záujem na ich riadnom a včasnom vykonaní.

2. Prijímateľ sa zaväzuje prijať, posúdiť a odsúhlasiť alebo zamietnuť príspevok k výstupom uvedeným v odseku 1 tohto článku, a to do 30 kalendárnych dní od ich prijatia.
3. Prijímateľ sa zaväzuje poskytnúť subdodávateľovi finančné prostriedky v celkovej sume 18386,70 EUR v súlade s článkom 3 Zmluvy s ESA (ďalej aj ako „celková suma“). Predmetná suma predstavuje pevnú sumu bez DPH a ďalších poplatkov. Prijímateľ poskytne finančné prostriedky subdodávateľovi po dosiahnutí jednotlivých míľnikov zadefinovaných v bode 4.2 Zmluvy s ESA a doručení podkladov uvedených v ods. 2 tohto článku, a to do 30 kalendárnych dní po ich pripísaní na účet prijímateľa v nasledovných častiach:

| **Míľnik** | **Suma finančných prostriedkov v EUR** |
|---|---|
| Advance Payment (zálohová platba po podpísaní kontraktu s ESA) | 3000,00 |
| Mílnik 1 | 2950,00 |
| Míľnik 2 | 4136,70 |
| Mílnik 3 | 8300,00 |
| Celková suma | 18386,70 |

4. Subdodávateľ je povinný poskytnúť prijímateľovi a poskytovateľovi všetku potrebnú súčinnosť pri výkone prípadnej kontroly na diaľku za účelom overenia postupu na projekte s cieľom zistiť oprávnenosť platby.
5. Subdodávateľ sa zaväzuje poskytnúť prijímateľovi v elektronickej forme podklady potrebné na vypracovanie „*Progress Report*“, a to v lehotách stanovených prijímateľom na základe písomnej výzvy v elektronickej forme doručenej na adresu uvedenú v článku VIII. ods. 2 tejto zmluvy.
6. Subdodávateľ sa zaväzuje poskytnúť prijímateľovi súčinnosť a všetky podklady potrebné na vypracovanie *„Contract Closure Documentation*“ v lehote písomne oznámenej prijímateľom na e-mailovú adresu subdodávateľa uvedenú v článku VIII. ods. 2 tejto zmluvy.
7. Ak poskytovateľ bude žiadať o opätovné predloženie príspevku od subdodávateľa v dôsledku nesplnenia požiadaviek, subdodávateľ sa zaväzuje poskytnúť prijímateľovi všetku potrebnú súčinnosť, a to bez nároku na ďalšiu platbu v súlade s bodom 5.5.1 Zmluvy s ESA.
8. Subdodávateľ ako pôvodca/spolupôvodca výstupov podľa tejto zmluvy sa zaväzuje poskytnúť prijímateľovi k týmto právam duševného vlastníctva nevýhradnú licenciu s neobmedzeným (územným, vecným a časovým) rozsahom a právom udeliť súhlas s použitím týchto výstupov tretej strane. Súčasne sa subdodávateľ zaväzuje poskytnúť prijímateľovi všetku potrebnú súčinnosť na splnenie povinností vyplývajúcich z bodu 6.2.1 a 6.2.2 Zmluvy s ESA.
9. Subdodávateľ je povinný na základe písomnej požiadavky prijímateľa poskytnúť prijímateľovi všetku súčinnosť pri uplatňovaní nárokov, ktoré vzniknú z dôvodu ohrozenia alebo porušenia práv duševného vlastníctva tretích osôb v súvislosti s činnosťou subdodávateľa. Subdodávateľ zodpovedá a je povinný prijímateľovi nahradiť všetky nároky autorov alebo iných oprávnených osôb, ktoré si úspešne uplatnia voči prijímateľovi alebo poskytovateľovi.

## Článok IV.
## Zodpovednosť za škodu

1. Zmluvná strana, ktorá poruší svoju povinnosť zo zmluvy, je povinná nahradiť škodu tým spôsobenú druhej strane, ibaže preukáže, že porušenie povinností bolo spôsobené okolnosťami vylučujúcimi zodpovednosť.
2. Subdodávateľ je povinný nahradiť prijímateľovi škodu, ktorá vznikla v dôsledku porušenia povinností vyplývajúcich zo Zmluvy s ESA pre neplnenie alebo nedostatočné

plnenie povinností zo strany subdodávateľa, na základe čoho si uplatňuje ESA nárok na náhradu škody voči prijímateľovi.

3. Zodpovednosť za škodu medzi zmluvnými stranami sa spravuje ustanoveniami zákona č. 513/1991 Zb. Obchodný zákonník v znení neskorších predpisov v spojení s článkom 5.3 Zmluvy s ESA.

## Článok V.
## Osobitné ustanovenia

1. Subdodávateľ je povinný bezodkladne písomne informovať prijímateľa o vzniku skutočností, ktoré by mohli mať podstatný vplyv na časový plán riešenia projektu alebo na rozsah prác, ktoré majú byť vykonané.
2. V prípade, ak si subdodávateľ nemôže plniť svoje záväzky vyplývajúce z tejto zmluvy z dôvodu vyššej moci (udalosť, ktorá je v čase podpisu zmluvy nepredvídateľná, neodvrátiteľná a nastane mimo kontroly dotknutej strany a znemožňuje dotknutej strane plniť zmluvu, napr.: správne akty vydané na základe politických rozhodnutí, následky prírodných katastrof, epidémie, vojny, teroristické útoky) včas a riadne, zaväzuje sa bez zbytočného odkladu, najneskôr do jedného týždňa informovať prijímateľa o vzniku, trvaní a následkoch vyššej moci, ktoré mu bránia v splnení povinností podľa tejto zmluvy. Subdodávateľ súčasne vynaloží primerané úsilie na zmiernenie dopadu na časový plán riešenia projektu a plnenie si svojich zmluvných povinností. Prijímateľ a subdodávateľ sa následne dohodnú na nových termínoch plnenia povinností, ktoré budú predmetom dodatku k tejto zmluve.
3. Subdodávateľ sa zaväzuje poskytnúť prijímateľovi všetku potrebnú súčinnosť pri výkone kontroly alebo auditu , a to počas realizácie projektu ako aj po jeho skončení.
4. V prípade vzniku závažných problémov spojených so včasným zaplatením splatných faktúr alebo so začatými aktivitami je subdodávateľ oprávnený kontaktovať priamo ESA na e-mailovej adrese: indirectpayments@esa.int

## Článok VI.
## Ochrana osobných údajov

Zmluvné strany sa zaväzujú postupovať pri výkone práv a povinností vyplývajúcich z tejto zmluvy v súlade s aktuálne platnými a účinnými predpismi na úseku ochrany osobných údajov, najmä s Nariadením EP a Rady (EÚ) č. 2016/679 z 27. apríla 2016 o ochrane fyzických osôb pri spracúvaní osobných údajov a o voľnom pohybe takýchto údajov, ktorým sa zrušuje smernica č. 95/46/ES (všeobecné nariadenie o ochrane údajov) a so zákonom č. 18/2018 Z. z. o ochrane osobných údajov a o zmene a doplnení niektorých zákonov. Zmluvné strany sa zároveň zaväzujú postupovať v súlade s prílohou Zmluvy s ESA - Annex: Personal Data "Controller to Controller" Annex (ďalej aj ako „PDCC Annex") a Personal Data Protection Framework of ESA zverejnenom na webovej stránke:
http://www.esa.int/About_Us/Law_at_ESA/Highlights_of_ESA_rules_and_regulations

## Článok VII.
## Doba trvania zmluvy a spôsoby jej ukončenia

1. Zmluva sa uzatvára na dobu určitú, a to do zániku Zmluvy s ESA.

2. Zmluva zaniká:
   a) uplynutím doby, na ktorú bola uzavretá;
   b) písomnou dohodou zmluvných strán.
3. Dohoda podľa odseku 1 písm. b) tohto článku zmluvy musí byt' uzatvorená písomne, podpísaná oboma zmluvnými stranami a musí obsahovať dohovor o vzájomnom vysporiadaní vzťahov vzniknutých v súvislosti so zmluvou.

## Článok VIII.
## Komunikácia a doručovanie

1. Zmluvné strany sa dohodli, že ich vzájomná záväzná komunikácia vyplývajúca zo zmluvy bude prebiehať v českom alebo slovenskom jazyku elektornickou formou. Ustanovenie odseku 3 tohto článku zmluvy týmto nie je dotknuté.
2. Zmluvné strany budú vzájomne, pre záväznú elektronickú formu komunikácie, používať tieto e- mailové adresy:

   Prijímateľ: Ján Kubančák: kubancak@saske.sk
   Subdodávateľ: Ing. Ondřej Ploc, Ph.D.: ploc@ujf.cas.cz

3. Zásielky doručované elektronicky budú považované za doručené momentom, kedy bude elektronická správa k dispozícii, prístupná v elektronickej schránke zmluvnej strany, ktorá je adresátom, teda momentom, kedy zmluvnej strane, ktorá je odosielateľom, je doručené potvrdenie o úspešnom doručení zásielky v elektronickej forme; ak nie je objektívne z technických dôvodov možné nastaviť automatické potvrdenie o úspešnom doručení zásielky, je zásielka doručovaná elektronicky považovaná za doručenú momentom odoslania elektronickej správy zmluvnou stranou, ak druhá zmluvná strana nedostala automatickú informáciu o nedoručení elektronickej správy.

## Článok IX.
## Záverečné ustanovenia

1. Táto zmluva nadobúda platnosť dňom jej podpisu oboma zmluvnými stranami a účinnosť dňom nasledujúcim po dni jej zverejnenia v Centrálnom registri zmlúv vedenom Úradom vlády Slovenskej republiky v súlade s § 47a zákona č. 40/1964 Zb. Občiansky zákonník v znení neskorších predpisov.
2. V prípade, že niektoré z ustanovení tejto zmluvy sa stane neplatným, zostáva platnosť ostatných ustanovení nedotknutá. Zmluvné strany sa v takom prípade zaväzujú bezodkladne vzájomným rokovaním nahradiť neplatné zmluvné ustanovenie novým platným ustanovením, prípadne vypustením takéhoto ustanovenia tak, aby zostal zachovaný účel a obsah jednotlivých ustanovení zmluvy.
3. Práva a povinnosti zmluvných strán výslovne neupravené touto zmluvou sa riadia ustanoveniami zákona č. 513/1991 Zb. Obchodný zákonník v platnom znení, zákona č. 40/1964 Zb. Občiansky zákonník v platnom znení a ďalšími príslušnými právnymi predpismi platnými v Slovenskej republike.
4. Akékoľvek zmeny a doplnenia zmluvy sa budú uskutočňovať formou písomných očíslovaných dodatkov, ktoré sa po obojstrannom súhlasnom podpise oprávnených zmluvných strán stanú neoddeliteľnou súčasťou tejto zmluvy.

5. Táto zmluva je vyhotovená v elektronickej podobe a podpísaná autorizovaným elektronickým podpisom.
6. Zmluvné strany zhodne vyhlasujú, že si túto zmluvu pred jej podpisom prečítali, bola uzatvorená po vzájomnom prerokovaní, je prejavom ich slobodnej a vážnej vôle, je určitá a zrozumiteľná, zmluva nebola uzatvorená v tiesni alebo za nápadne nevýhodných podmienok, zmluvné strany porozumeli jej obsahu a právnym účinkom z nej vyplývajúcim a na znak súhlasu s jej obsahom ju dobrovoľne a vlastnoručne podpísali.

V Košiciach dňa .....

Zuzana Gažová
Digitálne podpísal Zuzana Gažová
Dátum: 2025.06.06 11:43:12 +02'00'

.....

doc. RNDr. Zuzana Gažová, DrSc
riaditeľka
Ústav experimentálnej fyziky Slovenskej akadémie vied, v. v. i.

V Řeži dňa .....

Digitálně podepsal Ing. Ondřej Svoboda, Ph.D.
Datum: 2025.06.01 18:34:58 +02'00'

.....

Ing. Ondřej Svoboda, Ph.D.
riaditeľ
Ústav jaderné fyziky AV ČR, v. v. i.

**Prílohy:**

Príloha č. 1 – Zmluva s ESA - ESA Contract No. 4000148223/25/NL/MH/yd

Príloha č. 2 - Návrh projektu s referenciou *„ESADOS (ESA Support for Aircrew DOsimetry Services)*" (príloha č. 2)

Príloha č. 3 – Zápisnica z tzv. „Negotiations meetingu", ktorou sa ustanovujú modifikácie návrhu projektu (príloha č. 3)

**ESA Contract No 4000148223/25/NL/MH/yd**

**with**

**Institute of Experimental Physics, of the Slovak Academy of Sciences**

**ESADOS (ESA Support for Aircrew Dosimetry Services)**

# CONTRACT

Between:

**The EUROPEAN SPACE AGENCY**,
(hereinafter called the “Agency” or “ESA”),

having its seat at: 8-10 rue Mario Nikis, CS 45741, 75738 Paris CEDEX 15, France, represented by its Director General, Mr Josef Aschbacher,

acting through its establishment:

The European Space Research and Technology Centre (ESTEC),
located at: Keplerlaan 1,
2201 AZ Noordwijk,
The Netherlands,

of the one part,

and:

**Institute of Experimental Physics of the Slovak Academy of Sciences**,
(hereinafter called the “Contractor” or “IEP SAS”),

whose registered office is at:
Watsonova 47,
040 01 Košice,
Slovakia,

represented by its Director, Doc. RNDr. Zuzana Gažová, DrSc.

of the other part,

the following has been agreed between the Agency and the Contractor, hereinafter also referred to individually as “Party” and collectively as the “Parties”:

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**DEFINITIONS**

| | |
|---|---|
| "**Advance Payment**" | means a payment foreseen in the Contract intended to provide the Contractor with liquidity to allow the initiation of the contractual works. |
| "**Agency's Own Requirements**" | means the activities and programmes undertaken by the Agency in the field of space research and technology and space applications in accordance with Article V 1(a) and (b) of the European Space Agency Convention. |
| "**Contract**" | means an agreement established in writing the subject of which is any activity carried out to- or for the Agency in exchange of a price or another consideration, including any amendment to such agreement via a Contract Change Notice ("CCN"). |
| "**Day**" | means calendar day. |
| "**Force Majeure**" | means an event which is, unforeseeable, unavoidable and external at the time of Contract signature, occurs beyond the control of the affected Party and renders the performance of the Contract impossible for the affected Party, including but not limited to: Acts of God, Governmental Administrative Acts or omissions, consequences of natural disasters, epidemics, war hostilities, terrorist attacks. |
| "**Intellectual Property Rights**" | means all Registered Intellectual Property Rights, and all unregistered intellectual property rights granted by law without the need for registration with an authority or office including all rights in information, data, blueprints, plans, diagrams, models, formulae and specifications together with all copyright, unregistered trademarks, design rights, data base rights, topography rights, know-how and trade secrets or equivalent rights or rights of action anywhere in the world. |
| "**Legitimate Commercial Interests**" | means an interest the Contractor can demonstrate which is important to its ability to commercially exploit Intellectual Property Rights arising from work performed under the Contract for a defined period of time which includes but is not limited to an economic position vis-à-vis a competitor, loss of profits or survival of an undertaking. |
| "**Member State**" | means a State which is Party to the Convention of the European Space Agency in accordance with Articles XX and XXII of the said Convention. |
| "**Participating States**" | means a Member or non-Member State participating in a given Agency programme according to Article V.1 |

| | |
|---|---|
| | (a) and (b) of the European Space Agency Convention. |
| "**Participating State's Own Public Requirements**" | means a public programme in the field of space research and technology and their space applications fully funded or funded to a substantial extent by the Participating State. |
| "**Persons and Bodies**" | means any individual, partnership, company, research organisation or legal entity under the jurisdiction of a Participating State which, when relevant, meets the criteria set out in Article II (3) of Annex V to the European Space Agency Convention. |
| "**Progress Payment**" | means a payment that is made against:<br>(a) successful achievement, certified in writing by the Agency's representatives, of a milestone defined in the milestone payment plan of a fixed price contract;<br>(b) cost reports approved by the Agency in a cost reimbursement contract for a period agreed in the Contract. |
| "**Registered Intellectual Property Rights**" | means all rights granted by law through registration with an authority or office (whether actually registered or in the form of applications) including all registered patents, utility models, designs, topography rights, domain names and trademarks or equivalent rights and rights of action anywhere in the world. |
| "**Subcontractor**" | means the economic operator who is under contract to a Contractor of the Agency to provide supplies or services in support of a Contract placed by the Agency. |
| "**Third Party**" | means a natural or legal person not having signed the Contract. |

## ARTICLE 1. SUBJECT OF THE CONTRACT; GENERAL TERMS OF EXECUTION

1.1 The Contractor undertakes to perform the activity: ESADOS (ESA Support for Aircrew Dosimetry Services) (all hereafter referred to as the "Work") and to deliver all the items listed in Article 2 of this Contract.

1.2 The Work shall be performed in accordance with the provisions stated in the following documents, listed in order of precedence in case of conflict:

a) The specific Articles of this Contract;

b) Appendix 1 hereto: Management, Reporting, Meetings and Deliverables;

c) The signed Minutes of the Negotiation Meeting held on 24/10/2024, reference SKR2_16_Negotiation MoM_v1, dated 01/04/2025, not attached hereto but known to both Parties;

d) The Contractor's Proposal, reference ESA-RPA/OKF/2024/01, dated 10/01/2024, not attached hereto but known to both Parties.

1.3 General Terms of Execution

1.3.1 The Contractor's own sales conditions shall not apply.

1.3.2 The language of this Contract and of all communications hereunder shall be English. The substantive law according to which this Contract shall be construed is the law of Slovakia.

1.3.3 The Parties shall use their best endeavours to amicably settle any dispute arising out of the Contract. Failing an attempt towards an amicable settlement, all disputes shall be finally settled in accordance with the Rules of Arbitration of the International Chamber of Commerce by one (1) or three (3) arbitrators designated in conformity with such Rules. The Arbitration Tribunal shall sit in Bratislava, Slovakia. The Arbitration proceedings shall be conducted in English. The Tribunal's award shall be final, binding on the Parties and no appeal shall lie against it. The enforcement of the award shall be governed by the rules of procedure in force in the state/country in which the award is to be executed.

1.3.4 The Contractor shall be fully responsible towards the Agency for the proper execution of the Work, including any subcontract agreed hereunder. Subcontracts other than those specified in Article 3.1 below are expressly excluded.

The conditions of the subcontracts shall secure for the Agency any rights granted to it under the terms of this Contract.

The Subcontractor shall have the same rights and obligations in relation to the work to be performed under the subcontract that the Contractor has agreed in relation to the Work performed under the present Contract.

Notwithstanding the normal communication lines within the consortium, and the overall responsibility of the Contractor to ensure proper and timely placing of subcontracts and processing of payments throughout the consortium, the Contractor shall ensure that the below provisions are duly reflected in all subcontracts entered into for the purpose of this Contract:

Should any Subcontractor encounter serious difficulties in the process leading to:
timely payment of due invoices (i.e. related to a milestone already achieved) to be made by the Subcontractor's direct customer (i.e. not ESA), or
contractual coverage of activities already kicked-off, the said Subcontractor may directly contact the Agency at: indirectpayments@esa.int

In doing so, such Subcontractor shall attach the Standard Contact Form, available at: https://esastar-publication.sso.esa.int/supportingDocumentation properly filled in or provide the same information in the body of the email.

In case any Subcontractor has SME status, as per the definition of SMEs given by the European Commission:
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003H0361&from=EN,
the Contractor shall ensure that the relevant subcontract foresees an automatic grant of a 35% Advance Payment.

The Contractor shall have the responsibility of obtaining the self-certification of the Subcontractor('s)(s') SME status as per certification model provided in the tender documentation.

1.3.5 The Contractor shall, at all times, comply with the nationality requirements stated in the Call for Proposals.

1.3.6 Any publicity material prepared by the Contractor related to an activity performed by the Contractor in the context of this Contract shall acknowledge that the activity is/was carried out "under a programme of, and funded by, the European Space Agency". It shall display the ESA logo if the Agency so requires. It shall also carry a disclaimer stating that the view expressed in such publications can in no way be taken to reflect the official opinion of the European Space Agency.

1.3.7 The Contractor shall, in accordance with the Agency's Policy on the Prevention, Detection and Investigation of Fraud, to the extent allowed by applicable national law, cooperate with the Agency's investigation team in any investigation of fraud initiated by the Agency and inform its personnel of their obligation to cooperate accordingly. The Contractor shall ensure that this provision is duly reflected in all subcontracts entered into for the purpose of this Contract.

## ARTICLE 2. DELIVERY REQUIREMENTS; PLACE AND DATE OF DELIVERY

2.1 General

2.1.1 Delivery shall be considered as effected only when the relevant deliverable items are in the Agency's possession.

2.1.2 Should it seem likely that the originally specified delivery date(s) may be exceeded, the Contractor shall immediately notify the Agency in writing and provide a detailed justification for the delay.

2.1.3 No price adjustment in favour of the Contractor will be applicable for the period of delay in delivery.

Penalties for late delivery do not apply, and similarly they will not apply in the subcontract(s) that may be placed by the Contractor.

Should the Agency conclude that the delays in delivery have impaired the intended objectives of the Work, the provisions of Article 5.7 below shall apply.

2.1.4 The Contractor shall be responsible for the appropriate marking, packing, package labelling, insurance, freight, carriage and delivery relative to all deliverable items due hereunder and shall bear any cost relative to all of the above. Deliverable items shall furthermore be packed to guard against loss, damage or deterioration during transport and delivery. If found damaged or defective upon delivery, the Agency reserves the right to return the affected items at the Contractor's expenses.

Should in the execution of this Contract a need arise to provide the Agency with information which is subject to export control laws and regulations, the Contractor shall be responsible to ensure in all cases that such information is passed on to the Agency in strict compliance with the provisions of such export control laws and regulations.

2.1.5 In the event of an alleged delay in delivery due to Force Majeure, the Contractor shall report to the Agency the Force Majeure event and its immediate consequences within one (1) week after its occurrence. The Contractor shall bear the burden of proof for the existence, duration and consequences of Force Majeure, such proof to be provided within one (1) month from the occurrence of the Force Majeure event.

In case of Force Majeure, the Contractor shall not be considered at default and its obligations under the Contract shall be suspended during the Force Majeure event. The Contractor shall make reasonable efforts to mitigate the impact on the schedule and the performance of its contractual obligations.

Force Majeure event at Subcontractor's level shall be considered a case of Force Majeure for the performance of the Contractor's obligations, if the Contractor proves that the delay in the delivery of the equipment or works covered by the subcontract due to the Force Majeure event had an unavoidable impact on the final delivery dates stipulated in the Contract.

In case of Force Majeure, an extension of the time-limit for execution or a postponement of delivery dates shall be granted in writing by the Agency.

If the delay due to the Force Majeure exceeds three (3) months, the Parties are entitled to terminate the Contract by giving not less than two (2) months' written notice to the other Party,

unless the Parties agree to modify the Contract in order to take into account the effects of the Force Majeure.

In case of termination due to Force Majeure, the amount to be paid shall be calculated as per Articles 5.8.2 and 5.8.4. No other payments, compensation or indemnities shall be due by the Agency to the Contractor.

2.2 Acceptance and Rejection

The acceptance by the Agency of the deliverables shall be declared upon verification, by the Agency, that the Work has been performed in compliance with the Agency's requirements and that the required results have been achieved. The said deliverables shall be considered as accepted in the absence of an explicit reaction in respect to the same, by the Agency, within one (1) calendar month counting from the time of submission for acceptance. The provisions of Article 5.8 below shall apply in this respect.

2.3 Deliverable Documents

The Contractor shall, during the performance of this Contract, deliver all documentation and reports specified in in the Contractor's Proposal, in the format and quantities specified therein.

These shall be sent to the Agency's Technical Officer mentioned in Article 5.1 unless otherwise specified, in accordance with the following specific provisions:

2.3.1 The draft versions of the final documents as defined in the Contractor's Proposal, shall be submitted for approval, in electronic format, to the Agency's Technical Officer specified herein, not later than 30 June 2026.

The finalised versions thereof shall be issued not later than four (4) weeks after the approval of the draft versions, as specified in Appendix 1.

2.3.2 The Contract Closure Documentation shall be digitally submitted and approved in esa-star (https://esastar-ccd.sso.esa.int/Home/Index)

2.4 Other Deliverables

2.4.1 Software

The Contractor shall deliver the software in source code, models and/or data files to the Agency's Technical Officer in the format(s) specified in the Contractor's Proposal, not later than 31st July 2026.

2.5 Warranty

Warranty shall apply to all deliverable items under this Contract with the exception of those commercial products purchased and delivered to the Agency together with their own warranty.

The Contractor's warranty obligations shall cover the cost incurred by the Contractor and any Subcontractors to remove, replace, repair, update, correct, re-install and re-test, as the case may be, the defective items and shall include the production and delivery of the relevant updated documentation.

The Contractor’s obligation does not extend to cases of defects to the items caused by the Agency through misuse or modification of the items without the Contractor’s consent.

The warranty period shall run for a period of one (1) year from acceptance by the Agency and shall be extended by a period equivalent to that during which the items are not available to the Agency due to the defect having been detected or being corrected.

## ARTICLE 3. PRICE

3.1 The total price of this Contract amounts to:

**92,821 EUR**

**(Ninety-two Thousand, Eight Hundred Twenty-One Euro),**

broken down per Contractor and Subcontractor(s) as follows:

| Company Name | ESA Entity Code | Type P/Prime; SI/Subco Indirect | Country (ISO Code) | Total Amount in Euro |
|---|---|---|---|---|
| Institute of Experimental Physics of the Slovak Academy of Sciences | 1000025275 | P | SK | 74,435 |
| Nuclear Physics Institute of the Czech Academy of Sciences (NPI CAS) | 1000003679 | S | CZ | 18,386 |

The Agency may decide that certain items produced or purchased under the Contract during its implementation (see ARTICLE 7 below) shall become ESA Fixed Assets. Such items shall be identified as becoming ESA Fixed Assets by means of a Contract Change Notice.

The abovementioned price is hereby defined as a Firm Fixed Price and, as such, it shall not be subject to any adjustment or revision by reason of the actual costs incurred by the Contractor in the performance of this Contract.

3.2 Any amount stated above does not include any value added taxes (“VAT”) or import duties in the Member States of the Agency.

3.3 The price is stated as being “Delivered Duty Paid” (“DDP”) for all deliverables, exclusive of import duties and VAT in accordance with the Incoterms® 2020, to the addressees mentioned, or referred to, in ARTICLE 5 of this Contract. Reference to the Incoterms® in this provision is exclusively for the purpose of price definition. The price furthermore includes all costs relative to the Contractor’s obligations under Article 2.1.4 above.

## ARTICLE 4. PAYMENTS AND INVOICING

4.1 Payments

Payments shall be made within thirty (30) Days of submission via esa-p to ESA of the required documents and fulfilment of the requirements specified in Articles 4.1.1 – 4.1.3 below[1]. Only upon fulfilment of these requirements shall the Agency regard the invoice as due.

Requirements to be fulfilled:

4.1.1 Advance Payment:

- Advance Payment Request ("APR") (if any): to be submitted after signature of this Contract by both Parties. The Advance Payment constitutes a debt of the Contractor to the Agency until it has been set-off against subsequent milestone(s) as shown in Article 4.2 here below.

4.1.2 Progress Payment(s)[2]:

- Milestone Achievement Confirmation ("MAC") (hereinafter referred to as "confirmation") with supporting documentation, as necessary, submitted by the Contractor and attached in esa-p. The supporting documentation shall justify the actual achievement of the milestone(s) as defined in the Payment Plan specified in Article 4.2 here below; and
- Invoice.

4.1.3 Final Settlement:

- Confirmation submitted by the Contractor with supporting documentation as necessary attached in esa-p. The supporting documentation shall justify the actual achievement of the milestone(s) as defined in the Payment Plan specified in Article 4.2 here below; and
- Invoice; and
- Delivery, and acceptance by the Agency, of all due items and fulfilment of all other obligations in accordance with the terms of this Contract; and
- Contract Closure Documentation, digitally submitted and approved in esa-star.

Payments shall be made according to the provisions hereunder:

4.1.4 The Agency shall credit the account of the Contractor to the Contractor's benefit and to the benefit of the Contractor's Subcontractor(s). The Contractor shall be responsible for approving or rejecting, within ten (10) Days of receipt, the relevant Subcontractor('s)(s') invoice(s) and related supporting documents (e.g. MACs, Cost Reports). The Contractor shall also be responsible for paying the accounts of its Subcontractor(s), for this Contract, in accordance with the applicable law and normal commercial practice. The Contractor shall indemnify the Agency against any claims arising from such Subcontractor(s), caused by the Contractor's failure to pay the Subcontractor(s). The Contractor shall supply to the Agency, upon request, evidence of the payment(s) made to its Subcontractor(s).

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[1] This is reflected in esa-p as "30 days upon receipt by ESA, in esa-p, of both the confirmation and the invoice", see in esa-p GUIDE Frequently Asked Questions & Answers for Suppliers at: http://esa-p-help.sso.esa.int/FAQ_for_Suppliers.pdf.

[2] For detailed information on how to submit and approve confirmations, invoices and APR in esa-p, you may consult the following two Quick Guides:

http://esa-p-help.sso.esa.int/Quick_Guide_How_to_submit_a_Confirmation_or_Invoice_or_APR.pdf
http://esa-p-help.sso.esa.int/Quick_Guide_How_to_approve_a_Confirmation_or_Invoice_or_APR.pdf.

The Agency shall be afforded all the necessary visibility, whether remotely or by means of inspection of the Contractor's and Subcontractors' premises, in order to ascertain the progress of the Work prior to authorising the relevant payment.

4.1.5 In the event that the achievement of a milestone is delayed but the milestone is partially met at the milestone planning date foreseen, the Agency may, as an exception, effect a payment against an approved confirmation of the partially achieved milestone, not exceeding the value of the Work performed at the date of payment.

4.1.6 When releasing the payment for a given milestone, if applicable, the Agency's payment shall be made after due deduction of the corresponding off-set of the Advance Payment(s) as per the conditions of Article 4.2 here below.

In case of partial payment(s), the Agency shall deduct from the corresponding invoice(s) relative to the same milestone any outstanding amount of the Advance Payment(s) still to be off-set.

4.1.7 All invoices shall be submitted to the Agency in electronic form through the esa-p on-line system.

a) The Contractor shall ensure that the APR (if any), all confirmations and all invoices are submitted for payment exclusively through the Agency's esa-p system. If the Contractor has no access to the Agency's esa-p system at the time of signature of this Contract, an immediate request for an esa-p user account shall be made by the Contractor to the ESA Helpdesk (mail to: esait.Service.Desk@esa.int), specifying a contact name, the company name and the ESA Contract Number.

b) In cases where the Agency's esa-p system is inoperative at the moment of submission of the confirmation, the Contractor may submit the confirmation by email to the Agency's Technical Officer mentioned in Article 5.1.1a) of this Contract. A template confirmation form can be obtained upon request to esait.Service.Desk@esa.int.

c) The Contractor undertakes to complete confirmations and invoices, and to strictly adhere to the instructions (including those for billing taxes and duties, where applicable) contained in esa-p.

If applicable, invoices shall separately show all due taxes or duties.

In the case of invoices submitted by the Contractor which are free of VAT, reference shall be made to the number indicated on the VAT Exemption Form which the Agency provided to the Contractor when forwarding the present Contract for signature. On invoices submitted via esa-p, the number shall be put in the respective field "VAT Exemption Number".

4.1.8 Payments shall be made by the Agency in EURO to the account specified by the Contractor. Such account information shall clearly indicate the IBAN (International Bank Account Number) and BIC/SWIFT (Bank Identification Code). The Parties agree that payments shall be considered as effected by the Agency on time if the Agency's orders of payment reach the Agency's bank within the payment period stipulated in Article 4.1 above.

4.1.9 Any special charges related to the execution of payments shall be borne by the Contractor.

4.1.10 Any questions concerning the operation of esa-p shall be addressed to the ESA Helpdesk (mail to: esait.Service.Desk@esa.int).

4.1.11 Any questions concerning the latest status of due invoices can be addressed to the ESA Payment Officer (mail to: esa.payment.officer@esa.int).

4.2 The following Payment Plan is agreed for this Contract:

| Milestone (MS) Description | Schedule Date | Payments from ESA to (Prime) Contractor (in Euro) | Country (ISO code) |
|---|---|---|---|
| Progress Payment (MS 1): Upon successful completion of WP201 and WP202 and successful review and acceptance by the Agency of all related deliverable items D201.1, D201.2, D202.3 and D202.4 | September 2025 | 30,000 | SK |
| Progress Payment (MS 2): Upon successful completion of WP204 and successful review and acceptance by the Agency of all related deliverable items D204.1 and D204.2 | February 2026 | 20,821 | |
| Final Settlement (MS 3): 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 Contract Closure Documentation | August 2026 | 42,000 | |
| **TOTAL** | | **92,821** | |

Advance Payment(s) [3] and other Financial Conditions:

| Prime (P) | Company Name | ESA Entity Code | Country (ISO code) | Advance Payment (in Euro) | Offset against[4] | Offset by Euro | Condition for release of the Advance Payment |
|---|---|---|---|---|---|---|---|
| P | Institute of Experimental Physics of the Slovak Academy of Sciences | 1000025275 | SK | 10,000 | MS 1 | 10,000 | Upon signature of the Contract by both Parties |

[3] Whenever an SME (as per definition in http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003H0361&from=EN) is involved as Prime or Subcontractor, it shall be entitled to a 35% Advance Payment of its part of the Contract price irrespective of any cash disbursement needs.

[4] An SME has the right to request offset of the 35% advance at the end of the Contract, i.e. the last two milestones (ideally 25% at the last milestone and 10% at the preceding milestone), if this can be justified in view of the economic progress in the Contract.

For information purposes only, distribution by the Prime Contractor of ESA's payments between the Prime Contractor and the Subcontractor(s):

| **For information purposes:** Amounts in Euro for Contractor and Subcontractor(s) | | | | | | |
|---|---|---|---|---|---|---|
| **Milestone** | **Insert Prime Contractor** | ***Insert Country (ISO code)*** | **Insert Subcontractor A** | ***Insert Country (ISO code)*** | **Insert Subcontractor B** | ***Insert Country (ISO code)*** |
| MS 1 | 24 050.00 | SK | 5 950.00 | CZ | - | |
| MS 2 | 16 704.50 | SK | 4 136.70 | CZ | - | |
| MS 3 | 33 680.00 | SK | 8 300.00 | CZ | - | |
| **TOTAL** | **74434.50** | | **18 386.70** | | **-** | |

## ARTICLE 5. SPECIFIC PROVISIONS

5.1 Approval / Representatives of the Parties during Contract Execution

For the purpose of this Contract, the authorised representative of the Agency's Director General is Mr Stephen Airey, Head of Capability and Country Support Division.

5.1.1 The Agency's representatives are:

a) **Mr Giovanni Santin (TEC-EPS)** for technical matters or a person duly authorised by him (the "Technical Officer").

All correspondence for technical matters shall be addressed as follows:

| | To: | With copy to: | | |
|---|---|---|---|---|
| Name | Giovanni Santin (TEC-EPS) | Ms Ines Castelao (CIC-IC) *Akkodis for ESA* | Mr Marnix Houten (CIC-CSS) | Ms Ysee Douenne (CIC-CSS) *Akkodis for ESA* |
| Telephone No. | +31681366557 | +31641752242 | +31715658834 | |
| Email Address | giovanni.Santin@esa.int | ines.castelao@ext.esa.int | marnix.houten@esa.int | ysee.douenne@ext.esa.int |

b) **Mr Marnix Houten (CIC-CSS)** for contractual and administrative matters or a person duly authorised by him/her (the "Contracts Officer").

All correspondence for contractual and administrative matters (with the exception of invoices as mentioned in ARTICLE 4 above) shall be addressed as follows:

| | To: | | With copy to: | |
|---|---|---|---|---|
| Name | Mr Marnix Houten (CIC-CSS) | Ms Ysee Douenne (CIC-CSS) *Akkodis for ESA* | Giovanni Santin (TEC-EPS) | Ms Ines Castelao (CIC-IC) *Akkodis for ESA* |
| Telephone No. | +31715658834 | | +31681366557 | +31641752242 |
| Email Address | marnix.houten@esa.int | ysee.douenne@ext.esa.int | giovanni.Santin@esa.int | ines.castelao@ext.esa.int |

c) Personal Data Protection matters shall be addressed to the ESA Data Protection Officer at the following email address:
dpo@esa.int

5.1.2 Contractor's Representatives:

All correspondence for the Contractor shall be addressed as follows:

Ústav experimentálnej fyziky SAV
Watsonova 47
040 01 Košice

a) for technical matters as follows:

| | To: | With copy to: |
|---|---|---|
| Name | Jan Kubancak | Simon Mackovjak |
| Telephone No. | +421949665221 | +421557922370 |
| Email Address | kubancak@saske.sk | mackovjak@saske.sk |

b) for contractual and administrative matters as follows:

| | To: | With copy to: |
|---|---|---|
| Name | Jan Kubancak | Simon Mackovjak |
| Telephone No. | +421949665221 | +421557922370 |
| Email Address | kubancak@saske.sk | mackovjak@saske.sk |

c) Personal Data Protection matters shall be addressed to the Data Protection contact point as follows:

| | To: |
|---|---|
| Name | Jan Kubancak |
| Telephone No. | +421949665221 |
| Email Address | kubancak@saske.sk |
| Mail Address | Ústav experimentálnej fyziky SAV<br>Watsonova 47<br>040 01 Košice |

5.1.3 Communications related to the Contract affecting its terms and conditions shall only bind the Parties, if signed by the Agency's and the Contractor's duly Authorised Representatives.

The Parties agree that electronic signature of this Contract shall have the same force and effect as hand-signed originals and shall be binding on both Parties to this Contract.

5.2 Personal Data Protection

5.2.1 The Agency shall be a separate Data Controller of the personal data of the Contractor specified in Article 5.1.2, as well as in the Proposal.

5.2.2 The Agency processes Personal Data subject to the ESA PDP Framework, i.e. the Personal Data Protection Framework applicable to ESA and available at http://www.esa.int/About_Us/Law_at_ESA/Highlights_of_ESA_rules_and_regulations

5.2.3 A Privacy Notice regarding the processing of the Personal Data by the Agency for this processing operation is available at (https://esastar-publication.sso.esa.int/supportingDocumentation/details/39)

5.2.4 The Contractor shall share the above-mentioned ESA Privacy Notice, with all Key Personnel whose Curricula Vitae were submitted to ESA.

5.2.5 The Contractor shall be a separate Data Controller of the contact details of the Agency's Representatives as specified in Article 5.1.1.

5.2.6 The Contractor shall process the above-mentioned contact details of the Agency's Representatives subject to the Personal Data protection laws and regulations applicable to the Contractor (e.g EU Regulations in the field of personal data protection, including but not limited to the General Data Protection Regulation (Regulation (EU) nr. 2016/679) (hereinafter "GDPR").

5.2.7 The Personal Data exchanged by the Parties in the frame of this Contract will only be processed for:

a) the performance of the Contract, including implementation, management, monitoring, audits and the fulfilment of the obligations set out in herein.
b) the management of the relationship of the Parties in relation to the Contract, notably for administrative, financial, audit or for communication purposes;
c) the compliance with any legal or regulatory obligation to which a Party is subject.

5.3 Infringement of the Law – Infringement of Third-Party Rights

5.3.1 The Agency shall not be responsible if the Contractor infringes the laws or statutes of its country or of any other country whatsoever.

5.3.2 In the event of a reasonable suspicion of infringement of any patent rights and other Intellectual Property Rights of a Third Party, the Work being performed under this Contract shall be stopped immediately. Assessment of the suspicion shall be performed by the Contractor and, if confirmed, both Parties shall agree on a new approach to achieve the objectives of this Contract, either by obtaining the applicable licence(s) from the Third Party by the Contractor and/or by signing a Contract Change Notice (CCN) agreed upon between both Parties, in order to avoid the infringement. The purpose of the CCN shall be either to (i) restart the Work, if plausible, due under the changed circumstances; or (ii) terminate the Contract, in accordance with Article 5.7.4 hereunder, if the infringement cannot be avoided.

Notwithstanding the above, the Contractor shall indemnify the Agency from and against all claims, proceedings, damages, costs and expenses arising from infringement or alleged infringement of any patent rights and other Intellectual Property Rights of a Third Party with respect to the Work under this Contract. This obligation does not extend to infringements resulting from the use of documents, patterns, drawings or items supplied by the Agency or from a modification or combination of the deliverables due hereunder made by the Agency after their acceptance.

5.4 Liabilities

5.4.1 Claims between the Parties in respect of damages to staff and goods occurring during the execution of the Contract shall be settled in the following manner:

5.4.1.1 Claims for injuries, including death, sustained by the Parties' representatives or employees (staff) by virtue of their involvement in the Contract shall be settled in accordance with the Law governing the Contract.

5.4.1.2 Claims for damage caused by one of the Parties to goods owned by the other Party shall be settled in accordance with the Law governing the Contract. Except in case of gross negligence or wilful misconduct, the total aggregate liability of either Party for damage to goods owned by the other Party shall not exceed the amount which is quoted in the Contract as the total Contract price.

5.4.2 Except in case of gross negligence and wilful misconduct, the Parties shall not be liable towards each other for consequential damages sustained by the Parties, arising from and during the execution of the Contract. For the sake of clarity and as an example, consequential damages include, but are not limited to: loss of contract, income or revenue; loss of profit or interests; loss of financing; loss of customer; loss of availability and use of facilities; loss of availability and use of employees' productivity or loss of services of such persons; loss of opportunity; loss of rental expenses.

5.5 Customer Furnished Items (CFI)

It is not foreseen that the Agency will provide any items to the Contractor.

5.6 Items Made Available by the Agency

It is not foreseen that the Agency will make any items available to the Contractor.

5.7 Agency's Rights in Case of Contractor's Under-Performance

5.7.1 Should any of the results of the Work fail to meet the agreed requirements and/or specifications, the Agency reserves the right to reject such results and require their resubmission following an iteration of the relevant Work by the Contractor at no additional charge.

5.7.2 Should any of the results of the Work fail to meet any of the agreed requirements and/or specifications to such an extent as to seriously jeopardise the performance of this Contract and/or to defeat its objectives, the Agency reserves the right to terminate this Contract by giving written notice by registered mail.

5.7.3 Should the Contractor fail to obtain an export authorisation from the competent national authority, the Agency shall have the right to terminate this Contract without further notice.

5.7.4 Termination of this Contract as specified above shall entail no compensation being due to the Contractor other than the amounts corresponding to the milestone payments already made hereunder at the time of serving the termination notice. Any amounts corresponding to Advance Payments not entirely offset hereunder shall remain payable to the Agency.

5.8 Termination without fault of the Contractor

5.8.1 The Agency shall have the right at any time to terminate this Contract either wholly or in part by giving written notice by registered mail. In the case of termination of a Contract by the Agency without fault of the Contractor, the Contractor shall, on receipt of the Agency's instructions, forthwith take the necessary steps to implement them. The Parties shall use their best efforts to mitigate the consequences of the termination. The period to be allowed to implement them shall be agreed between the Parties but shall not exceed three (3) months.

5.8.2 Subject to the Contractor conforming with the instructions referred in Article 5.8.1, the Agency shall take over from the Contractor at a fair and reasonable price all finished parts not yet delivered to the Agency, all unused and undamaged material, bought-out components and items in the course of manufacture in the possession of the Contractor and properly obtained by or supplied to the Contractor for the performance of the Contract, except such materials, bought-out components and items in the course of manufacture as the Contractor shall, with the agreement of the Agency, elect to retain.

5.8.3

a) The Agency shall indemnify the Contractor against such part of any loss of profit as is attributable to the termination of the Contract and against any damage resulting from the termination of the Contract, in particular against any commitments, liabilities or expenditure which are reasonably and properly chargeable by the Contractor and are related to the Contract, in so far as the said commitments, liabilities or expenditure would otherwise, subject to the conditions stated in Article 5.7.1, represent a loss by the Contractor by reason of the termination of the Contract.

b) The amount of compensation payable under Article 5.8.3a) shall be fixed on the basis of evidence produced by the Contractor and accepted by the Agency. It shall take account of the proportion of the Contract completed and shall be consistent with the provisions of Article 5.8.4

5.8.4 The Agency shall in no circumstances be liable to pay any sum which, when added to the other sums paid, due or becoming due to the Contractor under the Contract, exceeds the total price for the Work set forth in the Contract.

5.9 Changes to this Contract

5.9.1 The Agency reserves the right at any time to request a change to the requirements covered by this Contract. The Agency may also accept changes proposed by the Contractor. The requesting Party shall communicate all change requests to the other Party in writing through the Parties' Representatives indicated in Article 5.1 above.

5.9.2 The cost impact relative to any change resulting from a request, by the Agency, to modify the requirements covered by this Contract shall be borne by the Agency. The Contractor shall be responsible for the consequences and shall bear the cost of any other change.

5.9.3 When responding to a change request issued by the Agency or as a means to propose changes to the Agency, the Contractor shall submit a committing change proposal including a detailed quotation of the effects of the change on the contractual Work, price, schedule, deliverable items and any other contractual terms and conditions.

5.9.4 Upon evaluation and acceptance by the Agency of a change proposal, any amendment to this Contract shall be introduced in the form of a Contract Change Notice (CCN) according to the CCN form attached in Appendix 2. In case of rejection, the Agency shall inform the Contractor accordingly, together with the reasons for the rejection.

## ARTICLE 6. INTELLECTUAL PROPERTY RIGHTS

6.1 Information to be provided by the Contractor – Protection of information.

6.1.1 Information, data, reports and results arising from Work performed under this Contract shall be delivered to the Agency. The Agency shall have the right to make such information, data, reports and results available to the Participating States and any Persons and Bodies under their jurisdiction, to use on the terms set forth in the following clauses.

6.1.2 For the purpose of this Contract, "Proprietary Sensitive Information" shall mean information corresponding to business related information (e.g., business plans) and/or Intellectual Property Rights vesting in an entity, the uncontrolled dissemination of which is likely to impair the entity's long-term ability to use and exploit the aforesaid and/or to maintain a competitive advantage.

The Contractor shall not mark any (electronic) documentation as Proprietary Sensitive Information, unless agreed in advance with the Agency in writing. Any request from the Contractor shall be submitted in writing and accompanied by an appropriate justification.

6.1.3 Neither Party shall disclose any documentation obtained from the other Party, and which both Parties recognise as being Proprietary Sensitive Information without the other Party's previous written authorisation. Without prejudice to the foregoing and limited to the purpose and scope of this Contract, both Parties may circulate such documentation to their employees or collaborators that require the said documentation for the sole purpose of complying with, or inspecting the progress of, this Contract.

6.1.4 The obligations provided in Articles 6.1.2 and 6.1.3 shall not apply to (electronic) documentation which:

- at the time of circulation has already entered in public domain or which after circulation enter in public domain other than through a breach of the Contract;
- at the time of circulation is already known by the receiving Party and is not hindered by any obligation not to circulate;
- is later acquired by the receiving Party from another source and is not hindered by any obligation not to circulate; or
- is required to be circulated by law or order of a court of competent jurisdiction.

6.2 Ownership and Use of Intellectual Property Rights

6.2.1 Ownership of Intellectual Property Rights

The Contractor shall own all Intellectual Property Rights and have the right to apply for, and to own, any Registered Intellectual Property Rights arising from Work performed under this Contract. The Contractor shall as soon as possible report to the Agency any results arising from such a Work which may in its opinion be protected as Registered Intellectual Property Rights and state whether it intends to apply for such protection. At the Contractor's specific request in order to allow for filing of patent applications, the Agency shall not disclose any relevant information and results for a period of twelve (12) months from the date it was reported to the Agency.

The Contractor shall subsequently inform the Agency of any application to register such results arising from Work performed under this Contract and, within two (2) months of the date of filing, provide the Agency with all details on that application. The Agency shall have

an irrevocable right to use the information used in that application, for its own requirements on the terms set out in Article 6.2.2 below but, unless agreed otherwise with the Contractor, the Agency shall not disclose such information until publication of the registration application.

6.2.2 Use of Intellectual Property Rights

All Intellectual Property Rights arising from Work performed under the Contract shall be available to:

a) The government of the Republic of Slovakia, for use on the basis of a free worldwide license, together with the right to grant sub-licenses for its own needs, and;

b) The Agency, to use on a free of charge, worldwide licence, with the right to grant sub-licences, for the Agency's future activities and programmes.

For the avoidance of doubt, the term "use" for the purposes of software and/or hardware (design) shall include, but not be limited to, use to operate, integrate, validate, maintain, modify and upgrade items developed under the Contract.

In view of the objectives of this activity, the Agency explicitly reserves the right to widely disseminate any output of the activity, partial or otherwise, both during the execution of this Contract or after its end, without any restriction.

6.3 Background Intellectual Property.

6.3.1 Background Intellectual Property - Definition

For the purpose of this Contract, "Background Intellectual Property" means all Intellectual Property, belonging to the Contractor or to a Third Party, which:

a) has not been generated under contract with the Agency either prior to or during execution of this Contract, and
b) is relevant to the Work carried out under this Contract, and
c) the Contractor uses to achieve the objectives of this Contract, and
d) is delivered to the Agency to enable it to use, operate, copy, distribute and sublicense the deliverable items due under this Contract as specified in the Agency's requirements, and
e) is duly identified as such in this Contract.

Conversely, "Foreground Intellectual Property" means all Intellectual Property generated through Work carried out under, or directly or indirectly funded through, this Contract.

6.3.2 Use of Background Intellectual Property

The Contractor has confirmed that all results of this Contract (or any part thereof) shall be deemed and treated as not containing any Background Intellectual Property.

Nevertheless, should the Contractor unilaterally decide to use existing Intellectual Property to achieve the objectives of this Contract, all results of this Contract (or any part thereof) shall be deemed and treated as Foreground Intellectual Property not containing any Background Intellectual Property. The Contractor shall grant to the Agency, and/or ensure that the Agency be granted, all the necessary rights in this respect.

6.4 The free licences provided for the benefit of ESA

The free licences provided on Intellectual Property arising from Work performed under this Contract and/or Background Intellectual Property indicated in Article 6.3 for the benefit of ESA shall be deemed granted through signature of the present Contract and without the need to implement a separate licence.

6.5 Transfer outside Slovakia

6.5.1 Any transfer of Intellectual Property arising from work performed under the Contract by the Contractor to any entity outside Slovakia shall comply with all applicable laws including all export control laws, regulations, rules and procedures and any relevant international agreements relating to the export of goods and services.

Property owned by the Contractor

6.5.2 The Contractor shall not transfer any Intellectual Property Rights arising from work performed under the Contract which the Contractor owns to any entity outside Slovakia without seeking the prior written authorisation of the Government of Slovakia, which shall be requested through the Agency. If the Contractor intends to transfer any such Intellectual Property Rights to an entity outside Slovakia, it shall at its earliest convenience and in any event before making any unconditional commitment provide the Agency with a written request accompanied by a Statement setting out details of:

a) the proposed transferee outside Slovakia;
b) the terms of the transfer (together with all countries of destination) and the intended use of the subject matter to be transferred;
c) any further information required by the ESA Division for Industrial Policy Implementation.

6.5.3 The Contractor shall identify in the Statement all relevant national approval or consent procedures which need to be obtained for the said transfer to comply with national legislation and whether any such approvals or consents have been applied for or granted.

6.5.4 The Contractor shall wait 5 weeks from submission of the written request to the Agency before entering into any unconditional commitment.

6.5.5 The Agency shall not Disclose the Contractor’s written request or Statement but shall promptly circulate the request and Statement to the Government of Slovakia for approval.

6.5.6 If the Contractor has assigned Intellectual Property Rights arising from work performed under the Contract to a Third Party, the Agency may request that the Contractor shall ensure that the assignee complies with clauses 6.5.2-6.5.7.

Recommendation

6.5.7 The Agency’s recommendation and decision of the Government of Slovakia shall be communicated to the Contractor.
The request for a transfer outside Slovakia shall be addressed to:

Capability and Country Support Division,

Attn.: Mr Stephen Airey,

ESA/ESTEC,
Keplerlaan 1,
2201 AZ Noordwijk,
The Netherlands,

with a copy to the technical and administrative representatives of the Agency identified in Article 5.1.1.

## ARTICLE 7. MANAGEMENT AND CONTROL OF INVENTORY ITEMS/FIXED ASSETS UNDER THE CONTRACT

The following provisions apply to any items other than those items which fall within the scope of ARTICLE 2 of the Contract.

The Contractor shall specify, record, manage and control any and all customer items and ESA Fixed Assets under construction (reference is made to Article 3.1 above) that are subject to this Contract. Such items are:

i. items produced or purchased under the Contract, including electronic components, special jigs, tools, test equipment, which are paid for under the Contract with an individual or batch value (value of group of items) in the national currency equivalent to or above five thousand (5,000) Euro;
ii. if any, items identified as becoming ESA Fixed Assets in ARTICLE 3 above or in a subsequent CCN;
iii. Items Made Available by the Agency, if any (see Article 5.5 of the Contract).

The Contractor shall operate an inventory control system ("Inventory Control System") of all the above-mentioned items and shall mark them as falling under this Article of the Contract.

The Inventory Control System shall:
- record the existence, location, operational status and condition of all inventory items, and
- record the value and estimated life duration of all inventory items, and
- record changes in inventory value, and
- enable financial reconciliation to be made and status reports to be prepared for incorporation of the relevant data into the Agency's annual financial accounts.

The Contractor shall, as part of the Inventory Control System, maintain an Inventory/Fixed Asset Record (in an electronic tool of its choice) which shall, as a minimum, contain the information as shown in Appendix 3 to this Contract.

The Inventory/Fixed Asset Record shall be kept updated by the Contractor. It shall be made available to the Agency upon request but as a minimum yearly during the execution of the Contract (and at completion of each Project Phase as per ECSS-M-ST-10 if applicable). A final consolidated record shall be submitted with the final contractual deliverables as foreseen in Appendix 1 to this Contract.

If the Inventory/Fixed Asset Record also includes any of those items which fall within the scope of ARTICLE 2 of the Contract, these items are to be clearly set apart.

Items, for which no place of delivery has been identified in ARTICLE 2 of this Contract, are subject to the following provisions:

Upon completion of the Work specified in the Contract, the Agency shall take decisions regarding the final destination and final ownership of each item listed in the Inventory/Fixed Asset Record. The Agency shall be free to choose amongst the following options with respect to the final destination and final ownership of such items:

a) the right to claim delivery to the Agency and transfer of ownership (the latter if applicable) - with issue of appropriate instructions concerning packing and shipment (at the Contractor's expense);
b) the right to claim or retain ownership and to negotiate with the Contractor a loan agreement if the Contractor is interested in keeping and using an item, with loan conditions making the

Contractor responsible for the custody, the delayed delivery and the risks involved (at the Contractor's expenses).

c) the right to extend the custody of an item to the Contractor and to postpone its delivery to the Agency and the associated transfer of ownership – on conditions to be negotiated;
d) the renunciation of any rights to claim delivery and to claim transfer of ownership, leaving the item definitively in the possession and in the ownership of the Contractor, with or without financial compensation for the Agency (e.g., repurchase by the Contractor) and with or without special instruction,
e) the right to request the Contractor to dispose of an item on conditions to be negotiated.

Should the Agency decide to transfer an ESA Fixed Asset to a Third Party or to dispose of the Fixed Asset, the Contractor shall provide the full inventory information of the Fixed Asset to the Agency and complete the transfer or disposal forms to be provided by the Agency upon request by the Contractor. The information to be given by the Contractor in the forms shall be agreed with the Agency.

The decisions taken by the Agency shall lead to instructions or negotiations, as the case may be, and the results shall be recorded in the relevant sections of the digital Contract Closure Documentation (CCD) in esa-star (http://esastar-ccd.sso.esa.int). The CCD shall not be finalised and signed before disposition of all items has been given by the Agency and recorded in the documentation.

Electronically signed by the Parties to this Contract,

| | |
|---|---|
| In: Košice, Slovak Republic | In: Noordwijk, the Netherlands |
| On: ..... | On: ..... |
| For the Institute of Experimental Physics SAS | For the European Space Agency (ESA) |
| ---------- | ---------- |
| doc. RNDr. Zuzana Gažová, DrSc.<br>Director of the IEP | Stephen Airey<br>Head of the Capability & Country Support Division |

# APPENDIX 1

## STANDARD REQUIREMENTS FOR MANAGEMENT, REPORTING, MEETINGS AND DELIVERABLES

The following are the requirements for Management, Reporting, Meetings and Deliverables applicable to the present activity.

## 1.1. Management

### *1.1.1. General*

The Contractor shall implement effective and economical management for the project.

The Contractor's nominated Project Manager shall be responsible for the management and execution of the work to be performed and, in the case of a consortium, for the coordination and control of the consortium's work.

### *1.1.2. Communications*

All communications to the Agency, affecting technical terms and conditions of the activity, shall be addressed in writing to the Agency's representatives nominated in the Contract.

## 1.2. Access

During the course of the Contract the Agency shall be afforded free access to any plan, procedure, specification or other documentation relevant to the programme of work.

## 1.3. Reporting

### *1.3.1. Minutes of Meeting*

The Contractor is responsible for the preparation and distribution of Minutes of Meetings held in connection with the Contract. Electronic versions shall be issued and distributed to all participants, to the Agency's Technical Officer and to the Agency's Contracts Officer, not later than ten (10) days after the meeting concerned.

The minutes shall clearly identify all agreements made and actions accepted at the meeting.

### *1.3.2. Bar-chart Schedule*

The Contractor shall be responsible for maintaining the bar chart for work carried out under the Contract, as agreed with the Agency.

The Contractor shall present an up-to-date chart for review at all subsequent meetings, indicating the current status of the Contract activity (WPs completed, documents delivered, etc.).

### *1.3.3. Progress Reports*

Every month, the Contractor shall provide a Progress Report in electronic format to the Agency's representatives, covering the activities carried out under the Contract. This report shall refer to the current activities shown on the latest issued bar chart and shall give:

- Action items completed during the reporting period;
- Description of progress: actual vs schedule, milestones and events accomplished;
- Reasons for slippages and/or problem areas, if any, and corrective actions planned and/or taken, with revised completion date per activity;
- Events anticipated during the next reporting period (e.g. milestones reached);
- Milestone payment status.

### *1.3.4. Problem Notification*

The Contractor shall notify the Agency's representatives (Technical Officer and Contracts Officer) of any problem likely to have a major effect on the time schedule of the work or to significantly impact the scope of the work to be performed.

### *1.3.5. Technical Documentation*

As they become available and not later than the dates in the delivery plan, the Contractor shall submit for the Agency's approval Technical Notes, Task/WP Reports, etc.

Technical documentation to be discussed at a meeting with the Agency shall be submitted electronically two (2) weeks prior to the meeting.

Technical documents from Subcontractors shall be submitted to the Agency only after review and acceptance by the Contractor and shall be passed to the Agency via the Contractor’s formal interface to the Agency.

## 1.4. Meetings

The kick-off meeting shall take place by video- or tele-conference, or, alternatively, in person.

Progress Meetings shall be held by video- or teleconference.

The final presentation shall take place at the Agency's premises, to a public audience, within twelve (12) months of Contract closure. During the course of the activity the Agency will decide on the format for the final presentation (e.g. dedicated meeting, conference, specific event). Preference shall be given to a specific event where technologies related to a specific technology domain or technology theme are presented together.

Additional meetings may be requested either by the Agency or the Contractor.

With due notice to the Contractor the Agency reserves the right to invite Third Party(ies) to meetings to facilitate information exchange.

For each meeting the Contractor shall propose an agenda in electronic form and shall compile and distribute hand-outs of any presentation given at the meeting. Should the Contractor wish to invite Third Party(ies) to meetings, the prior approval of the Agency shall be sought.

## 1.5. Deliverable Items

In addition to the documents to be delivered according to section 1.3 here above the documentation and other deliverable items defined in the Applicable Documents under Article 1.2 of the Contract shall also be deliverables.

All documentation deliverables mentioned hereunder (including all their constituent parts) shall be delivered in electronic form in a format agreed by the Agency (PDF format, the native format and in other exchange formats where relevant).

Upon explicit request of the Agency, all the documentation shall also be delivered on computer readable media (e.g. USB key).

The draft version of the documentation shall be sent to the Agency's Technical Officer in electronic format not later than two (2) weeks before the documentation is to be presented.

All documents shall bear the appropriate copyright notice. In all cases, this shall include the title, ESA Contract number, deliverable number, date, status (draft), version and/or revision number. The information shall be repeated consistently in the header or footer of every page.

**Definition of Deliverable Documents**

- TDP TECHNICAL DATA PACKAGE
  The Technical Data Package consists of the final versions of all approved technical documents, delivered during the execution of the activity.

- ESR EXECUTIVE SUMMARY REPORT
  The Executive Summary Report shall concisely summarise the findings of the Contract. It shall be suitable for non-experts in the field and should also be appropriate for publication. For this reason, it shall not exceed five (5) pages of text and ten (10) pages in total (one thousand five hundred (1500) to three thousand (3000) words).

  Note: The Agency may request the Contractor to produce the Summary Report in the form of a paper suitable for publishing in a technical journal.

- FR FINAL REPORT
  The Final Report shall provide a complete description of all the work done during the activity and shall be self-standing, not requiring to be read in conjunction with reports previously issued. It shall cover the whole scope of the activity, i.e. a comprehensive introduction of the context, a description of the programme of work and report on the activities performed and the main results achieved.

- CCD CONTRACT CLOSURE DOCUMENTATION
  The Contract Closure Documentation is a mandatory deliverable, due at the end of the Contract. Work performed under Contract Change Notices adding new tasks with respect to the original Contract shall require separate Contract Closure Documentation.

# APPENDIX 2

## CONTRACT CHANGE NOTICE

For submission of a change, the Contractor shall submit its proposal in the format of a CCN using the cover page included below. The form shall be filled with the following information as a minimum:

- The Contractor's name and the ESA Contract number;
- The title of the area affected by the change (Work Package reference, new work, etc.);
- The name of the initiator of the change (Contractor or ESA);
- The description of the change (including Work Package Descriptions, Work Breakdown Structure);
- The reason for the change;
- The price breakdown in Euro (€), if any (breakdown by company, Phase, etc., including PSS A2 and PSS A8 forms);
- The Milestone Payment Plan for the CCN, if any;
- Effect on other Contract provisions;
- Start of Work - end of Work (including contractual delivery dates and overall planning, milestones, etc.);
- A CCN Form, as per the format below, signed by the Contractor's representatives.

The Contractor shall, on request of the Agency, provide additional documentary evidence. At the request of either Party, the proposed change may be discussed at a Change Review Board, consisting of both the Contracts Officer and the Technical Officer of each Party.

<table>
<tr><td>  </td><td>DIRECTORATE:</td><td>Contractor:</td></tr>
<tr><td colspan="2"></td><td>ESA Contract No.:<br>4000148223/25/NL/MH/yd</td></tr>
<tr><td colspan="2">CONTRACT CHANGE NOTICE No.</td><td>DATE:</td></tr>
<tr><td colspan="2" rowspan="2">TITLE OF AREA AFFECTED (WORK PACKAGE ETC):</td><td>WP REF:</td></tr>
<tr><td>INITIATOR OF CHANGE:</td></tr>
<tr><td colspan="3">DESCRIPTION OF CHANGE</td></tr>
<tr><td colspan="3">REASON FOR CHANGE</td></tr>
<tr><td colspan="3">PRICE BREAKDOWN (Currency)/PRICE-LEVEL</td></tr>
<tr><td colspan="2" rowspan="2">EFFECT ON OTHER CONTRACT PROVISIONS</td><td>START OF WORK</td></tr>
<tr><td>END OF WORK</td></tr>
<tr><td>CONTRACTOR’S PROJECT MANAGER:<br><br>DATE:</td><td colspan="2">CONTRACTOR’S CONTRACTS OFFICER:<br><br>DATE:</td></tr>
<tr><td colspan="3">[DISPOSITION RECORD OR OTHER AGREED CONDITION RECORDED WITH THE CCN APPROVAL]</td></tr>
<tr><td>ESA TECHNICAL OFFICER:<br><br>DATE:</td><td colspan="2">ESA CONTRACTS OFFICER:<br><br>DATE:</td></tr>
</table>

# APPENDIX 3

## INVENTORY/FIXED ASSET RECORD

1.1. Content of electronic Inventory/Fixed Asset Record

The Contractor shall establish an electronic Inventory/Fixed Asset Record with, as a minimum, the following information:

For all items:

- Contract number/subcontract number, if applicable;
- unique item number;
- confirmation that the item has been marked with the unique item number;
- description of item;
- part number/serial number/type code;
- quantity;
- system/subsystem;
- property owner;
- manufacturer;
- classification (category – see section 1.2 below);
- acquisition value (i.e. original purchase price or price at Contract signature as applicable);
- date of purchase or production ("in service date" if not corresponding with date of purchase/production);
- in-service date;
- foreseen useful life (to be agreed with ESA);
- physical location (e.g. facility, building, room);
- entity responsible for care and custody;
- related WBS code or other identifier (to be coordinated with the Agency);
- description and date of any change to the property item;
- planned method of disposal (if applicable).

In addition to the above, the following information shall be added to those items that are identified as becoming ESA Fixed Assets in Article 3 of the Contract, as applicable:

- Acquisition value
  - revision of this value as a result of change(s) to the asset;
- Impairment report of each ESA Fixed Asset remaining in the custody of the Contractor after its acceptance by ESA (using the template that will be provided by the Agency upon announcement by the Contractor that the item has been impaired);
- date of acceptance by ESA (planned date of acceptance);
- foreseen handling after ESA's acceptance (e.g. transfer to ESA, continuing in custody of the Contractor).

1.2. Classification of Inventory/Fixed Assets items

For the purpose of Inventory/Fixed Asset Control, items shall be classified into five (5) categories, according to the source and intended use of the items, as follows:

| Source/Purpose | Supplier-acquired Items | Customer-furnished Items |
|---|---|---|
| Consumable items (e.g. parts, materials, supplies) | Class 1 | Class 2 |
| Capital items/production support equipment and tools (e.g. instruments, jigs, fixtures) | Class 3 | Class 4 |
| Items purchased by the supplier or his lower tier suppliers on their own account but amortised under the Contract | Class 5 | |

Note 1: Consumable items are parts, materials, supplies, components, modules, minor expendable tools, assemblies, units and subsystems, which through the production process lose their identity and are absorbed directly or indirectly by the system/product to be provided under the Contract.
Note 2: Consumable items are in principle not capitalised per item; however, before consumption they are identified as assets of the Agency under the collective term “Consumable”.
Note 3: Capital items/production support equipment and tools are jigs, fixtures, devises, apparatus, instruments, machines, installations, technical facilities, buildings, computer programmes, documentation, models, samples or any other item, which, after their use in or in conjunction with the production process under the Contract, are expected to have a residual utility or other value for the Agency.
Note 4: Capital items have a useful life of more than one (1) year and are identified as individual items in the supplier’s and its lower tier suppliers’ list of Agency’s assets.

**TITLE OF THE PROPOSAL: ESADOS (ESA Support for Aircrew DOsimetry Services)**

## PART 1 TECHNICAL AND APPLICATION PART

### 1.0 INTRODUCTION AND SCOPE

**Introduction**

The technical developments of civil aviation, supersonic flights and space travel, together with more accurate knowledge about cosmic radiation, motivated in 1966 the **International Commission on Radiological Protection, ICRP,** to consider the biological effects of the varying solar radiation and the relatively constant galactic radiation, and to recommend for aircrew preventive measures in specific cases. **The 1990 ICRP Recommendations stated that exposures to cosmic radiation during flight in jet aircraft should be included as part of occupational exposure of aircrew.**

Due to the complex nature of primary and secondary cosmic ray fields in the atmospheres and inside the aeroplanes, the most common way of dose determination is its computation with various computer codes developed especially for this purpose. One can cite codes like, SIEVERT, EPCARD, JISCARD, PC-AIRE, CARI, IASON-FREE, AVIDOS and others (see e. g. Eurados report No. 2021-03 - Comparison of Codes Assessing Radiation Exposure at Aviation Altitudes in Case of Solar Particle Events or European Commission report No. 173 - Comparison of codes assessing radiation exposure of aircraft crew due to galactic cosmic radiation).

**Currently, in the European Union, the radiation protection of aircrew is based on national implementations of article 26 of the EU COUNCIL DIRECTIVE 2013/59/EURATOM of 5 December 2013.** The article 26 of the directive states: ***"****The exposure of air crew to cosmic radiation should be managed as a planned exposure situation. The operation of spacecraft should come under the scope of this Directive and, if dose limits are exceeded, be managed as a specially authorised exposure.*

**Typical aircrew dosimetry implementation framework in Europe**

In most countries, the aircrew dosimetry is implemented in the way illustrated in Figure 1.1. Airline forwards crew presence and flight data to a subject that is allowed to provide aircrew dosimetry services and the dosimetry service sends the results of exposure determination back to the airline. Airline then informs crew members and radiation protection authority about the exposures. usually, the airline itself may also act as a dosimetry service, if it has a permission from the national radiation protection authority.

**The main problem related to processes shown in Figure 1.2 is the availability of the space weather data for some codes. When no space weather data is available, the computation of aircrew radiation exposure is not possible, as computer codes rely on it.**

One of the most widely used computer codes for crew radiation exposure calculation is the CARI code developed and provided by the American FAA's Civil Aerospace Medical Institute. **The reason is simple – the CARI code results are generally accepted by the radiation protection authorities, offered for free and no licence for its use is required[1].**

The program calculates the effective dose of galactic cosmic radiation received by an individual (based on an anthropomorphic phantom) on an aircraft. The altitude limit is now 300,000 ft. Calculations dating to 1958 are possible without providing added data.

In addition, many flight planning and scheduling software solutions commonly used by the airlines, like e. g. the LEON (https://www.leonsoftware.com/), support direct exports of flight data into the CARI compatible input formats and import of computed radiation exposure data back into the software,resulting in even wider use of CARI code.

**The problem occurs when we want to calculate the radiation exposure based on recent data.** A user has typically to download the file that contains the latest values of heliocentric potential. **Nowadays, the file is available for download for free only from the FAA CARI code pages[2], NEVERTHELESS THE DATA ARE OFFERED FOR FREE AND THEIR AVAILABILITY IS NOT GUARANTEED.**

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[1] please refer to https://www.faa.gov/data_research/research/med_humanfacs/aeromedical/radiobiology/cari7 and Final Report of EURADOS WG 5 - Cosmic Radiation Exposure of Aircraft Crew Compilation of Measured and Calculated Data - https://energy.ec.europa.eu/system/files/2014-11/140_0.pdf

[2] https://www.faa.gov/sites/faa.gov/files/data_research/research/med_humanfacs/aeromedical/MV-DATES.zip

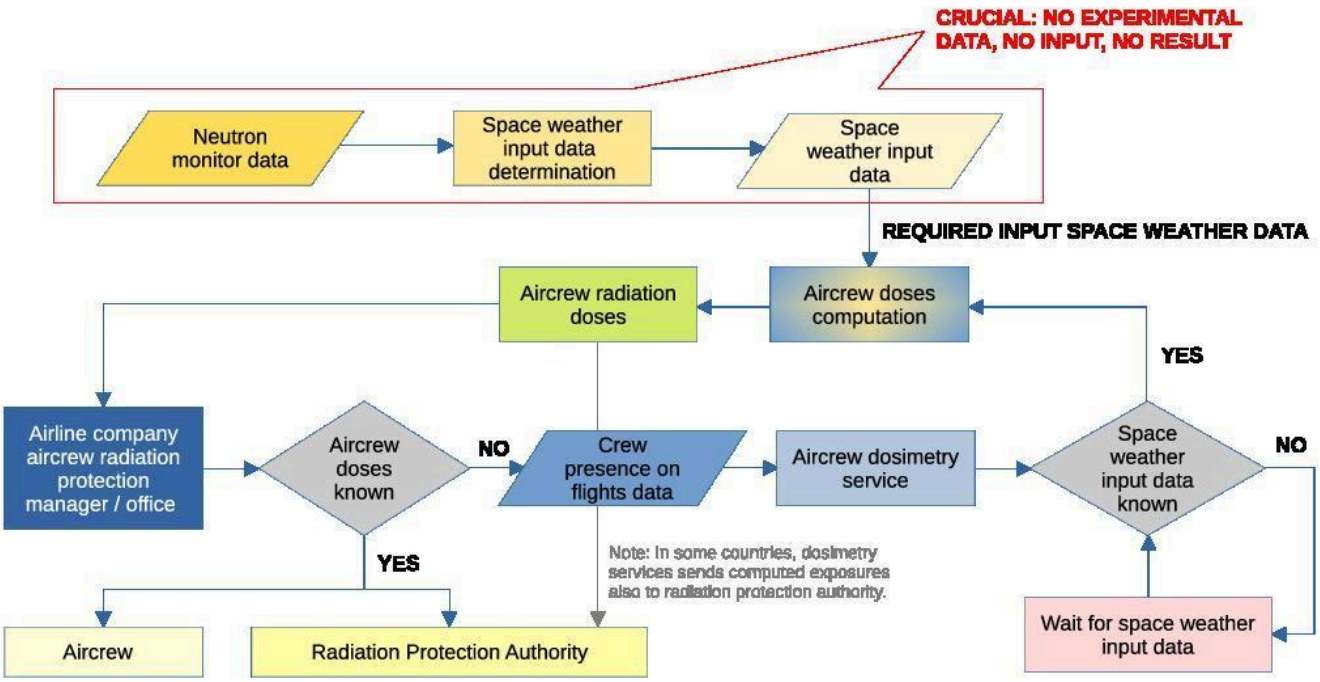



***Figure 1.1 – Typical aircrew dose assessment framework in EU countries. The weakest point of the whole diagram is the availability of space weather data.***

**Scope of the project**

The scope of the ESADOS project is defined by the

- needs for radiation protection of aircrew, required to be performed by the legislation currently valid in the European Union and many other countries,
- NEEDS FOR DIVERSIFICATION AND AVAILABILITY OF SPACE WEATHER INPUT DATA SOURCES for the CARI code, and
- needs for creating a model that will forecast the heliocentric potential values from 2 to 3 months ahead.

In the project, **we would like to create a product that** would use the **long-term space weather data from the Lomnicky stit high mountain observatory neutron monitor to compute and publish current values of heliocentric potential online**. In addition, based on our data, we will create a model that will predict the value of heliocentric potential for the next month.

How we would like to solve the problem with a single source of heliocentric potential data and what will be the output from our project?In short, at the beginning, we will create a model that will be used for automatic calculation and forecasting of heliocentric potential from Lomnicky stit neutron monitor data. Then, the model will be validated using the data obtained directly onboard aircraft and a website product will be created. In the final stage, we will promote our new product through our results published in scientific papers in appropriate scientific journals.

**The project will comprise:**

1. Creation of the theoretical model for computation and forecast of heliocentric potential based Lomnicky stit neutron monitor data (TRL1).

2. Creation of computer algorithm for automated space weather data processing and heliocentric potential calculation (TRL2).

3. Creation of computer algorithm for automated heliocentric potential forecast (TRL2).

4. Verification and validation of the algorithms for heliocentric potential determination and forecast (TRL3).

5. Publication of achieved results in appropriate scientific journal (TRL3)

6. Creation and promotion of a new website product – an alternative heliocentric potential space weather data source for CARI code (TRL3).

7. Preparation of proof-of-concept of new product for ESA SWESNET space weather network, section 1.3 - space radiation products. The new product will provide the SWESNET with alternative values of recent and forecast heliocentric potential values for further use not only in CARI code (TRL3).

The start TRL of the project is TRL1 and the final TRL will be the TRL3. The opportunity of the project is to create a service that has potential to be finally offered as a product on IEP SAS operated website as well as on ESA SWESNET site in future.

## 1.1 TECHNICAL OBJECTIVES:

What do we want to develop?

The goal of our project is to create an alternative data source – source of recent and forecast heliocentric potential values computed using our neutron monitor data and provided to users via a convenient website application. **Website users with subscription will have the data availability guaranteed.** Preliminary interest in this product has been expressed by several airlines, aircrew dosimetry services as well as radiation protection authorities. For more details please refer to attached “letters of support”. The product has potential to become a part of the ESA SWESNET Space Weather Service Network in future and the proof-of-concept of such a solution is also one of the deliverables of our project.

Target levels of performance to be achieved

Our effort has to result in creation of

- TRL3 level IEP SAS website and
- TRL3 proof-of-concept of ESA SWESNET product,

both providing recent and forecast values of the heliocentric potential based on Lomnicky stit neutron monitor data.

## 1.2 REQUIREMENTS:

Requirements are listed in table below:

| Technical Objective | Technical requirements | Justification / verification |
|---|---|---|
| **HP models** | ● journal article “Application of the heliocentric potential to aircraft dosimetry” (https://doi.org/10.1093/rpd/nci090)<br>● IEP SAS and NPI CAS expert input<br>● neutron monitor data with one hour time resolution<br>● computer with the<br>○ R software environment for statistical computing and graphics<br>○ Python/PHP/Apache/MySQL<br>○ office software package | - achievements of required technical goals will be verified in a validation process, which will use data from measurements of cosmic rays radiation doses onboard aircraft performed by the NPI CAS |
| **Validation** | ● must be done by comparing values computed using the heliocentric potentials based on Lomnicky stit neutron monitor data and data from real measurements onboard aircraft performed by NPI CAS | - achievements of required technical goals will be proved when the difference between the measured and computed values will by within the accuracy interval defined by the CARI code manufacturer (FAA) |
| **IEP website** | ● website product is required to have following features:<br>○ must provide historic as well as forecast heliocentric potential data (up to three months ahead)<br>○ access to the HP data after registration<br>○ must contain links to documents proving the scientific validity of the published values of HP | - validation of the technical goal will be realised by testing all the functionalities of the site |

| Technical Objective | Technical requirements | Justification / verification |
|---|---|---|
| **SWESNET proof-of-concept** | ● proof-of-concept must prove that the solution offered by the IEP SAS is suitable to become a part of the ESA SWESNET network<br>● the proof must be realised by demonstration of functionalities of IEP website and by achieved scientific results | - proof and reliability is the key aspect necessary for a product to become a part of ESA SWESNET product, achievements of the goals will be verified by accepting the proof-of-concept by the ESA |
| **Promotion** | ● promotion has to be realised with emphasis on scientific validation of offered results<br>● results has to presented at least in one impacted international scientific journal focused on radiation protection and at least at one conference that deals with the radiation protection topic<br>● EURADOS and FAA will be notified about the availability of alternative source of heliocentric potential | - the verification of achievements of the required technical level will be realised implicitly via peer review process when publishing the scientific paper in scientific refereed journal, by feedback from scientific expert communities |

1.3 TECHNOLOGY READINESS LEVEL:

**Current level of maturity (TRL1)**
At the moment, we have the neutron monitor data and basic principles of how to determine the heliocentric data from the neutron monitor data.

**Intermediate step (TRL2)**
Create, describe, verify and validate models for heliocentric potential calculation and create corresponding algorithms for determination of heliocentric potential from the Lomnicky stit neutron monitor data.

**Level of technical maturity to be reached (TRL3)**
**Website product / application** where the heliocentric potential will be available for users for download. At this point, we will deal with the proof-of-concept solution. The website product will be offered for free for unregistered users but without legal warranty of data availability. There will be an option of paid website product with guaranteed availability of heliocentric potential data for historic as well as future values.

**ESA SWESNET proof-of-concept** of the website module that could be transferred to the ESA SWESNET pages.

1.4 ENGINEERING APPROACH

1.4.1 State of the Art

As we mentioned in section 1.0 - INTRODUCTION AND SCOPE, each airline registered in a European Union country is obliged to implement aircrew radiation protection measures. In Slovakia and the Czech Republic, the CARI code is used almost exclusively.

The CARI model takes into account various factors, including flight parameters, geographical location, and **solar activity**. Input parameters necessary for calculation of effective dose of a crew member include flight route, flight altitude, aircraft technical parameters, the date and time of the flight and the heliocentric potential, which is the key factor. **As we mentioned in the introduction, nowadays there exists only a single source of heliocentric potential data - the FAA CARI web pages.**

The CARI related FAA website, which publishes the values of heliocentric potential, contains this statement[3]:

"*Heliocentric potentials for recent months (last 12 months) are preliminary. The data above is based on ground level neutron measurements provided by Dr. Eduard Vashenyuk of the Apatity Cosmic Ray Station of the Polar Geophysical Institute, Russia.*"

**In other words it means that several thousand aircrew members rely only on one source of data. In addition, the page with heliocentric potential values misses the statement that would guarantee the availability of the data in future.**

**To solve this situation, we would like to implement our new ideas and use the neutron monitor at the Lomnicky stit to create another independent source of heliocentric potential values for all CARI users.**

[3] https://www.faa.gov/data_research/research/med_humanfacs/aeromedical/radiobiology/heliocentric; information as stated on website on January 14, 2024, 17:42 UTC

Similar services and products, like e.g. human spaceflights and aviation services, among them the AVIDOS, are already part of ESA SWESNET space weather network. We believe that we could enrich the SWESNET with valuable modules that could be used by many CARI code users.

#### 1.4.2 Technical Steps

The project consists of FOUR major technical STEPS and MANAGEMENT of the project. Meeting the requirements of the major technical steps will lead into achievement of the main goals of the project described in section 1.1.

The steps are as follows:

I. MANAGEMENT OF THE PROJECT
II. CREATION OF THE MODEL FOR HELIOCENTRIC POTENTIAL DETERMINATION
III. VALIDATION OF THE MODEL FOR HELIOCENTRIC POTENTIAL DETERMINATION
IV. WEBSITE PRODUCT AND PROMOTION
V. ESA SWESNET PROOF-OF-CONCEPT CREATION

**I. MANAGEMENT OF THE PROJECT**

Management of the project is the key technical step that will ensure that

- the project is running according to the schedule,
- the communication between IEP SAS and NPI CAS is effective and cooperation productive,
- reporting and cooperation with the ESA is efficient and responsive, and
- the objectives of the project will be achieved.

Due to its importance, management of the project is put into a separate work package WP 100 (see the flowchart). Detailed overall management of the project is discussed in PART 2 of the proposal.

**II. CREATION OF THE MODEL FOR HELIOCENTRIC POTENTIAL DETERMINATION**

Determining the heliocentric potential from ground neutron monitor response involves analysing the data from neutron monitors, which are instruments designed to measure cosmic-ray flux at the Earth's surface.

The heliocentric potential is related to the solar modulation of cosmic rays and reflects the influence of the solar activity on the galactic cosmic-ray particles. The general steps involved in the determination of the heliocentric potential from the neutron monitor response that user has to make are:

- collect raw neutron monitor data
- analyse the raw data and exclude the faulty values (some can occur e.g. when lightning strikes the building of the Lomnicky stit observatory etc.)
- apply barometric pressure correction on measured valid data
- **use the** mathematical **model** to transform the neutron monitor measured data into the heliocentric potential values; **the heliocentric potential is the result of a steady-state solution to the diffusion equation of cosmic rays through the solar wind. The counting rate of any high-latitude, ground-level neutron monitor can be used to determine this potential, which will return cosmic ray spectra in real time**[4]

In the first step and under the expert supervision of NPI CAS, we prepare a mathematical model that will be adopted for the conditions of the Lomnicky stit neutron monitor. Considering the requirements of the computations of the heliocentric potential, we will prepare the IT infrastructure necessary to run our computations and website product and prepare the computation algorithms that will represent the computer implementation of our model.

Our numerical implementation of the model will be tested on historical data and results will be compared with the historical heliocentric potential data available at the FAA website.

Finally, based on historical data, the best method for forecasting heliocentric potential data up to three months ahead will be selected.

**III. VALIDATION OF THE MODEL FOR HELIOCENTRIC POTENTIAL DETERMINATION**

Validation of the model for heliocentric determination and forecast will be performed in following steps:

- preparation of data from measurements onboard jet aircraft by the NPI CAS

[4] Keran O'Brien, Ernst Felsberger, Peter Kindl, Application of the heliocentric potential to aircraft dosimetry, Radiation Protection Dosimetry, Volume 116, Issue 1-4, 20 December 2005, Pages 336–342, https://doi.org/10.1093/rpd/nci090

- calculation of values of radiation doses for measured routes by the IEP SAS using the CARI code and heliocentric potential values computed from Lomnicky stit neutron monitor data
- **comparison of real measurements onboard aircraft with calculations using the CARI code and heliocentric potential values based on Lomnicky stit neutron monitor data; comparison will include following statistical tests:**
  - **comparison of mean values and their differences including uncertainties;** result will be acceptable if the mean values will be equal at uncertainty significance level
  - **linear regression of the differences of mean values;** result will be acceptable if f(x) = 0 will be valid within computation and measurement uncertainty intervals
- evaluation of results of comparison and creation of detailed report by the IEP SAS
- critical evaluation and review of the IEP SAS report by the NPI CAS; output of this package will be a detailed report with breakdown of IEP SAS report

**IV.WEBSITE PRODUCT AND PROMOTION**

The activities are covered by the work-package WP400. Technical steps are as follows:

- creation of website product as follows:
  - full responsive design
  - based on CakePHP5 framework (backend + frontend)
  - database: MySQL
  - user management system
- promotion of achieved results in at least one scientific paper in impacted journal (most probably the Oxford University Press Radiation Protection and Dosimetry journal)
- promotion of our website product at conferences focused on radiation protection topic

**V.ESA SWESNET PROOF-OF-CONCEPT CREATION**

The activities are covered by the work package WP400. Technical steps are as follows:

- creation of report that will contain
  - full description of the website product
  - steps necessary to transfer our website product to ESA SWESNET
- sending the report and our offer to ESA SWESNET management and negotiation of further steps how to implement our product to ESA SWESNET

1.4.3 Proposed Work Logic

Proposed work logic is presented in figure 1.2.

1.4.4 Implementation aspects

Baseline of this project comes from our experience with requirement for determination of heliocentric potential (HP) from our neutron monitor data relatively recently. At that time, an aircrew dosimetry company urgently needed the recent values of heliocentric potential for the last two months but the values were not available at the FAA website at that time. Due to insufficient time available we had to determine HP in a very fast way so we created an approximate method that allowed us to determine the HP values in a relatively fast way, nevertheless for the price of larger uncertainty of result.

The **original method was based on the extrapolation of a simple mathematical linearly dependent function** that was mapping a behaviour of our neutron monitor output for specific intervals into the values of HP. The trade-off of this approach was that

- we did not have time to perform the detailed long-term analysis of results and
- we did not have the ability to compare the results computed with our HP values with the real aircraft measurements.

Considering our previous experience, we have prepared a methodology that will lead to more reliable results and its first iteration will look as described further.

**First iteration of the ESADOS project:**

1. On contrary to the original method from the past, the calculation of the heliocentric potential will not be based on extrapolation of regression function but on the computation from the very definition of heliocentric potential (HP) using the neutron monitor response(NM)[5].

[5] Keran O'Brien, Ernst Felsberger, Peter Kindl, Application of the heliocentric potential to aircraft dosimetry, Radiation Protection Dosimetry, Volume 116, Issue 1-4, 20 December 2005, Pages 336–342, https://doi.org/10.1093/rpd/nci090

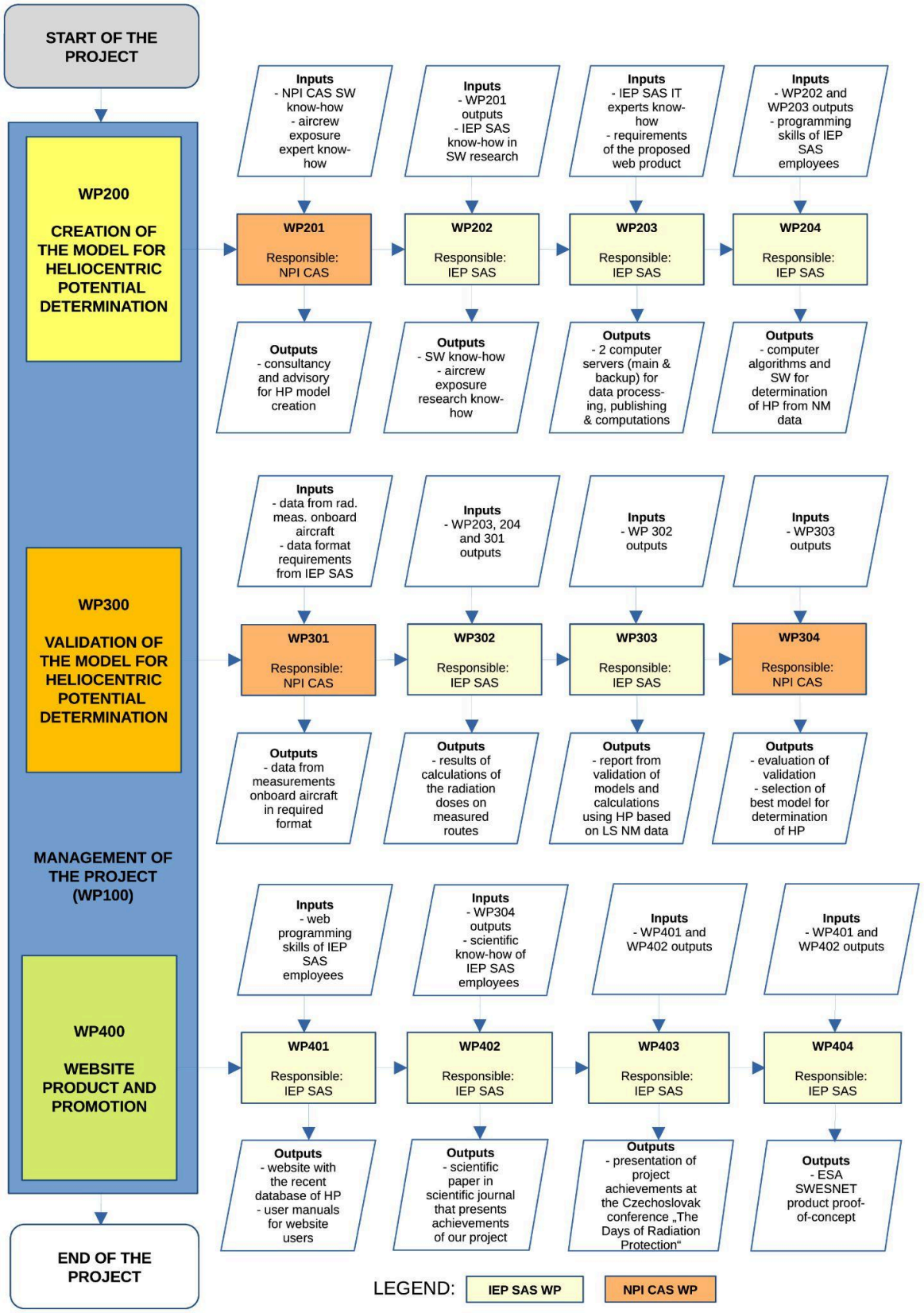



***Figure 1.2 – Proposed work logic of the ESADOS project***

2. Consequently, the HP values calculated from the Lomnicky stit NM response will be used in computation; The FAA HP data is based on ground level neutron measurements provided by Dr. Eduard Vashenyuk of the Apatity Cosmic Ray Station of the Polar Geophysical Institute, Russia[6]. Due to the different geolocation of both stations, we expect

[6] https://www.faa.gov/data_research/research/med_humanfacs/aeromedical/radiobiology/heliocentric

statistically insignificant differences in our values and values presented by FAA.

3. In the third iteration step, we compare radiation doses measured on predefined routes onboard aircraft with the radiation doses computed with CARI code and using our HP values.

4. After obtaining a set of measured and computed results, the statistical analysis of the mean values and variances of the data sets will be performed.

5. **In case of satisfactory results, we will start to prepare a scientific journal with a description of our achievements.** Otherwise, we will have to return to the step 1 and find the causes leading to wrong results.

6. Afterwards, having working algorithms, we will prepare their computer algorithmic implementation and we will create a website product.

7. After testing and evaluating work of the website product, we will prepare a proof-of-concept documentation of our product and start the negotiations with the ESA SWESNET to begin the process of transfer of our website product to the ESA SWESNET space weather network portfolio.

1.5 TECHNICAL FEASIBILITY, PROBLEM AREAS AND DEVELOPMENT RISK:

TECHNICAL FEASIBILITY

From a technical feasibility point of view, there are currently no restrictions, because the most important resources – access to international scientific journals and erudite human resources are already available, because these people and their know-how are part of the project team. Ordering the main and back-up servers, which are both commonly available servers, as planned in WP203, should be realised without any problems. Risks related to human resources are discussed below.

Success of the project is supported by the long-term know-how of the IEP SAS and NPI CAS project members and space research activities in which they participate. The most important ones are:

- operation of the neutron monitor at the Lomnický štít observatory by the IEP SAS
- performing a long term cosmic rays radiation doses measurements onboard aircraft by the NPI CAS
- making research in radiation protection from cosmic rays on the NPI CAS side and making research of cosmic rays by observing them with neutron monitor on the other side
- experience of the staff on both sides

PROBLEM AREAS

The project belong to type A - Research and Preparatory Activities, the risks assessment is considered basic and reduced to:

- lack of trust in the team
- conflict and tension
- low engagement
- poor change management
- not going in the same direction

All above described can be eliminated by mutual motivation of the team members and by sustaining the healthy working environment.

DEVELOPMENT RISK

Currently, we consider following risks that could occur during the project realisation:
- member will leave the project team;
- delay in building new IT infrastructure caused by administrative problems with order of new hardware
- misunderstanding will occur between primary contractor and subcontractor
- lack of trust in the new web product and interest in using our website product.

Review of risks and their mitigations is presented in Table 1.1.

The risks a), b) and c) cannot be influenced, however they can cause only slight delay in the project. Risks a), b) and c) can be eliminated according to the scheme presented in table below.

The risk d) is eliminated thanks to the "letters of support" received from three Slovakian universities and can be further successfully eliminated by organising generally science and engineering propagating events like e.g. day of open doors for university students at the Lomnický štít high mountain observatory or at the Institute of Experimental Physics.

| Description of the risk | Solution to mitigate the consequences |
|---|---|
| Member will leave the project team | ● qualified members of the IEP SAS or NPI CAS could take a position or additionally/alternatively, a tender for this position will be organised; the best participant will be chosen as his successor.<br>● due to the sufficient number of staff members with appropriate expertise, the risk of not being able to generate the courses material is low and considered it is technically feasible<br>● we do not have an single point failure concerns |
| Delay in building new IT infrastructure | ● elimination through assisting the administration in buying process<br>● selection of reliable supplier of IT hardware |
| Occurrence of misunderstanding between prime and subcontractor | ● eliminated by the fact that key person from the IEP SAS, Jan Kubancak, was working at the NPI CAS for 10 years<br>● thanks to his knowledge of work and research on both workplaces, he knows exactly what should the IEP SAS require from NPI CAS and vice versa to reach goals of this project |
| Lack of trust in the new web product | ● active promotion of the website product |

**Table 1.1 - Elimination of risks related to the project**

## 1.6 PROSPECT FOR EXPLOITATION AND USE

### 1.6.1 Potential for further use in ESA activities and special interest factors

Compliance of the project with the ESA RPA call

This project belongs to type A activities - Research and preparatory activity. According to ITT conditions, such a project should serve as a preparation for future involvements in the ESA optional programmes or should serve as initial steps of a product development for Space applications.

Our project fits both conditions. If we understand our project as a first step, the second step could be the transition of our project from our website application to the ESA Space Weather Service Network portal. In addition, results of such a project will prepare us for development of higher TRL products in future.

Potential market and involvement of potential users

Preliminary interest in our project was expressed by heads of respective sections and departments of several organisations, including:

- Dr. **Darina Palenikova**, MPH, **the Head of the Radiation Protection Department of the Ministry of Transport of the Slovak Republic**
- Ing. **Slavka Jandurova, executive director of ATF-Aviation airline company**, which has an official permission from Ministry of Transport of the Slovak Republic to evaluate the radiation load of the AATF-Aviation crew members
- Ing. **Andrej Durikovic**, **director of the Slovak Government Flight Service, Ministry of Interior of the Slovak Republic**

Copies of the support letters are attached to the project proposal.

Technical advantages of our solution over current state of the art

Main exploitation benefits

**Our solution will provide all CARI code users across the world with the:**

- independent data source that will ensure continuity in case of outage of primary heliocentric potential data source and

- add forecast values of the heliocentric potential up to three months ahead the current date to make the crew radiation exposure optimization easier.

Other exploitation benefits

What is important, each airline can obtain permission from radiation protection authority for evaluation of their crew radiation exposure with the CARI code and increase its competitiveness on the global market by minimising costs

related to dosimetry. As a by-side effect, no information about the flights has to be sent to dosimetry services and the privacy of the private customers could become even higher than nowadays.

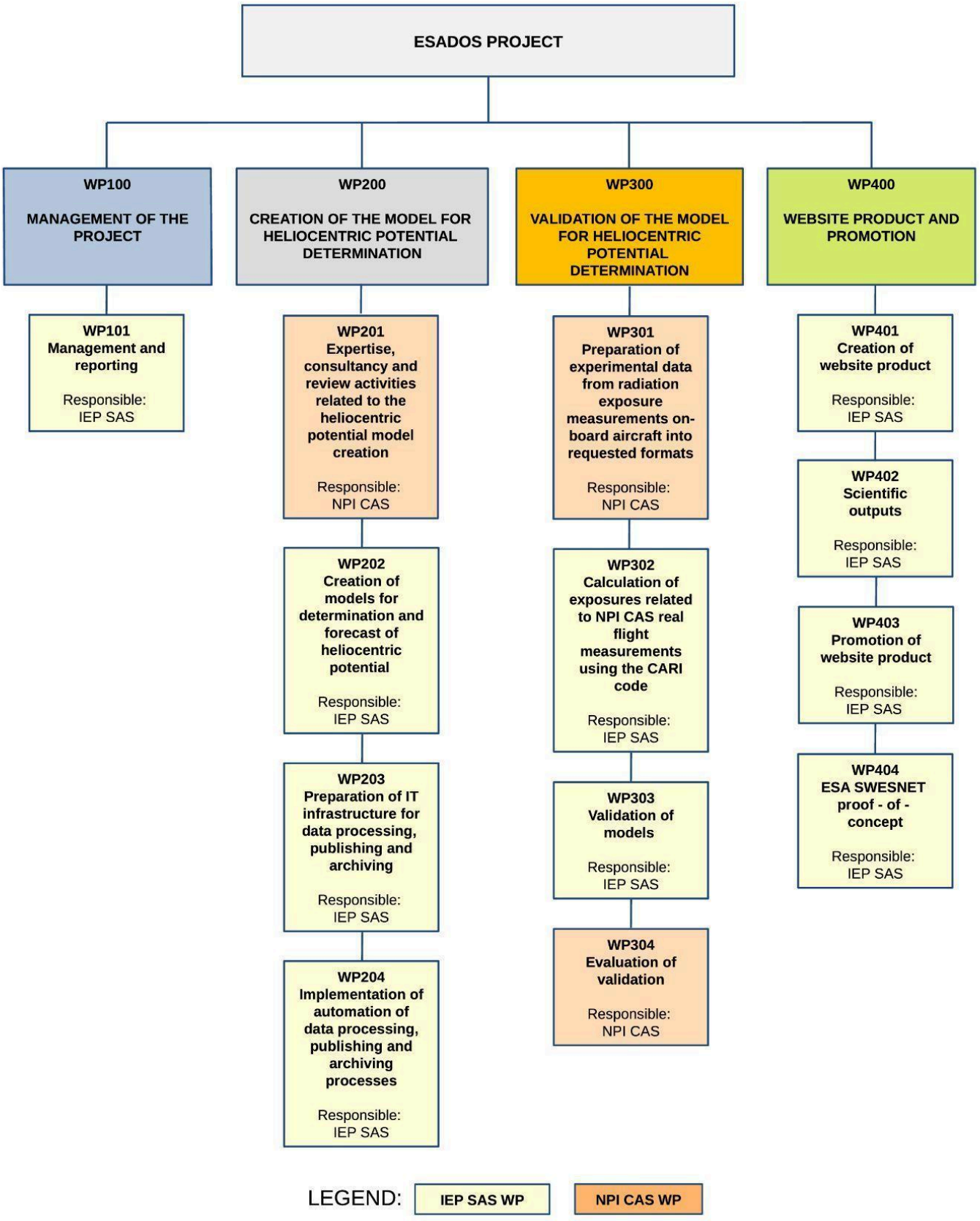



***Figure 1.4 – WBS structure of the ESADOS project***

Future steps and potential for further use by the ESA

One of the work packages is related to the creation of a proof-of-concept of our product for the ESA SWESNET space weather network. Additionally, outputs of the project can be further used in other related ESA programmes, like e.g. in ESA Space Safety Programme (S2P).

### 1.6.2 Business Case Summary

**Our business strategy is based on the fact that the FAA website does not guarantee the availability of heliocentric potential. According to the FAA website, the heliocentric potentials for recent months (last 12 months) are preliminary.** The data above is based on ground level neutron measurements provided by Dr. Eduard Vashenyuk of the Apatity Cosmic Ray Station of the Polar Geophysical Institute, Russia[7].

We see a chance of our product in providing the heliocentric potential data with legal warranty of their availability in future for a specific period of time. This is a way we could make contracts with our potential stakeholders. In addition, we would like to implement free service, but this service would be without any legal warranty for data availability.

## 1.7 TECHNICAL PROGRAMME OF WORK

### 1.7.1. Work Breakdown Structure (WBS)

WBS structure of the ESADOS project is presented in figure 1.4.

### 1.7.2. Work Package Description (WPD)

ESADOS project work packages are defined in 4 logical major groups (WP100, WP200, WP300 and WP400), which are presented in figure 1.4. Subpackages of each group, i.e. WP101, WP201-204, WP301-304 and WP401-404 are described in the tables beneath.

| **WP101** | | | |
|---|---|---|---|
| **WP Title:** | Management and Reporting | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Ján Kubančák | | |
| | | | |
| **Start event:** | Kick-off meeting | Start date: | T0 |
| **End event:** | Final meeting | End date: | T0 + 15 |
| | | | |
| **Inputs:** | Project proposal | | |
| **Tasks:** | ● organising of kick-off and final meetings and technical reviews<br>● producing of reports for ESA<br>● organising of regular monthly meetings<br>● organising work package review meetings (after finishing a major work package group)<br>● preparation of materials for annual review meeting for ESA & delegation<br>● schedule updating (if necessary)<br>● identification of schedule slippage and instigation of mitigation actions<br>● quality control of deliverables prior to delivery<br>● monitoring and control of actions and action item list<br>● financial management<br>● evaluation of risks and management of mitigating actions<br>● cost monitoring and CCN handling (as required)<br>● preparation of CCD, TDP, ESR, FR, and FP | | |
| **Outputs:** | Progress Report WP200 (RPT-WP200)<br>Progress Report WP300 (RPT-WP300)<br>Progress Report WP400 (RPT-WP400)<br>Technical Data Package (TDP)<br>Final Report (FR)<br>Contract Closure Documentation (CCD)<br>Final Presentation (FP) | | |

[7] https://www.faa.gov/data_research/research/med_humanfacs/aeromedical/radiobiology/heliocentric

| **WP201** | | | |
|---|---|---|---|
| **WP Title:** | Expertise, consultancy and review activities related to the heliocentric potential model creation | | |
| **Company:** | Nuclear Physics Institute of the CAS | | |
| **WP Manager:** | Ondřej Ploc | | |
| | | | |
| **Start event:** | WP201 kick-off meeting | **Start date:** | T0 |
| **End event:** | WP201 final meeting | **End date:** | T0 + 12 |
| | | | |
| **Inputs:** | Project proposal<br>Results of measurements performed on-board Czech Airlines aircraft<br>Expertise in the field of radiation protection of aircrew and spacecrew | | |
| **Tasks:** | ● provide expertise, consultancy and advisory to IEP SAS during creation of models for determination and forecast of heliocentric potential.<br>● review of the models created and help with fixing the issues, if found.<br>● assessment of validation of models prepared by IEP SAS within WP303.<br>● creation of WP201 final report | | |
| **Outputs:** | WP201 final report (deliverable D201) | | |

| **WP202** | | | |
|---|---|---|---|
| **WP Title:** | Creation of models for determination and forecast of heliocentric potential | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Ján Kubančák | | |
| | | | |
| **Start event:** | WP202 kick-off meeting | **Start date:** | T0 |
| **End event:** | WP202 final meeting | **End date:** | T0 + 4 |
| | | | |
| **Inputs:** | Project proposal<br>IEP SAS expertise in space weather observations and radiation protection of aircrew and spacecrew<br>IEP SAS expertise in cosmic rays measurements | | |
| **Tasks:** | Preparation of mathematical model for determination and forecast of heliocentric potential from Lomnicky stit neutron monitor data. This will include:<br>● selection of appropriate mathematical functions for HP calculations<br>● testing the functions, examining their composition, domain, convergence and finding their simplifications and solutions<br>● selection of model for forecast of the HP values<br>● examining the domain, reliability and convergence of function, finding their simplifications and solutions<br>● testing the functions on real data<br>● comparison of achieved results with FAA values<br>● selecting of the best functions to be used further in numerical computer algorithms<br>● writing of WP202 final report | | |
| **Outputs:** | Mathematical models for determination of heliocentric potential data from Lomnicky stit neutron monitor data (deliverable D202.1)<br>Experimental input data range and format requirements(D202.2)<br>IT infrastructure requirements (deliverable D202.3)<br>WP202 final report (deliverable D202.4) | | |

| **WP203** | | | |
|---|---|---|---|
| **WP Title:** | Preparation of IT infrastructure for data processing, publishing and archiving | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Igor Strhársky | | |
| | | | |
| **Start event:** | WP203 kick-off meeting | **Start date:** | T0 + 1 |
| **End event:** | WP203 final meeting | **End date:** | T0 + 7 |
| | | | |
| **Inputs:** | IEP SAS IT expertise and best practices<br>IT infrastructure requirements (D202.3) | | |
| **Tasks:** | ● design of IT infrastructure that will allow computation of heliocentric potential data from neutron monitor data<br>● buying the equipment<br>● purchase of hardware<br>● preparation of IT infrastructure including the installation of operating systems, | | |

| **WP203** | |
|---|---|
| | all necessary software and connecting the computers<br>● preparation of WP203 final report |
| **Outputs:** | Both server computers installed and working (deliverable D203.1)<br>WP203 final report (deliverable D203.2) |

| **WP204** | | | |
|---|---|---|---|
| **WP Title:** | Implementation of automatization of data processing, publishing and archiving processes | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Igor Strhársky | | |
| | | | |
| **Start event:** | WP204 kick-off meeting | **Start date:** | T0 + 5 |
| **End event:** | WP204 final meeting | **End date:** | T0 + 9 |
| | | | |
| **Inputs:** | IT infrastructure<br>IEP SAS expertise | | |
| **Tasks:** | Transformation of mathematical models for calculation and forecast of heliocentric potential from Lomnicky stit neutron monitor data into the computer algorithms, tasks included:<br>● selection of best methods for numerical approximation of functions for retrospective HP determination (preferring the direct solution over iterative); subtasks included:<br>○ selection of most suitable methods<br>○ testing of consistency and numerical stability<br>○ testing of convergence<br>● selection of best methods for numerical approximation of functions for retrospective HP determination by comparing extrapolation and regression solutions; subtasks included:<br>○ testing of consistency and numerical stability<br>○ testing of reliability of forecasted values<br>○ determination of confidence intervals<br>● consultations of partial results with the NPI CAS experts<br>● preparation of WP204 final report | | |
| **Outputs:** | Computer algorithms (deliverable D204.1)<br>WP204 final report (deliverable D204.2) | | |

| **WP301** | | | |
|---|---|---|---|
| **WP Title:** | Preparation of experimental data from radiation exposure measurements on-board aircraft into requested formats | | |
| **Company:** | Nuclear Physics Institute of the CAS | | |
| **WP Manager:** | Ondřej Ploc | | |
| | | | |
| **Start event:** | WP301 kick-off meeting | **Start date:** | T0 + 6 |
| **End event:** | WP301 final meeting | **End date:** | T0 + 8 |
| | | | |
| **Inputs:** | Results of aircraft on-board measurements of radiation doses from cosmic rays with the HAWK TEPC<br>Requirements on input data format (D201.2) | | |
| **Tasks:** | ● preparation of the electronic file with the experimental data - results of onboard measurements in required range and format; the prepared information must include:<br>○ results of measurements performed on selected trajectories<br>○ information about the detectors used<br>○ information about trajectories itself<br>○ information about detectors calibration<br>○ uncertainty of results of measurements<br>● creation of WP301 final report | | |
| **Outputs:** | Experimental data (D301.1)<br>WP301 final report (deliverable D301.2) | | |

| **WP302** | |
|---|---|
| **WP Title:** | Calculation of exposures related to NPI CAS real flight measurements using the CARI code |
| **Company:** | Institute of Experimental Physics SAS |
| **WP Manager:** | Ján Kubančák |

| **WP302** | | | |
|---|---|---|---|
| | | | |
| **Start event:** | WP302 kick-off meeting | **Start date:** | T0 + 8 |
| **End event:** | WP302 final meeting | **End date:** | T0 + 10 |
| | | | |
| **Inputs:** | Experimental data (D204.1) | | |
| **Tasks:** | ● preparation of CARI input files for calculation of radiation protection quantities (dose, ambient dose equivalent) using the HP values computed from neutron monitor data<br>● calculation the radiation doses from cosmic rays for the routes contained in the experimental data file using the CARI code and values of heliocentric potential calculated from the Lomnicky stit neutron monitor data (the file is expected to contain several thousands results of onboard radiation measurements)<br>● creation of WP302 report | | |
| **Outputs:** | Results of CARI calculations (D302.1)<br>WP302 final report (D302.2) | | |

| **WP303** | | | |
|---|---|---|---|
| **WP Title:** | Validation of models | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Ján Kubančák | | |
| | | | |
| **Start event:** | WP303 kick-off meeting | **Start date:** | T0 + 10 |
| **End event:** | WP303 final meeting | **End date:** | T0 + 11 |
| | | | |
| **Inputs:** | Results of CARI calculations (deliverable D302.1)<br>Experimental data (deliverable D204.1) | | |
| **Tasks:** | ● validation of heliocentric potential models by means of analysis and comparison of experimental results with the results of calculations using the CARI code; validation includes<br>○ evaluation of models for HP calculation from existing data (i.e. retrospective calculation)<br>○ evaluation of models for forecast of HP<br>● creation of WP303 final report | | |
| **Outputs:** | Report on validation of heliocentric potential models (deliverable D303.1)<br>WP303 final report (deliverable D303.2) | | |

| **WP304** | | | |
|---|---|---|---|
| **WP Title:** | Evaluation of validation | | |
| **Company:** | Nuclear Physics Institute of the CAS | | |
| **WP Manager:** | Ondřej Ploc | | |
| | | | |
| **Start event:** | WP304 kick-off meeting | **Start date:** | T0 + 11 |
| **End event:** | WP304 final meeting | **End date:** | T0 + 12 |
| | | | |
| **Inputs:** | Report on validation of heliocentric potential models (deliverable D303.1) | | |
| **Tasks:** | ● evaluation of validation realised by the IEP SAS in WP303<br>● preparation of recommendations to fix issues, if any found<br>● creation of report from evaluation of validation of heliocentric potential models<br>● creation of WP304 final report | | |
| **Outputs:** | Report from evaluation of validation of heliocentric potential models (deliverable D304.1)<br>WP304 final report (deliverable 304.2) | | |

| **WP401** | |
|---|---|
| **WP Title:** | Creation of website product |

| **WP401** | | | |
|---|---|---|---|
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Igor Strhársky | | |
| | | | |
| **Start event:** | WP401 kick-off meeting | **Start date:** | T0 + 9 |
| **End event:** | WP401 final meeting | **End date:** | T0 + 12 |
| | | | |
| **Inputs:** | Heliocentric potential models algorithms<br>Web programming know-how | | |
| **Tasks:** | ● creation of a website that will provide its user with the latest as well as forecast heliocentric potential values computed from the Lomnicky stit neutron monitor data; included website features:<br>○ full responsive design<br>○ based on CakePHP5 framework (backend + frontend)<br>○ database: MySQL<br>○ user management system | | |
| **Outputs:** | Website product documentation including the source code (deliverable D401.1)<br>WP401 final report (deliverable D401.2) | | |

| **WP402** | | | |
|---|---|---|---|
| **WP Title:** | Scientific outputs | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Ján Kubančák | | |
| | | | |
| **Start event:** | WP402 kick-off meeting | **Start date:** | T0 + 12 |
| **End event:** | WP402 final meeting | **End date:** | T0 + 14 |
| | | | |
| **Inputs:** | Report on validation of heliocentric potential models (deliverable D303.1)<br>Report from evaluation of validation of heliocentric potential models (deliverable D303.1) | | |
| **Tasks:** | ● creation of a scientific article that will describe scientific results achieved within the project, the models and their validation and notify all readers about our website product<br>● creation of WP402 final report | | |
| **Outputs:** | Scientific article (deliverable D402.1)<br>WP402 final report (deliverable D402.2) | | |

| **WP403** | | | |
|---|---|---|---|
| **WP Title:** | Promotion of website product | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Ján Kubančák | | |
| | | | |
| **Start event:** | WP403 kick-off meeting | **Start date:** | T0 + 12 |
| **End event:** | WP403 final meeting | **End date:** | T0 + 13 |
| | | | |
| **Inputs:** | Report on validation of heliocentric potential models (deliverable D303.1)<br>Report from evaluation of validation of heliocentric potential models (deliverable D303.1)<br>Scientific article (deliverable D402.1) | | |
| **Tasks:** | ● creation of promotion materials of the website product, the materials will include:<br>○ poster for conferences<br>○ electronic presentations for conference<br>○ leaflet for potential users<br>● creation of WP403 final report | | |
| **Outputs:** | Poster (deliverable D403.1)<br>Presentation (deliverable D403.2)<br>WP403 final report (deliverable D403.3) | | |

| **WP404** | |
|---|---|
| **WP Title:** | ESA SWESNET site module proof - of - concept |
| **Company:** | Institute of Experimental Physics SAS |
| **WP Manager:** | Ján Kubančák |

| **WP404** | | | |
|---|---|---|---|
| | | | |
| **Start event:** | WP404 kick-off meeting | **Start date:** | T0 + 13 |
| **End event:** | WP404 final meeting | **End date:** | T0 + 15 |
| | | | |
| **Inputs:** | Report on validation of heliocentric potential models (deliverable D303.1)<br>Report from evaluation of validation of heliocentric potential models (deliverable D303.1)<br>Scientific article (deliverable D402.1)<br>Website product (WP401) | | |
| **Tasks:** | ● proof of concept of the ESA SWESNET module for providing the users with the heliocentric potential computed from Lomnicky stit neutron monitor values<br>● creation of WP404 final report | | |
| **Outputs:** | WP404 final report | | |

1.8 BACKGROUND OF THE COMPANY(IES)

**Institute of experimental physics SAS**

Institute of Experimental Physics is oriented to fundamental research in condensed matter physics, sub-nuclear physics, space physics and biophysics, employing ~100 scientific researchers (~80 FTEs). The research output is ~150 current content publications with ~1000 citations per year (Web of Science database, excluding big collaborations citations, with big collaborations it is more than 5000 citations/year).

The Institute has a long history in space research, starting with ground-based cosmic rays registration on Lomnický štít observatory since approx. 1950. The Neutron monitor was introduced to service in the frame of the International Geophysical Year 1957/58 and operated continuously to present days (http://neutronmonitor.ta3.sk/). The Institute joined space flights activities in 1970 in the frame of Russian Intercosmos programme, later contributing also to ESA programme and Chinese CNSA programme in the frame of various bi-lateral cooperations. The space programme is described on the website: http://space.saske.sk/.

Department of Space Physics (DSP, http://space.saske.sk) is one of seven IEP departments where this project will be conducted. DSP focuses on physical processes in the near-Earth's space, low energy cosmic rays, space weather, solar wind interactions in interplanetary space and cosmic rays research.

**Nuclear Physics Institute of the CAS**

Nuclear Physics Institute of the CAS, public research institution, conducts research in a broad field of nuclear physics, experimental as well as theoretical.

Institute of Nuclear Physics AS CR, v. v. i., (NPI CAS). NPI CAS is one of 54 public research institutions of the Academy of Sciences of the Czech Republic (AV). With its approximately 300 employees (of which approximately 120 scientific workers (PhD) and approximately 40 doctoral students), it represents the largest Czech institution in the field of nuclear physics. NPI CAS has long-term experience and achieves internationally recognized results in oriented research for the environment, health and energy security, in environmental science, medicine, radiopharmacy, materials research, which are based on instrumental and technological competences in accelerator technology and nuclear analytical methods in prestigious international projects.

NPI CAS, as a voting member of EURADOS, has an active role in the decision-making of the EURADOS group, which is a platform of institutions for the exchange of information, cooperation and coordination of research in the field of radiation dosimetry. This includes developing new dosimetry methods, standardizing procedures and sharing the latest knowledge.

Department of Radiation Dosimetry, which researchers will performs all subcontracting tasks related to our project, focuses on research on the effects of low radiation doses, characterization of ionising radiation transmission at molecular and cellular level, research on cosmic radiation on Earth, on board of aircrafts and spacecrafts, study of anthropogenic effects in nature and radiocarbon dating.

1.9 FACILITIES

*LOMNICKÝ ŠTÍT OBSERVATORY* (IEP SAS)

Lomnický štít observatory belongs to the external workplaces of the Institute of Experimental Physics. At the observatory, the institute operates several scientific instruments including the neutron monitor, which will be used for determination of the heliocentric potential. Neutron monitor at the Lomnický štít consists of 8 NM64 detection tubes which have been continuously operated since 1981. In the near future, a replacement of the tubes is planned, nevertheless this replacement process means a plus for our project and will not influence our results.

*DETECTORS PLACED ONBOARD COMMERCIAL JET AIRCRAFT* (NPI CAS)

The Nuclear Physics Institute of the Czech Academy of Sciences has performed for more than 20 years unique continuous measurements of radiation doses from cosmic rays directly on-board aircraft. These measurements are performed with the LIULIN detector placed continuously in one of the Czech Airlines planes. In additions, NPI CAS performs also campaign measurements onboard aircraft and participates in international comparisons of detectors place onboard aircraft, like e.g. the CONCORD experiment

**PART 2 MANAGEMENT PART**

2.1 TEAM ORGANISATION AND PERSONNEL

2.1.1 Proposed team

2.1.1.1 Overall team composition, key personnel

IEP SAS team consists of 7 people, three of them are key people. NPI CAS consists of 8 people, two of them are key people. Organigram that contains all key people is shown in figure 2.1. Their responsibilities are presented in table 2.1 below:

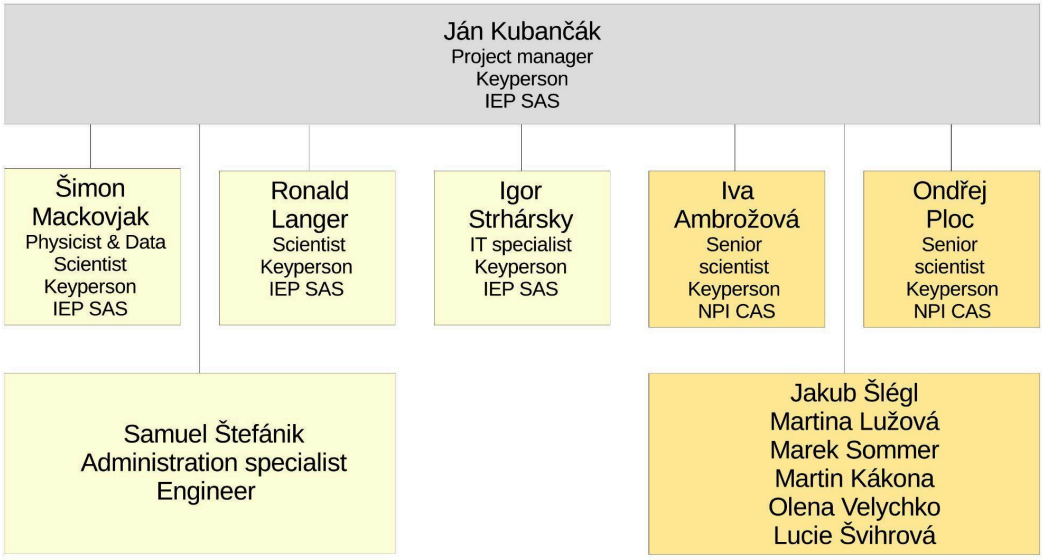



***Figure 2.1 – Overall team composition***

| Name and surname | Organisation | Role in the project |
|---|---|---|
| **Institute of experimental Physics SAS** | | |
| Ján Kubančák | IEP SAS | ● **key person**<br>● **project manager**<br>● **senior scientist** and nuclear engineer<br>● data processing and radiation protection specialist |
| Ronald Langer | IEP SAS | ● **key person**<br>● **scientist**<br>● Head of the IEP SAS Lomnický štít observatory and cosmic rays measurements expert |
| Igor Strhársky | IEP SAS | ● **key person**<br>● IT and electronics engineer specialist<br>● web programming specialist |
| Šimon Mackovjak | IEP SAS | ● **key person**<br>● scientist |
| Samuel Štefánik | IEP SAS | ● Lomnický štít observatory cosmic rays measurement instruments engineer |
| Administration specialist / Lomnický štít space physics laboratory | IEP SAS | ● administration specialist for tasks related to the ESADOS project |
| Engineer / Lomnický štít space physics laboratory | IEP SAS | ● engineer of detection systems and electronics |
| **Nuclear Physics Institute of the CAS** | | |
| Ondřej Ploc | NPI CAS | ● **key person**<br>● senior scientist |
| Iva Ambrožová | NPI CAS | ● **key person**<br>● senior scientist |

| Name and surname | Organisation | Role in the project |
|---|---|---|
| | | ● EURADOS WG11 member |
| Martin Kákona | NPI CAS | ● postdoc researcher |
| Jakub Šlegl | NPI CAS | ● Ph.D. student |
| Marek Sommer | NPI CAS | ● postdoc researcher |
| Martina Lužová | NPI CAS | ● Ph.D. student |
| Olena Velychko | NPI CAS | ● researcher |
| Lucie Švihrová | NPI CAS | ● Ph.D. student |

***Table 2.1 – Overall team composition***

2.1.1.2 Rationale of the proposed industrial organisation

The rationale between splitting the project into two organisations, i.e. IEP SAS and NPI CAS is justified by the:

- results of their previous cooperation;
- slightly shifted and overlapping fields of their research;
- main focus of their activities on cosmic rays research.

While the IEP SAS focuses mainly on cosmic rays observation and creation of mathematical models, the Department of Radiation Dosimetry of the Nuclear Physics Institute of the CAS has extensive experience with the measurement and assessment of radiation exposures from cosmic rays and other mixed ionising radiation fields. Scientists from IEP CAS were involved in the most important worldwide projects related to aircrew and spacecrew radiation dosimetry. One can state their contribution in the field of ionising radiation exposure measurements on-board aircraft published within the EURADOS WG 5 report, issued by the European Commission as document "*Radiation Protection 140: Cosmic Radiation Exposure of Aircraft Crew*". One has to note that this document belongs to the set of documents that laid out the foundations of the aircrew radiation protection in general.

Activities related to aircrew and spacecrew radiation protection of the NPI CAS include:

- participation of research staff in EURADOS groups
- measurements of cosmic radiation onboard commercial jet aircraft
- evaluation of radiation exposures from cosmic rays
- performing of Monte Carlo calculations of cosmic rays and calibration of the detectors using theses calculations

As can be seen from the team composition table, we have succeeded to obtain key person
Ondrej Ploc for this activity, who deals with the aircrew and space crew radiation protection for more than 15 years and participated in many cosmic rays radiation protection related experiments throughout his research career.

On the other hand, the Department of Space Physics of the IEP SAS performs high mountain measurement of cosmic rays, further it focuses on development of cosmic rays transport models and development and manufacture of instruments for space satellites, all practically since its establishment more than 50 years ago.

Currently, the cooperation between NPI CAS and IEP SAS is active in several fields, including the:

- research of the transient gamma-ray emissions from thunderstorms, generated by electrons accelerated to relativistic energies in electric fields (e.g. see footnote [8]) or
- finding connection between measurements of cosmic rays at high-mountain observatories, aircraft and in space (e.g. see footnote[9]).

2.1.1.3 Position and responsibilities of the Key Personnel within his/her own company's (or institute's) and within the proposed team

| Key Personnel name | Company | Position within his/her company | Position within the proposed Team | List of responsibilities |
|---|---|---|---|---|
| Ján Kubančák | IEP SAS | scientist | ● project | - management of the |

[8] Šlegl, Jakub & Langer, Ronald & Brunclík, Tomáš & Mašek, Petr & Strharsky, Igor & Ambrožová, Iva & Chum, J. & Ploc, Ondrej. (2022). SPECTROMETRY OF HIGH-ENERGY PHOTONS ON HIGH MOUNTAIN OBSERVATORY LOMNICKÝ ŠTÍT DURING THUNDERSTORMS. Radiation Protection Dosimetry. 198. 623-627. 10.1093/rpd/ncac108.

[9] Kubancak, Jan & Ambrožová, Iva & Bütikofer, Rolf & Kudela, K & Langer, R & Davidkova, Marie & Ploc, Ondrej & Malusek, Alexandr. (2014). Liulin silicon semiconductor spectrometers as cosmic ray monitors at the high mountain observatories Jungfraujoch and Lomnický štít. Journal of Instrumentation. 9. P07018. 10.1088/1748-0221/9/07/P07018.

| | | | | |
|---|---|---|---|---|
| | | | manager<br>● cosmic rays radiation protection specialist | project<br>- cooperation with NPI CAS<br>- CARI code calculations<br>- HP models proposal and testing |
| Ronald Langer | IEP SAS | researcher head of | ● cosmic rays measurements expert | - neutron monitor data management<br>- creation of datasets |
| Igor Strhársky | IEP SAS | IT and electronics engineer | ● IT expert | - IT infrastructure design<br>- website product<br>- IT support |
| Šimon Mackovjak | IEP SAS | scientist | ● scientist | - design, implementation and validation of HP models |
| Ondřej Ploc | NPI CAS | senior researcher | ● NPI CAS activities manager | - expertise in measurements of cosmic rays onboard aircraft<br>- CARI code expert |
| Iva Ambrožová | NPI CAS | senior researcher | ● cosmic radiation specialist<br>● EURADOS WG11 group member | - expertise in radiation protection from cosmic rays |

2.1.1.4 Time dedication of key personnel

| Key Personnel | Total Hours dedicated to the Project | Total Working Hours during Project Timeframe | % of Total Working Hours dedicated to the Project |
|---|---|---|---|
| Ján Kubančák | 560 | 2 400 | 23 |
| Ronald Langer | 544 | 2 400 | 23 |
| Igor Strhársky | 700 | 2 400 | 29 |
| Šimon Mackovjak | 192 | 2 400 | 8 |
| Ondřej Ploc | | | |
| Iva Ambrožová | | | |
| **TOTAL** | | | |

## 2.2 CURRICULA VITAE

**CV – Ján Kubančák, Ph.D.**

Ján Kubančák deals with the topic of radiation protection, dosimetry of mixed ionising radiation fields and cosmic radiation detection and dosimetry since his master studies at the Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague. His Ph.D. thesis focused on dosimetry of cosmic radiation using the semiconductor detectors was elaborated at the Department of Radiation Dosimetry of the Nuclear Physics Institute of the Czech Academy of Sciences, where he also worked during the doctoral studies. Currently, he works as a researcher at the Lomnicky stit cosmic rays laboratory operated by the Institute of Experimental Physics SAS, where he deals with cosmic rays measurements and radiation protection from cosmic rays. Detailed version of the CV is attached.

**CV – Ronald Langer, associate scientist**

Ronald Langer graduated in 1983 from the Faculty of Mathematics and Physics of the Comenius University in Bratislava. Since 1985 he has been a staff scientist at the Department of Space Physics of the Institute of Experimental Physics of the Slovak Academy of Science in Košice. He is responsible for the operation of the Lomnický štít Observatory with a neutron monitor, the SEVAN detector and other devices. He has experience with the statistical checking of neutron monitors and other devices data collections. He is an investigator of international projects with the Czech Academy of Science and the Bulgarian Academy of Science. Detailed version of the CV is attached.

**CV – Igor Strhársky, IT engineer**

Igor Strharsky obtained his master degree in computer science at the Technical University of Kosice in 1992. Since 1992, he works at the IEP SAS as computer and electronics engineer. He specialises in Microprocessor systems (practice 8080/85, 8086, 8051 family, Atmel AVR, ARM ...), CPLD/FPGA (Xilinx, Actel), A/D & D/A conversion, serial communication (RS232, RS422/485, MIL-STD-1553 , ethernet..), software (assembler, C/C++, HTML, PHP, MySQL), PC programming (OS Windows, Linux) and PCB design (Altium designer). Work with IEP SAS has involved responsibility for design and development of scientific instruments for space research in physics, especially for energetic particle

spectroscopy. Igor Strhársky participated in following experiments: DOK-S / INTERBALL, SONG-E / CORONAS-I, MEP-1 / COMPASS, EPD / CESAR, SONG-EM / CORONAS-F, NUADU / DOUBLE STAR, PEEL / HOTPAY-2, MEP-2 / Radioastron, Neutronmonitor Lomnicky stit / NMDB, ESA PECS projects. Detailed version of the CV is attached.

**CV - Dr. Šimon Mackovjak, PhD., scientist**
In August 2014, he obtained his Ph.D. degree in Astronomy and Astrophysics in the Faculty of Mathematics, Physics, and Informatics at Comenius University in Bratislava (Slovakia) where he had been focused on data analysis from space-based solar spectrometers and imagers. During his Ph.D. studies, he worked as a junior researcher at the Department of Solar Physics, Astronomical Institute of the Czech Academy of Sciences. Afterward, he continued as a post-doc at ISDC Data Centre for Astrophysics, University of Geneva (Switzerland) on data analysis and study of airglow in upper Earth's atmosphere. Then in 2016, he started to work at the Institute of Experimental Physics, Slovak Academy of Sciences and participated in the ESA/PECS project SK1-05 and then he led ESA/PECS projects SK2-09 (AMON-net), SK3-02 (SPACE::LAB) and SK6-29 (ASPIS). He also has led a Space Weather (SWE) part of the ESA / AD03 project SK-S2P and SK7-03 project SK-S2P-Edu. Currently he is leading the ESA/RPA project SKR1_23 (Vigil-ML) and co-leading SKR1_08 (SCSS-Net). He is a co-author of more than 25 refereed scientific publications with a total number of more than 300 citations (WoS) mainly in the space weather domain.

**CV - Ondřej Ploc, Ph.D.**
Ondřej Ploc focuses on dosimetry in mixed radiation fields, radiation protection, cosmic radiation, dosimetry on board aircraft and spacecraft, radiation phenomena in the atmosphere and radiotherapy. He received his Ph.D. in Nuclear Engineering at the Department of Dosimetry and Application of Ionizing Radiation, Faculty of Nuclear and Physical Engineering, CTU in Prague. During his professional career, he worked as a postdoc in the National Institute of Radiological Sciences, Chiba, Japan and at the Chalmers University of Technology, Gothenburg, Sweden. Currently, he works at the Nuclear Physics Institute of the CAS in Prague and at the Czech Institute for Accreditation, Prague. During his career, he was principal investigator and co-investigator of several national and international grants, managed several scientific projects, of which detailed description can be found in the attached CV.

**CV - Iva Ambrožová, Ph.D.**
Iva Ambrožová (born Jadrníčková) obtained her Ph.D. in Nuclear Engineering at the Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering in 2006. Her work focuses on dosimetry and microdosimetry in neutron, photon, and heavy charged particle beams and fields; exposure and radiation protection onboard spacecraft and aircraft. During her scientific career, he received several awards for outstanding scientist and she is a EURADOS WG 11 member since 2012.

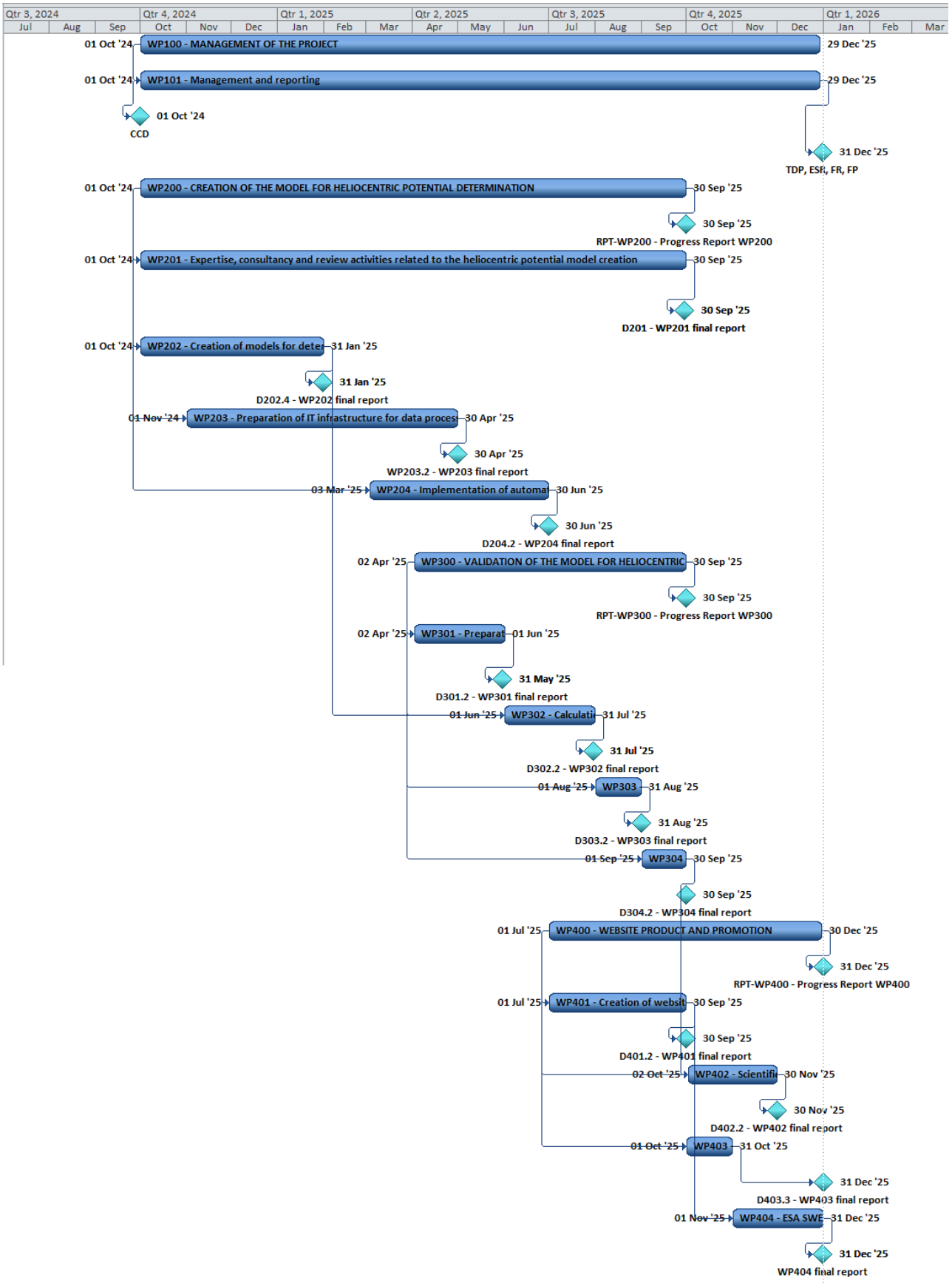
## 2.3 MANAGEMENT OF SUBCONTRACTOR(S)

The project will be realised in cooperation with one subcontractor - the Nuclear Physics Institute of CAS. Subcontractor will deliver two complete work packages and will cooperate on another two work packages. There will be an official agreement between IEP SAS and NPI CAS on solving the ESADOS project. She is principal investigator and co-investigator of several national and international grants. Her work experience includes National Institute of Radiological Sciences, Chiba, Japan and National Radiation Protection Institute, Prague. Iva Ambrožová currently works at the Nuclear Physics Institute of the CAS in Prague as a vice-head of the Department of Radiation Dosimetry. Please refer to more details in the attached CV.

| Work-package with the NPI CAS participation | Shared with IEP SAS | Tasks within the work package | Monitoring and control |
|---|---|---|---|
| WP201 | No | ● expertise, consultancy and review activities<br>● participation on the creation of model for heliocentric potential determination | Realised through:<br>● kick-off meeting<br>● ad-hoc meetings<br>● requiring inputs for other work packages<br><br>Communication itself:<br>● phone<br>● mail<br>● online meetings<br>● visits of workplace |
| WP301 | No | ● evaluation of validation of heliocentric potential model elaborated by IEP SAS in WP303 | |
| WP304 | Yes | ● cooperation on creation of scientific outputs of the project | |

## PLANNING

### 2.4.1. Gantt chart




### 2.4.2 Proposed Schedule

Proposed schedule is presented in the table below.

| Task Name | Duration | Start | Finish |
|---|---|---|---|
| WP100 - MANAGEMENT OF THE PROJECT | 327.88 days | Tue 01/10/24 | Tue 30/12/25 |
| WP101 - Management and reporting | 327.88 days | Tue 01/10/24 | Tue 30/12/25 |
| CCD | milestone(s) | Tue 01/10/24 | Tue 01/10/24 |
| TDP, ESR, FR, FP | milestone(s) | Wed 31/12/25 | Wed 31/12/25 |
| WP200 - CREATION OF THE MODEL FOR HELIOCENTRIC POTENTIAL DETERMINATION | 262.88 days | Tue 01/10/24 | Tue 30/09/25 |
| RPT-WP200 - Progress Report WP200 | milestone(s) | Tue 30/09/25 | Tue 30/09/25 |
| WP201 - Expertise, consultancy and review activities related to the heliocentric potential model creation | 262.88 days | Tue 01/10/24 | Mon 30/09/25 |
| D201 - WP201 final report | milestone(s) | Tue 30/09/25 | Tue 30/09/25 |
| WP202 - Creation of models for determination and forecast of heliocentric potential | 88.88 days | Tue 01/10/24 | Fri 31/01/25 |
| D202.4 - WP202 final report | milestone(s) | Fri 31/01/25 | Fri 31/01/25 |
| WP203 - Preparation of IT infrastructure for data processing, publishing and archiving | 129.88 days | Fri 01/11/24 | Wed 30/04/25 |
| WP203.2 - WP203 final report | milestone(s) | Wed 30/04/25 | Wed 30/04/25 |
| WP204 - Implementation of automatization of data processing, publishing and archiving processes | 86.88 days | Mon 03/03/25 | Mon 30/06/25 |
| D204.2 - WP204 final report | milestone(s) | Mon 30/06/25 | Mon 30/06/25 |
| WP300 - VALIDATION OF THE MODEL FOR HELIOCENTRIC POTENTIAL DETERMINATION | 131 days | Wed 02/04/25 | Tue 30/09/25 |
| RPT-WP300 - Progress Report WP300 | milestone(s) | Tue 30/09/25 | Tue 30/09/25 |
| WP301 - Preparation of experimental data from radiation exposure measurements on-board aircraft into requested formats | 44 days | Wed 02/04/25 | Sun 01/06/25 |
| D301.2 - WP301 final report | milestone(s) | Sat 31/05/25 | Sat 31/05/25 |
| WP302 - Calculation of exposures related to NPI CAS real flight measurements using the CARI code | 44.88 days | Sun 01/06/25 | Thu 31/07/25 |
| D302.2 - WP302 final report | milestone(s) | Thu 31/07/25 | Thu 31/07/25 |
| WP303 - Validation of models | 20.88 days | Fri 01/08/25 | Sun 31/08/25 |
| D303.2 - WP303 final report | milestone(s) | Sun 31/08/25 | Sun 31/08/25 |
| WP304 - Evaluation of validation | 22 days | Mon 01/09/25 | Tue 30/09/25 |
| D304.2 - WP304 final report | milestone(s) | Tue 30/09/25 | Tue 30/09/25 |
| WP400 - WEBSITE PRODUCT AND PROMOTION | 132 days | Tue 01/07/25 | Wed 31/12/25 |
| RPT-WP400 - Progress Report WP400 | milestone(s) | Wed 31/12/25 | Wed 31/12/25 |
| WP401 - Creation of website product | 65.88 days | Tue 01/07/25 | Tue 30/09/25 |
| D401.2 - WP401 final report | milestone(s) | Tue 30/09/25 | Tue 30/09/25 |
| D401.3 - User manual of the website product | | | |
| WP402 - Scientific outputs | 43 days | Wed 01/10/25 | Sun 30/11/25 |
| D402.2 - WP402 final report | milestone(s) | Sun 30/11/25 | Sun 30/11/25 |
| WP403 - Promotion of website product | 22.88 days | Wed 01/10/25 | Fri 31/10/25 |
| D403.3 - WP403 final report | milestone(s) | Wed 31/12/25 | Wed 31/12/25 |
| WP404 - ESA SWESNET proof - of - concept | 43.88 days | Sat 01/11/25 | Wed 31/12/25 |
| WP404 final report | milestone(s) | Wed 31/12/25 | Wed 31/12/25 |

### 2.4.3 Meeting and Travel Plan

Meeting and travel plan is presented in the table below.

| Meeting | Purpose | Companies attending | Date(s) | Location | Work Package or Milestone |
|---|---|---|---|---|---|
| Kick-off meeting | Division of tasks, commencement of the project. | IEP SAS, NPI CAS | Oct 2024 | teleconference | WP101, WP201, WP202 |
| WP201 and WP202 meeting | Work meeting related to the heliocentric potential model creation | IEP SAS, NPI CAS | Dec 2024 | NPI CAS, Prague | WP201, WP202 |
| WP202 final meeting | Evaluation of achievements of WP202, preparation of final report. | IEP SAS, NPI CAS | Jan 2025 | teleconference | WP202 |

| Meeting | Purpose | Companies attending | Date(s) | Location | Work Package or Milestone |
|---|---|---|---|---|---|
| WP203 kick off meeting | Setting up WP203 tasks to achieve goals of the work package. | IEP SAS | Nov 2024 | IEP SAS, Košice | WP203 |
| WP203 final meeting | Evaluation of results achieved within the work package, preparation of WP203 final report. | IEP SAS | Apr 2025 | teleconference | WP203 |
| WP204 kick off meeting | Setting up WP204 tasks to achieve goals of the work package. | IEP SAS | Mar 2025 | IEP SAS, Košice | WP204 |
| WP204 final meeting | Evaluation of results achieved within the work package, preparation of WP204 final report. | IEP SAS, NPI CAS | Jun 2025 | teleconference | WP204 |
| WP301 kick off meeting | Setting up WP301 tasks to achieve goals of the work package. | IEP SAS, NPI CAS | Apr 2025 | teleconference | WP301 |
| WP302 final meeting | Evaluation of results achieved within the work package, preparation of WP302 final report. | IEP SAS | Jun 2025 | NPI CAS, Prague | WP302 |
| WP303 kick off meeting | Setting up WP303 tasks to achieve goals of the work package. | IEP SAS | Jul 2025 | IEP SAS, Košice | WP303 |
| WP303 final meeting | Evaluation of results achieved within the work package, preparation of WP303 final report. | IEP SAS | Aug 2025 | IEP SAS, Košice | WP303 |
| WP304 kick off meeting | Setting up WP304 tasks to achieve goals of the work package. | IEP SAS, NPI CAS | Sep 2025 | teleconference | WP304 |
| WP304 final meeting | Evaluation of results achieved within the work package, preparation of WP304 final report. | IEP SAS, NPI CAS | Sep 2025 | teleconference | WP304 |
| WP201 final meeting | Evaluation of results achieved within the work package, preparation of WP201 final report. | IEP SAS, NPI CAS | Sep 2025 | teleconference | WP201 |
| WP401 kick off meeting | Setting up WP401 tasks to achieve goals of the work package. | IEP SAS | Jun 2025 | NPI CAS, Prague | WP401 |
| WP401 final meeting | Evaluation of results achieved within the work package, preparation of WP401 final report. | IEP SAS | Sep 2025 | teleconference | WP401 |
| WP402 kick off meeting | Preparation of a common scientific paper containing the results of the ESADOS project, division of tasks. | IEP SAS | Oct 2025 | teleconference | WP402 |
| WP402 final meeting | Evaluation of the final version of the manuscript that will be sent to the scientific journal. Preparation of final report. | IEP SAS, NPI CAS | Nov 2025 | teleconference | WP402 |
| WP403 kick off meeting | Setting up WP403 tasks to achieve goals of the work package. | IEP SAS, NPI CAS | Oct 2025 | teleconference | WP403 |
| WP403 final meeting | Evaluation of results achieved within the work package, preparation of WP403 final report. | IEP SAS | Dec 2025 | teleconference | WP403 |
| | | | | | |

| Meeting | Purpose | Companies attending | Date(s) | Location | Work Package or Milestone |
|---|---|---|---|---|---|
| Final meeting before final presentation | Final check of the presentation prepared for Final meeting in ESTEC. | IEP SAS, NPI CAS | Dec 2025 | teleconference | WP100 |
| Final Presentation | Presentation of results achieved within the project. | IEP SAS, ESA | Dec 2025 | ESTEC | |

2.5 DELIVERABLE ITEMS

2.5.1 Documentation

| Doc ID | Title | Milestone | Description of documents * |
|---|---|---|---|
| D201 | WP201 final report | WP201 finished | Document is the survey of all expertise, consultancy and review activities done by the NPI CAS within the work package WP201. It contains a detailed description of what tasks occurred and were solved during the preparation of the mathematical models and testing the models on experimental real flight data provided by the NPI CAS. |
| D202.1 | Mathematical models for determination of heliocentric potential data from Lomnicky stit neutron monitor data | WP202 finished | Document contains a document with the description of mathematical models that will be used for determination of heliocentric potential from Lomnicky stit neutron monitor data. |
| D202.2 | Experimental input data range and format requirements | Mathematical models completed | Document contains a short survey of all requirements on format and range of experimental data from real flight measurements onboard aircraft that will be provided by NPI CAS in the work package WP301. |
| D202.3 | IT infrastructure requirements | Mathematical models completed | Document contains a short survey of all requirements related to main and backup computer servers that will host and back up our website application. |
| D202.4 | WP202 final report | WP202 finished | Document contains overview of all tasks performed within the work package WP202 and results achieved. |
| D203.1 | WP203 final report | WP203 finished | Document contains overview of all tasks performed within the work package WP203 and results achieved. |
| D204.2 | WP204 final report | WP204 finished | Document contains overview of all tasks performed within the work package WP204 and results achieved. |
| D301.2 | WP301 final report | WP301 finished | Document contains overview of all tasks performed within the work package WP301 and results achieved. |
| D302.1 | Results of CARI calculations | CARI calculations with our HP values finished | A data set that will contain results fo radiation doses calculations performed with the CARI code using the heliocentric potential values calculated from the response of the Lomnicky stit neutron monitor. |
| D302.2 | WP302 final report | WP302 finished | Document contains overview of all tasks performed within the work package WP302 and results achieved. |
| D303.1 | Report on validation of heliocentric potential models | Validation completed | Report will contain detailed evaluation of mathematical models from physical as well as statistical point of view. It will |
| D303.2 | WP303 final report | WP303 final report | Document contains overview of all tasks performed within the work package WP303 and results achieved. It will assess the accuracy and reliability of the models and will constitute the base of the scientific article. |
| D304.1 | Report from evaluation of validation of heliocentric potential models | Evaluation of validation completed | Document will contain evaluation of the validation of the models. |
| D304.2 | WP304 final report | WP304 | Document contains overview of all tasks performed |

| Doc ID | Title | Milestone | Description of documents * |
|---|---|---|---|
| | | finished | within the work package WP304 and results achieved. |
| D401.2 | WP401 final report | WP401 finished | Document contains overview of all tasks performed within the work package WP401 and results achieved. |
| D402.1 | Scientific article | Scientific article manuscript sent to journal | This deliverable comprises the scientific article itself. The article will be sent to an impacted scientific journal. |
| D402.2 | WP402 final report | WP402 finished | Document contains overview of all tasks performed within the work package WP302 and results achieved. |
| D403.1 | Poster | Poster ready for use at workshops and conferences | This deliverable is represented by the poster that will be used for scientific and promotional purposes at conferences attended by the IEP SAS and NPI CAS workers. |
| D403.2 | Presentation | Presentation ready for use at workshops and conferences | This deliverable is represented by the electronic presentation that will be used for scientific and promotional purposes at conferences attended by the IEP SAS and NPI CAS workers. |
| D403.3 | WP403 final report | WP403 finished | Document contains overview of all tasks performed within the work package WP403 and results achieved. |
| D404.1 | ESA SWESNET proof of concept | WP404 finished | |
| D404.2 | WP404 final report | WP404 finished | |
| TDP | Technical Data Package | Final Review | As defined Appendix 1 to the Draft Contract |
| FR | Final Report | Final Review | see above |
| CCD | Contract Closure Documentation | Contract Closure | see above |
| FP | Final Presentation | Final Review | |

2.5.2 Other Deliverables (Hardware, Software, Models, Data, etc.)

| Item Identifier | Title | Milestone | Quantity to be delivered | Format / Description |
|---|---|---|---|---|
| D204.1 | Computer algorithms | WP204 finished | 1 pc | Data set delivered in compressed archive file via esa-p SAP portal. |
| D301.1 | Experimental data | Mathematical models completed | 1 pc | Data set delivered in compressed archive file via esa-p SAP portal. |
| D401.1 | Website product including the documentation and the source code | Website product with HP values running | 1pc | Website running online at the own 3rd level domain under saske.sk |

**PART 3 FINANCIAL PART**

3.1 PRICE QUOTATION FOR THE CONTEMPLATED CONTRACT:

Firm Fixed Price (FFP) for the project SIREN is 124 590 Euro. The price includes taxes and other financial duties required by the law in Slovakia and Czech Republic.

FFP part related to the prime contractor is equal to 99 672 Euro, FFP part related to subcontractor is equal to 24 918 Euro.

3.2 DETAILED PRICE BREAKDOWN

3.2.1 PSS costing forms:

IEP SAS

- ***PSS A1*** *Company Cost Rates and Overheads*
- ***PSS A2*** *Company Price Breakdown Form*
- ***PSS A2*** *Exhibit A – Other Cost Element Details (if applicable)*
- ***PSS A2*** *Exhibit B – Travel and subsistence plan*
- ***PSS A8*** *Manpower & Price Summary per WP*

NPI CAS

- ***PSS A1*** *Company Cost Rates and Overheads*
- ***PSS A2*** *Company Price Breakdown Form*
- ***PSS A2*** *Exhibit A – Other Cost Element Details (if applicable)*
- ***PSS A2*** *Exhibit B – Travel and subsistence plan*
- ***PSS A8*** *Manpower & Price Summary per WP*

3.2.2 Milestone Payment Plan

| **Milestone (MS) Description** | **Schedule Date** | **Payments from ESA to (Prime) Contractor (in Euro)** | **Country (ISO code)** |
|---|---|---|---|
| Progress Payment (MS 1): Upon successful completion of WP201 and WP202 and successful review and acceptance by the Agency of all related deliverable items D201.1, D201.2, D202.3 and D202.4 | To + 4 months | 42 250 | SK |
| Progress Payment (MS 2): Upon successful completion of WP203 and WP204 and successful review and acceptance by the Agency of all related deliverable items D203.1, D204.1 and D204.2 | T0 + 9 months | 50 340 | |
| Final Settlement (MS 3): 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 Contract Closure Documentation | To + 15 months | 32 000 | |
| **TOTAL** | | 124 590 | |

| **Prime (P)** | **Company Name** | **ESA Entity Code** (at contract signature) | **Country (ISO code)** | **Advance Payment (in Euro)** | **Offset against** | **Offset by Euro** | **Condition for release of the Advance Payment** |
|---|---|---|---|---|---|---|---|
| P | IEP SAS | 1000025275 | SK | 9 600 | MS 1 | 9 600 | Upon signature of the Contract by both Parties |
| | NPI CAS | 1000003679 | CZ | 2 400 | MS1 | 2 400 | Upon signature of the Contract by both Parties |

For information purposes only, distribution by the Prime Contractor of ESA's payments between the Prime Contractor and the Subcontractor(s):

| **For Information purposes only:**<br>**Amounts in Euro for Contractor and Subcontractor(s)** | | | | | | |
|---|---|---|---|---|---|---|
| **Milestone (MS) Description** | **Prime Contractor** | ***Insert Country (ISO code)*** | **Sub-contract or name** | ***Insert Country (ISO code)*** | **Sub-contract or name** | ***Insert Country (ISO code)*** |
| MS1 | 36 112 | SK | 9 012 | CZ | | |
| MS2 | 31 560 | SK | 15 906 | CZ | | |
| MS3 | 32 000 | SK | - | - | | |
| Total | 99 672 | SK | 24 918 | CZ | | |

3.1 COST TO COMPLETION

We suppose that the cost to shift our website product to the ESA Space Weather Service Network portal could be equal to approximately 30 000 Euro.

**PART 4 CONTRACT CONDITIONS PART:**

4.1 INTELLECTUAL PROPERTY RIGHTS

4.1.1. Background Intellectual Property and Third-Party Intellectual Property Rights

In line with Article 6.3 of the Draft Contract, no Background Intellectual Property and no Third-Party Intellectual Property Rights will be used to achieve the objectives of the work. We will use only available scientific

4.1.2 Foreground Intellectual Property

Intellectual property is related to the neutron monitor data and data from measurements onboard aircraft only. To create models and website product, only non copyrighted material and information sources will be used.

4.1.3 Ownership of Foreground Intellectual Property

Foreground Intellectual Property Rights created as a result of the present activity will belong to the Tenderer. Based on the agreement between IEP SAS and NPI CAS about our collaboration, foreground intellectual property rights will be divided based on the contribution of each party to the achieved results.

The Agency shall have an irrevocable right to use the information used in that application, for its own requirements on the terms set out in Article 6.2.2 of the draft Contract.

The Nuclear Physics Institute of the CAS will not apply any Intellectual Property Restrictions against the Institute of Experimental Physics SAS.

4.2 IMPORT AND EXPORT LICENCES

4.2.1 Import and Export Licences applicable to this Activity

The Tenderer declares that no items subject to import or export control will be used in the execution of this activity.

4.2.2 Import and Export Licences applicable to a product or services arising from or resulting from this Activity

The Tenderer declares that any products or services arising from or resulting from this activity will not be subject to import or export control or make use of any import/export controlled items.

**ATTACHMENTS**:

ANNEX 1:
Signed **PSS-A1** form(s) per participating entity

Signed **PSS-A2** form(s) per participating entity and for the cost at overall consortium level including its signed **Exhibit A** (cost specification) and signed **Exhibit B** (Travel and Subsistence Plan), if applicable

Signed **PSS-A8** form(s) per participating entity and for the cost at overall consortium level at all sublevels in numeric sequence indicating. The PSS-A8 form(s) shall be provided in a readable (landscape) format

LETTERS OF SUPPORT:

Letter of support from the Ministry of Transport of the Slovak Republic, a Slovakian radiation protection authority for aircrew.

Letter of support from the ATF-Aviation airline, a subject with permission to officially assess the radiation exposure of their aircrew.

Letter of support from the Slovak Government Flight Service, Ministry of Interior of the Slovak Republic, a Slovakian official government airline.

DETAILED CV OF KEY PEOPLE:

CV - Jan Kubancak
CV - Ronald Langer
CV - Igor Strharsky
CV - Simon Mackovjak
CV - Ondrej Ploc
CV - Iva Ambrozova

**Requesting Party Activities (RPA)**

Date: **24/October/2024**
Time: **10:30**

REFERENCE Nr. OF MINUTES OF MEETING: **SKR2_16_Negotiation MoM_v1**

SUBJECT: **ESADOS (ESA Support for Aircrew Dosimetry Services)**

PARTICIPANTS TO THE NEGOTIATION MEETING & SIGNATURE

| Company | Name and Title | Attendance (Yes / No) | Signature & Date |
|---|---|---|---|
| ESA | Marnix Houten, Head of CIC-CSS | No | |
| Akkodis for ESA | Ysée Douenne, Contract Officer (CIC-CSS) | Yes | |
| ESA | Giovanni Santin, Technical Officer (TEC-EPS) | Yes | |
| Akkodis for ESA | Inês Castelão, Country Desk Officer (CIC-IC) | Yes/No | |
| Institute of Experimental Physics SAS | Ján Kubančák, Project Manager | Yes | 2025-03-13 |
| Nuclear Physics Institute of the CAS | Ondřej Ploc, Keyperson | Yes | 2025-03-13 |

**Main Objective(s) & Scope:**
This negotiation meeting is held to ensure the activity delivers on the high-level project offering approved in the frame of the ESA Delegate Body approval process (ref. ESA IPC(2024)98).

The proposal included activities (**namely, WP 203, 401, 402, and 403**) that were considered to be out of scope by the TEB. The TEB's recommendation, and thus the subsequent approval of the contract, was dependent on the descoping of the aforementioned activities and reducing the costs to a maximum value of **€92,821.20.** Please note that the maximum value of 20% of the total (now reduced) price for tasks assigned to non-Slovakian entities as sub-contracts is still applicable.

*"The objective is to develop a model for one-month forecasting of aviation crew radiation doses, based on data obtained through the Lomnicky Stit High Mountain Observatory as an alternative data source to the current only and of EU located source used as input for the CARI tool.*

*To be able to do so, the following steps will be conducted:*

- *Creation of the theoretical model for computation and forecast of heliocentric potential based on data from the Lomnicky stit neutron monitor (instruments designed to measure cosmic-ray flux at the Earth's surface) and implementation of the automatic computation algorithm,*
- *Verification and validation of the new heliocentric potential determination and forecast by comparison of real measurements onboard aircraft with calculations using the CARI code and heliocentric potential values based on Lomnicky stit neutron monitor data,*
- *Preparation to develop the results in a new product for the ESA SWESNET space weather network for uses also beyond the CARI tool.*

*This project shall be funded entirely through the Slovakian Requesting Party Activities programme."*

The following comments were made by ESA and answered by the company:

**NP-1**: As mentioned in the section above, the project must be rescoped and exclude the following tasks: **WP 203, 401, 402, and 403**. To this end, the consortium must also reduce the costs to a maximum value of **€92,821.20** (as per PSS A8), while taking into consideration that the maximum value of 20% of the total (now reduced) price for tasks assigned to non-Slovakian entities as sub-contracts is still applicable. The WBS, WPD, Gantt chart and PSS forms shall be updated accordingly. This is a Go/No-Go point for the negotiation of the contract.

Response inputs provided before the negotiation meeting:

Task WP 203 is very important for the project and cancelling it within the project will bring many difficulties. Nevertheless, we firmly believe that we can find the solution.

- *Reasoning of the WP203 creation:*

  Purpose of WP203 was to create a modern IT infrastructure background to deliver the results of the ESADOS project using modern IT infrastructure and latest software technologies. Our current data server, which is used for data storing, processing and archiving, is one decade old and running on Debian 8 operating system which cannot be upgraded due to insufficient hardware resources (Debian Long Term Support Team announced that Debian 8 jessie support has reached its end-of-life on June 30, 2020).

- *Proposed solution for WP203 replacement:*

  As excluding of the task WP 203 is Go/No-Go point for funding of this project, we can skip it. The WP 203 plays key role in realization of task WP 401, nevertheless the tasks WP 401, 402 a 403 have to be excluded from the project. As a consequence, modern web user interface operated by the IEP SAS will be not one of the project outputs. The user interface will be implemented only via WP 404 on algorithmic level, i. e. proof of concept of the ESA SWESNET module for providing the users with the heliocentric potential computed from Lomnicky stit neutron monitor values. In other words, we will miss the modern web interface of the ESA SWESNET proof of concept.

- *Final price for the project:*

  Final price for the project was decrease to 92 821.20 EUR, price of the primary contractor is 74 434.50 EUR, price of the subcontractor is 18 386.70 EUR.

Summary of the discussion:
Bidder accepts the NP-1 comments in full scale. Updated PSS forms are inserted in section NP-3 and also provided as attachment of this document in XLSX files.

NP-1 Status: Closed.

**NP-2**: The preliminary requirements are not presented and a clear indication of parameters by which to measure the success of the proposed activity is missing. Verification methods/success criteria to compare to existing solutions and to drive the implementation of the proposed work are not provided. The bidder shall provide an updated set of requirements, taking into consideration the following points:

- Temporal as well as spatial resolution targets (including target resolution and accuracy) shall be defined

- The bidder shall also clarify the requirement for the forecast as they mention a need to forecast the heliocentric potential values from 2 to 3 months ahead but propose to create a model that will only predict the value for the next month.

Response inputs provided before the negotiation meeting:

- I am afraid I do not understand what is meant by your first comment, i.e. what you mean by the: "Temporal as well as spatial resolution targets (including target resolution and accuracy) shall be defined". Please would it be possible to develop this point a bit more.

Yes, you are right. In the scope of the project there is written:

> The scope of the ESADOS project is defined by the:
>
> - …
> - …
> - needs for creating a model that will forecast the heliocentric potential values from 2 to 3 months ahead.

That paragraph should be changed into:

> The scope of the ESADOS project is defined by the:
>
> - …
> - …
> - needs for creating a model that will forecast the heliocentric potential values at least one month ahead.

Last sentence of the chapter "*Scope of the project*" should be rewritten as follows:

In addition, based on our data, we will create a model that will predict the value of heliocentric potential with high precision for the next month and with reasonable precision for three upcoming months.

High precision means that the uncertainty of the prediction will be sufficient for personal dosimetry purposes, i.e. relative uncertainty of the result will be better than 25% (i. e. the CARI code result accuracy). Reasonable precision means that the uncertainty of the heliocentric potential prediction will be given by the extrapolation model and can be higher during solar maximum periods. The predicted value will be always stated together with thew uncertainty of its determination.

Regarding the preliminary requirements and measure of success one can state that the task will be successfully finished, if the agreement between the measured values of ambient dose equivalent during flights onboard aircraft (input requirement # 1 provided by the NPI CAS) and the values computed using CARI code and Heliocentric Potential values determined from the Lomnicky stit neutron monitor (input requirement # 2 provided by the NPI CAS) will be better than 25% (25% is the uncertainty of the CARI code result).

Summary of the discussion:

Answers were accepted by ESA.

NP-2 Status: Closed.

**NP-3**: The technical steps of the program of work are presented and considered sensible, but it is strongly recommended that the bidder add a requirement consolidation step – and update the WBS, Gantt chart, WPD and PSS forms accordingly.

Response inputs provided before the negotiation meeting:

Required changes were done and project proposal was changed correspondingly (changes in the electronic document are tracked). For more details, please refer to updated project proposal.

Summary of the discussion:

All recommendations were taken into account, the WBS, Gantt chart, WPD and PSS forms were updated. The required information is provided below:

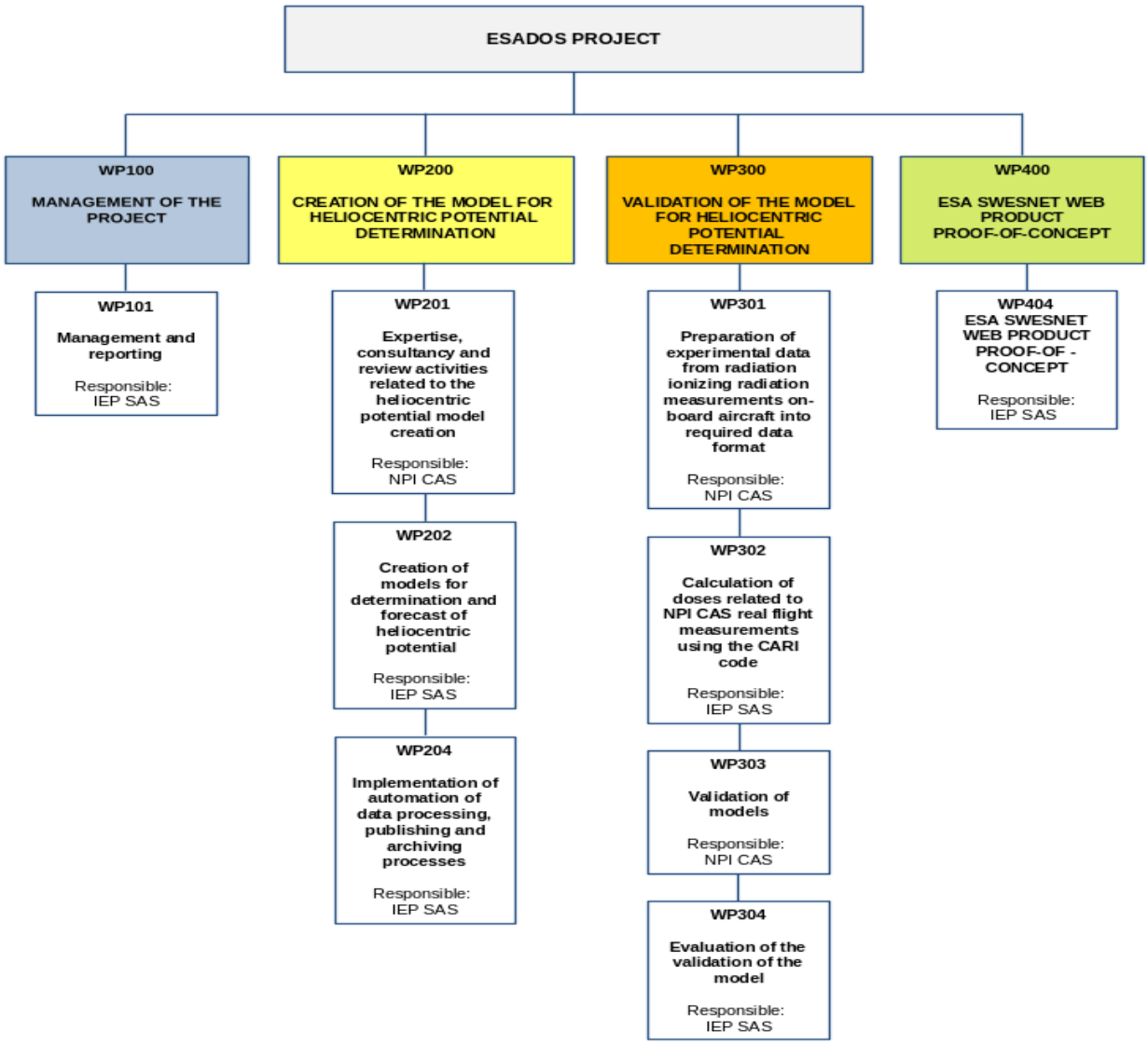



**Fig. 1: Updated Works Breakdown Structure**

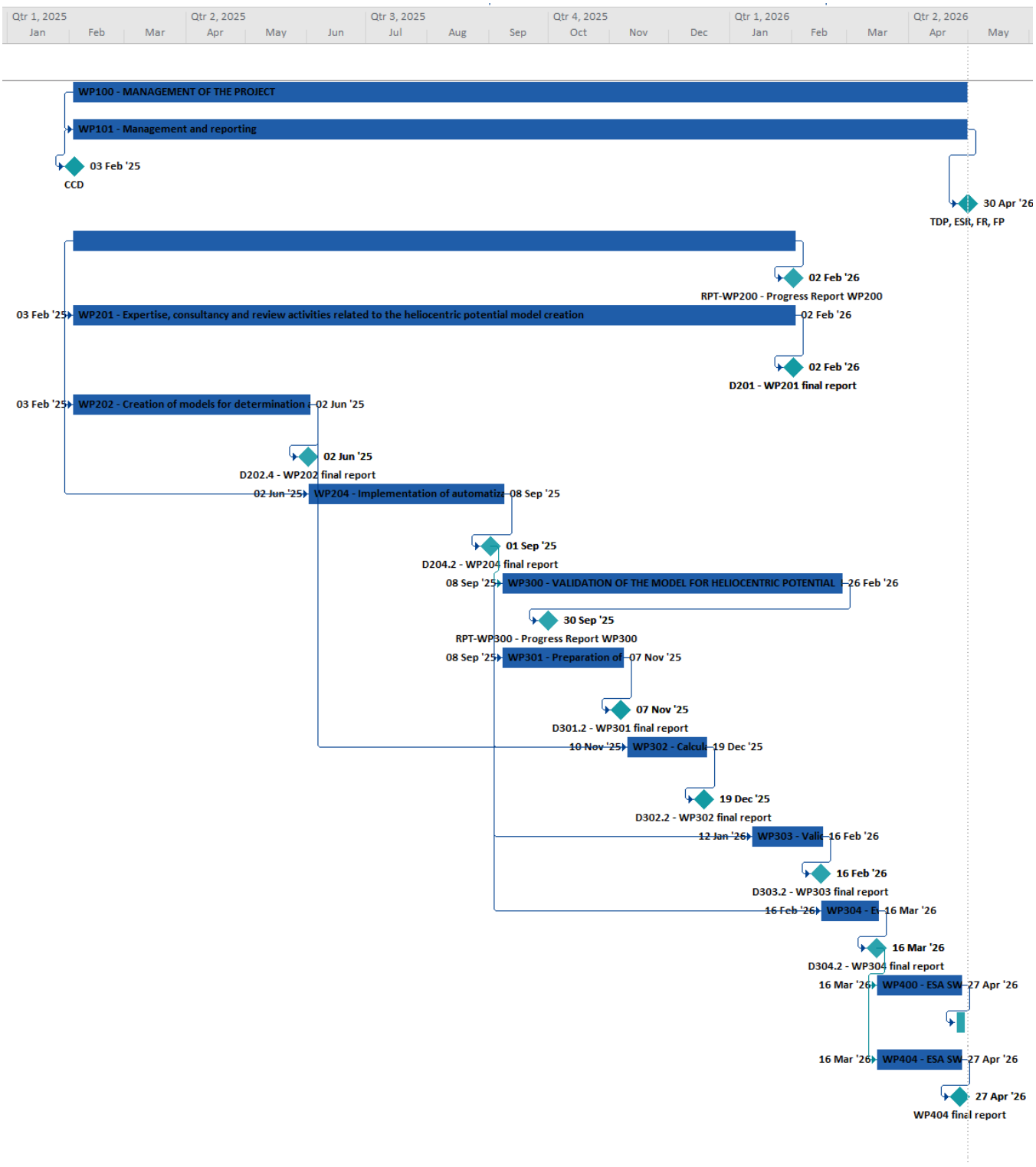



**Fig. 2: Updated Gantt chart**

| Task Name | Duration | Start | Finish |
|---|---|---|---|
| WP100 - MANAGEMENT OF THE PROJECT | 327.88 days | Mon 03/02/25 | Thu 30/04/26 |
| WP101 - Management and reporting | 327.88 days | Mon 03/02/25 | Thu 30/04/26 |
| CCD | 0 days | Mon 03/02/25 | Mon 03/02/25 |
| TDP, ESR, FR, FP | 0 days | Thu 30/04/26 | Thu 30/04/26 |
| WP200 - CREATION OF THE MODEL FOR HELIO- | 264.88 days | Mon 03/02/25 | Mon 02/02/26 |

| Task Name | Duration | Start | Finish |
|---|---|---|---|
| CENTRIC POTENTIAL DETERMINATION | | | |
| RPT-WP200 - Progress Report WP200 | 0 days | Mon 02/02/26 | Mon 02/02/26 |
| WP201 - Expertise, consultancy and review activities related to the heliocentric potential model creation | 264.88 days | Mon 03/02/25 | Mon 02/02/26 |
| D201 - WP201 final report | 0 days | Mon 02/02/26 | Mon 02/02/26 |
| WP202 - Creation of models for determination and forecast of heliocentric potential | 87.88 days | Mon 03/02/25 | Mon 02/06/25 |
| D202.4 - WP202 final report | 0 days | Mon 02/06/25 | Mon 02/06/25 |
| WP204 - Implementation of automatization of data processing, publishing and archiving processes | 70.88 days | Mon 02/06/25 | Mon 08/09/25 |
| D204.2 - WP204 final report | 0 days | Mon 01/09/25 | Mon 01/09/25 |
| WP300 - VALIDATION OF THE MODEL FOR HELIOCENTRIC POTENTIAL DETERMINATION | 125.88 days | Mon 08/09/25 | Thu 26/02/26 |
| RPT-WP300 - Progress Report WP300 | 0 days | Tue 30/09/25 | Tue 30/09/25 |
| WP301 - Preparation of experimental data from radiation exposure measurements on-board aircraft into requested formats | 45.88 days | Mon 08/09/25 | Fri 07/11/25 |
| D301.2 - WP301 final report | 0 days | Fri 07/11/25 | Fri 07/11/25 |
| WP302 - Calculation of exposures related to NPI CAS real flight measurements using the CARI code | 29.88 days | Mon 10/11/25 | Fri 19/12/25 |
| D302.2 - WP302 final report | 0 days | Fri 19/12/25 | Fri 19/12/25 |
| WP303 - Validation of models | 26.88 days | Mon 12/01/26 | Mon 16/02/26 |
| D303.2 - WP303 final report | 0 days | Mon 16/02/26 | Mon 16/02/26 |
| WP304 - Evaluation of validation | 20.88 days | Mon 16/02/26 | Mon 16/03/26 |
| D304.2 - WP304 final report | 0 days | Mon 16/03/26 | Mon 16/03/26 |
| WP400 - ESA SWESNET WEB PRODUCT | 30.88 days | Mon 16/03/26 | Mon 27/04/26 |
| RPT-WP400 - Progress Report WP400 | 1 day | Mon 27/04/26 | Tue 28/04/26 |
| WP404 - ESA SWESNET WEB PRODUCT Proof - of - concept | 30.88 days | Mon 16/03/26 | Mon 27/04/26 |
| WP404 final report | 0 days | Mon 27/04/26 | Mon 27/04/26 |

**Tab. 1: Updated Gantt chart table**

## Updated work packages descriptions

| **WP101** | | | |
|---|---|---|---|
| **WP Title:** | Management and Reporting | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Ján Kubančák | | |
| | | | |
| **Start event:** | Kick-off meeting | Start date: | T0 |
| **End event:** | Final meeting | End date: | T0 + 15 |
| | | | |
| **Inputs:** | Project proposal | | |
| **Tasks:** | ● organising of kick-off and final meetings and technical reviews<br>● producing of reports for ESA<br>● organising of regular monthly meetings<br>● organising work package review meetings (after finishing a major work package | | |

| WP101 | | | |
|---|---|---|---|
| **WP Title:** | Management and Reporting | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Ján Kubančák | | |
| | | | |
| **Start event:** | Kick-off meeting | Start date: | T0 |
| **End event:** | Final meeting | End date: | T0 + 15 |
| | | | |
| | group)<br>● preparation of materials for annual review meeting for ESA & delegation<br>● schedule updating (if necessary)<br>● identification of schedule slippage and instigation of mitigation actions<br>● quality control of deliverables prior to delivery<br>● monitoring and control of actions and action item list<br>● financial management<br>● evaluation of risks and management of mitigating actions<br>● cost monitoring and CCN handling (as required)<br>● preparation of CCD, TDP, ESR, FR, and FP | | |
| **Outputs:** | Progress Report WP200 (RPT-WP200)<br>Progress Report WP300 (RPT-WP300)<br>Progress Report WP400 (RPT-WP400)<br>Technical Data Package (TDP)<br>Final Report (FR)<br>Contract Closure Documentation (CCD)<br>Final Presentation (FP) | | |

| WP201 | | | |
|---|---|---|---|
| **WP Title:** | Expertise, consultancy and review activities related to the heliocentric potential model creation | | |
| **Company:** | Nuclear Physics Institute of the CAS | | |
| **WP Manager:** | Ondřej Ploc | | |
| | | | |
| **Start event:** | WP201 kick-off meeting | **Start date:** | T0 |
| **End event:** | WP201 final meeting | **End date:** | T0 + 12 |
| | | | |
| **Inputs:** | Project proposal<br>Results of measurements performed on-board Czech Airlines aircraft<br>Expertise in the field of radiation protection of aircrew and spacecrew | | |
| **Tasks:** | ● provide expertise, consultancy and advisory to IEP SAS during creation of models for determination and forecast of heliocentric potential.<br>● review of the models created and help with fixing the issues, if found.<br>● assessment of validation of models prepared by IEP SAS within WP303.<br>● creation of WP201 final report | | |
| **Outputs:** | WP201 final report (deliverable D201) | | |

| WP202 | | | |
|---|---|---|---|
| **WP Title:** | Creation of models for determination and forecast of heliocentric potential | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Ján Kubančák | | |
| | | | |
| **Start event:** | WP202 kick-off meeting | **Start date:** | T0 |
| **End event:** | WP202 final meeting | **End date:** | T0 + 4 |
| | | | |
| **Inputs:** | Project proposal<br>IEP SAS expertise in space weather observations and radiation protection of aircrew and spacecrew<br>IEP SAS expertise in cosmic rays measurements | | |
| **Tasks:** | Preparation of mathematical model for determination and forecast of heliocentric potential from Lomnicky stit neutron monitor data. This will include:<br>● selection of appropriate mathematical functions for HP calculations<br>● testing the functions, examining their composition, domain, convergence and finding their simplifications and solutions<br>● selection of model for forecast of the HP values<br>● examining the domain, reliability and convergence of function, finding their simplifications and solutions | | |

| | |
|---|---|
| | ● testing the functions on real data<br>● comparison of achieved results with FAA values<br>● selecting of the best functions to be used further in numerical computer algorithms<br>● writing of WP202 final report |
| **Outputs:** | Mathematical models for determination of heliocentric potential data from Lomnicky stit neutron monitor data (deliverable D202.1)<br>Experimental input data range and format requirements(D202.2)<br>IT infrastructure requirements (deliverable D202.3)<br>WP202 final report (deliverable D202.4) |

| **WP204** | | | |
|---|---|---|---|
| **WP Title:** | Implementation of automatization of data processing, publishing and archiving processes | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Igor Strhársky | | |
| | | | |
| **Start event:** | WP204 kick-off meeting | **Start date:** | T0 + 5 |
| **End event:** | WP204 final meeting | **End date:** | T0 + 9 |
| | | | |
| **Inputs:** | IT infrastructure<br>IEP SAS expertise | | |
| **Tasks:** | Transformation of mathematical models for calculation and forecast of heliocentric potential from Lomnicky stit neutron monitor data into the computer algorithms, tasks included:<br>● selection of best methods for numerical approximation of functions for retrospective HP determination (preferring the direct solution over iterative); subtasks included:<br>○ selection of most suitable methods<br>○ testing of consistency and numerical stability<br>○ testing of convergence<br>● selection of best methods for numerical approximation of functions for retrospective HP determination by comparing extrapolation and regression solutions; subtasks included:<br>○ testing of consistency and numerical stability<br>○ testing of reliability of forecasted values<br>○ determination of confidence intervals<br>● consultations of partial results with the NPI CAS experts<br>● preparation of WP204 final report | | |
| **Outputs:** | Computer algorithms (deliverable D204.1)<br>WP204 final report (deliverable D204.2) | | |

| **WP301** | | | |
|---|---|---|---|
| **WP Title:** | Preparation of experimental data from radiation exposure measurements on-board aircraft into requested formats | | |
| **Company:** | Nuclear Physics Institute of the CAS | | |
| **WP Manager:** | Ondřej Ploc | | |
| | | | |
| **Start event:** | WP301 kick-off meeting | **Start date:** | T0 + 6 |
| **End event:** | WP301 final meeting | **End date:** | T0 + 8 |
| | | | |
| **Inputs:** | Results of aircraft on-board measurements of radiation doses from cosmic rays with the HAWK TEPC<br>Requirements on input data format (D201.2) | | |
| **Tasks:** | ● preparation of the electronic file with the experimental data - results of onboard measurements in required range and format; the prepared information must include:<br>○ results of measurements performed on selected trajectories<br>○ information about the detectors used<br>○ information about trajectories itself<br>○ information about detectors calibration<br>○ uncertainty of results of measurements<br>● creation of WP301 final report | | |
| **Outputs:** | Experimental data (D301.1)<br>WP301 final report (deliverable D301.2) | | |

| **WP302** | | | |
|---|---|---|---|
| **WP Title:** | Calculation of exposures related to NPI CAS real flight measurements using the CARI code | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Ján Kubančák | | |
| | | | |
| **Start event:** | WP302 kick-off meeting | **Start date:** | T0 + 8 |

| WP302 | | | |
|---|---|---|---|
| **End event:** | WP302 final meeting | **End date:** | T0 + 10 |
| | | | |
| **Inputs:** | Experimental data (D204.1) | | |
| **Tasks:** | ● preparation of CARI input files for calculation of radiation protection quantities (dose, ambient dose equivalent) using the HP values computed from neutron monitor data<br>● calculation the radiation doses from cosmic rays for the routes contained in the experimental data file using the CARI code and values of heliocentric potential calculated from the Lomnicky stit neutron monitor data (the file is expected to contain several thousands results of onboard radiation measurements)<br>● creation of WP302 report | | |
| **Outputs:** | Results of CARI calculations (D302.1)<br>WP302 final report (D302.2) | | |

| WP303 | | | |
|---|---|---|---|
| **WP Title:** | Validation of models | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Šimon Mackovjak | | |
| | | | |
| **Start event:** | WP303 kick-off meeting | **Start date:** | T0 + 10 |
| **End event:** | WP303 final meeting | **End date:** | T0 + 11 |
| | | | |
| **Inputs:** | Results of CARI calculations (deliverable D302.1)<br>Experimental data (deliverable D204.1) | | |
| **Tasks:** | ● validation of heliocentric potential models by means of analysis and comparison of experimental results with the results of calculations using the CARI code; validation includes<br>○ evaluation of models for HP calculation from existing data (i.e. retrospective calculation)<br>○ evaluation of models for forecast of HP<br>● creation of WP303 final report | | |
| **Outputs:** | Report on validation of heliocentric potential models (deliverable D303.1)<br>WP303 final report (deliverable D303.2) | | |

| WP304 | | | |
|---|---|---|---|
| **WP Title:** | Evaluation of validation | | |
| **Company:** | Nuclear Physics Institute of the CAS | | |
| **WP Manager:** | Ondřej Ploc | | |
| | | | |
| **Start event:** | WP304 kick-off meeting | **Start date:** | T0 + 11 |
| **End event:** | WP304 final meeting | **End date:** | T0 + 12 |
| | | | |
| **Inputs:** | Report on validation of heliocentric potential models (deliverable D303.1) | | |
| **Tasks:** | ● evaluation of validation realised by the IEP SAS in WP303<br>● preparation of recommendations to fix issues, if any found<br>● creation of report from evaluation of validation of heliocentric potential models<br>● creation of WP304 final report | | |
| **Outputs:** | Report from evaluation of validation of heliocentric potential models (deliverable D304.1)<br>WP304 final report (deliverable 304.2) | | |

| WP404 | | | |
|---|---|---|---|
| **WP Title:** | ESA SWESNET WEB PRODUCT proof - of - concept | | |
| **Company:** | Institute of Experimental Physics SAS | | |
| **WP Manager:** | Ján Kubančák | | |
| | | | |
| **Start event:** | WP404 kick-off meeting | **Start date:** | T0 + 13 |
| **End event:** | WP404 final meeting | **End date:** | T0 + 15 |
| | | | |
| **Inputs:** | Report on validation of heliocentric potential models (deliverable D303.1) | | |

| WP404 | |
|---|---|
| | Report from evaluation of validation of heliocentric potential models (deliverable D303.1)<br>Scientific article (deliverable D402.1)<br>Website product (WP401) |
| **Tasks:** | ● proof of concept of the ESA SWESNET module for providing the users with the heliocentric potential computed from Lomnicky stit neutron monitor values<br>● creation of WP404 final report |
| **Outputs:** | WP404 final report (deliverable D404.1)<br><br>Website that will contain values of heliocentric potential calculated from the Lomnicky stit neutron monitor response. Website will be available only for registered ESA users and to the IEP and NPI staff which took part in the project. This web site will serve as proof – of -concept and becomes available to public only after it transition to ESA SWESNET site (deliverable D404.2) |

**Tab. 2: Updated WPD**

**Updated and signed PSSA forms are located in ANNEX 5.**

NP-3 Status: Closed.

**NP-4**: The details on the approach and methodology to be used are not provided with enough detail, raising some questions that require clarification:

- Which data will be collected (only referred to as "Lomnicky stit neutron monitor data", "Czech Airlines aircraft data")
- How will the data be analysed and integrated into the proposed model
- Which algorithms will be used for the integration of the data

Response inputs provided before the negotiation meeting:

- *Which data will be collected*

  We apologize for insufficient description of the data.

  By the neutron monitor data one means average count rate of the neutron monitor in impulses per one hour.

  By the Czech Airlines aircraft data one means long-term measurements of the ambient dose equivalent H*(10) during flights onboard the Czech Airlines aircraft. These measurements were performed with the Liulin detector owned by the Nuclear Physics Institute of the Czech Academy of Sciences. More description of these measurements can be found e.g. here: https://doi.org/10.1016/j.radmeas.2013.09.002[1]

  The text in the project proposal will be modified accordingly.

- *How will the data be analysed and integrated into the proposal model*

  Heliocentric potential is a measure of the Sun's magnetic activity, which influences the intensity of cosmic rays reaching Earth. Neutron monitor is a ground-based detector that measures the intensity of cosmic ray neutrons, which are produced when cosmic rays interact with the Earth's atmosphere.

[1] Ondrej Ploc, Iva Ambrozova, Jan Kubancak, Ivan Kovar, Tsvetan P. Dachev, Publicly available database of measurements with the silicon spectrometer Liulin onboard aircraft, Radiation Measurements,Volume 58 , 2013, Pages 107-112, ISSN 1350-4487, https://doi.org/10.1016/j.radmeas.2013.09.002

Neutron monitor data will be incorporated into the model in the same way, as it is implemented in this scientific article: https://doi.org/10.1016/S0160-4120(96)00086-4[2]

- Which algorithms will be used for the integration of the data

  Description of the algorithms for determination of the heliocentric potential from the neutron monitor data can be found in the separated document files specified in more detailed in the Annex 4 of this document.

Summary of the discussion:

The way of determination of the Heliocentric Potential from the Lomnicky stit neutron monitor data was clarified and the equation which will be used for its determination was presented.

NP-4 Status: Closed.

ESA's response:

- Regarding: Which algorithms will be used for the integration of the data

In addition, please explain in simple words where the core of the development work will be focussed.

Note: Please refer to Annex 4 of this document.

**NP-5**: It is not clear how performance and accuracy will be validated (and what are the requirements for these parameters), and what is the scope of the airborne radiation measurement campaigns (namely, it is unclear if this has been included under the scope of WP301). These shall be clarified.

Response inputs provided before the negotiation meeting:

In general, performance and accuracy of the model in mathematics, physics, chemistry and other sciences is always verified experimentally. In our case, the experimental verification is achieved via measurement of the ambient dose equivalent (please refer to footnote 1 for more details) onboard aircraft. These data for several decades of flights from the past already exist and the Nuclear Physics Institute of the CAS owns them. Based on our request, Nuclear Physics Institute of the CAS will prepare information about flights, H*(10) measured during these flights and we will compare the provided information with the results of the calculation based on heliocentric potential values determined from the Lomnicky stit neutron monitor response.

**If we get agreement between measured and calculated values better than 25% (i.e. the accuracy of the CARI code calculation), we can consider the model as successfully validated.**

Summary of the discussion:
NPI CAS owns the data from real measurements onboard aircraft and based on these data, we will validate the performance and accuracy of our Heliocentric Potential model. The successful validation criteria was set to the relative difference lower than 25%.

NP-5 Status: Closed.

**NP-6**: The baseline design is presented but shall be further clarified: namely, it shall be clarified what framework, software and algorithms already exist.

[2] K. O'Brien, W. Friedberg, Herbert H. Sauer, D.F. Smart, Atmospheric cosmic rays and solar energetic particles at aircraft altitudes, Environment International, Volume 22, Supplement 1, 1996, Pages 9-44, ISSN 0160-4120, https://doi.org/10.1016/S0160-4120(96)00086-4

Response inputs provided before the negotiation meeting:

Work is done from scratch, there are no data or information already prepared besides the data that will be used as input for our project. i.e. measurements of the neutron monitor and measurements of radiation load onboard aircraft.

The software that will be used for creation and testing of algorithms for determination of the Heliocentric Potential from the Lomnicky stit neutron monitor data will be the R (https://www.r-project.org/). After verification of the algorithms and models, the algorithms will be rewritten into the PHP so that they could be directly used with the planned web interface.

Experimental data from the NPI CAS will be provided to us in the structured data CSV file. Outputs of the CARI code calculations will be finally transformed into the structured CSV file. The reason for working with the CSV files is that most statistical codes can work easily with them.

Validation of the model will be performed via correlation analysis of the measured and computed data using the R.

Proof of concept of the module for the ESA SWESNET WEB PRODUCT will be created using the PHP Hypertext Preprocessor language in combination with the HTML code and MariaDB or MySQL database. Web front end will be prepared using the CakePHP framework. Additional mathematical PHP libraries can be used (Math / BigNum / Number PHP). Use of additional programming languages and server-side solutions is reserved.

Summary of the discussion:

Framework, software and algorithms that will be used within the project were presented, discussed and accepted by the ESA.

NP-6 Status Closed.

ESA's response:
It is still unclear what is to be developed and what already exists.

As it is written in the first section of our answer, the work is done from scratch. We have no other data, no other input than the long-term time series of results of measurements of our neutron monitor. Also, no algorithms have been developed yet and no website has been created yet.

At the end of the project, we will have working version of website, that will be available only to registered user from ESA and to us. Access of other users to this site will be allowed only after it becomes part of the ESA SWESNET, not before.

**NP-7**: The deliverable items list is presented but should be further detailed with more descriptive titles for the Technical Notes and expanded descriptions of the documents. This shall be updated.

Response inputs provided before the negotiation meeting:

All comments were accepted and the project proposal updated.

Summary of the discussion:

Comments of ESA were fully accepted. The updated deliverable items list is as follows:

## Updated deliverables list:

2.5.1 Documentation

| Doc ID | Title | Milestone | Description of documents * |
|---|---|---|---|
| D201 | WP201 final report | WP201 finished | Document is the survey of all expertise, consultancy and review activities done by the NPI CAS. It will be logically divided into the following sections:<br>• introduction with description of the goals of the workpackage<br>• description of the models that were selected in D202.1<br>• review of the models and proposed methods by the the IEP SAS experts in D201.1<br>• proposal of methodology for validation of the model(s) for determination of cosmic rays and assessment of the models<br>• requirements on content and range of NPI experimental date from measurements of ambient dose equivalent onboard aircraft |
| D202.1 | Mathematical models for determination of heliocentric potential data from Lomnicky stit neutron monitor data | WP202 finished | Document contains the description of mathematical models that will be used for determination of heliocentric potential from Lomnicky stit neutron monitor data. The algorithms are based on scientific publications, i.e. on:<br>*K. O'Brien, W. Friedberg, Herbert H. Sauer, D.F. Smart, Atmospheric cosmic rays and solar energetic particles at aircraft altitudes, Environment International, Volume 22, Supplement 1, 1996, Pages 9-44, ISSN 0160-4120, https://doi.org/10.1016/S0160-4120(96)00086-4*<br>• introduction with description of the goals of the workpackage<br>• description of current status in the field and reasoning of model selection<br>• description of selected model, its parameters and way, how to use in in the Lomnicky stit neutron monitor conditions |
| D202.2 | Experimental input data range and format requirements | Mathematical models completed | Document contains a short survey of all requirements on format and range of experimental data from real flight measurements onboard aircraft that will be provided by NPI CAS in the work package WP301.<br>• introduction with description of the goals of the workpackage<br>• requirements on content and range of NPI experimental data from measurements of ambient dose equivalent onboard aircraft |
| D202.4 | WP202 final report | WP202 finished | Document contains overview of all tasks performed within the work package WP202 and results achieved, namely:<br>• introduction with description of the goals of the workpackage WP202 |

| Doc ID | Title | Milestone | Description of documents * |
|---|---|---|---|
| | | | • description of current status in the field and reasoning of model selection<br>• description of selected model, its parameters and way, how to use in in the Lomnicky stit neutron monitor conditions<br>• introduction with description of the goals of the workpackage<br>• requirements on content and range of NPI experimental data from measurements of ambient dose equivalent onboard aircraft |
| D204 | WP204 final report | WP204 finished | Document contains overview of all tasks performed within the work package WP204 and results achieved, namely:<br>• introduction with description of the goals of the workpackage<br>• proposal of automation processes and computer algorithms for determination of heliocentric potential from Lomnicky stit neutron monitor live data<br>• proposal of data processing, archiving and back-up of computed heliocentric potential data<br>• proposal of ESA SWESNET WEB PRODUCT web site for publication of heliocentric potential data |
| D301.2 | WP301 final report | WP301 finished | Document contains description of data from measurements of ambient dose equivalent onboard aircraft provided to IEP SAS by the NPI CAS in the data file (D301.1). |
| D302.2 | WP302 final report | WP302 finished | Document contains a description of dataset, which is the result of CARI calculations of H*(10) for the NPI measurements of ambient dose equivalent onboard aircraft. |
| D303 | WP303 final report | WP303 finished | Report will contain results of the validation process of the models. It will contain:<br>• description of workpackage goals<br>• comparison of experimentally measured radiation doses with those calculated<br>• statistical comparison and agreement evaluation<br>• chapter devoted to final decision about the accuracy and precision of the models, and eligibility for their further use |
| D304 | Report from evaluation of validation of heliocentric potential models | WP304 finished | Document will contain a review of validation of the models from WP303. It will independently evaluate:<br>• eligibility of used methods<br>• supplement the information contained in the D303, if necessary<br>• |
| D404.1 | ESA SWESNET WEB PRODUCT proof of concept | WP404 finished | Proof of concept of the module for ESA SWESNET space weather network web. This will contain:<br>• description of the technologies used for creation of website<br>• description of communication of the website with |

| Doc ID | Title | Milestone | Description of documents * |
|---|---|---|---|
| | | | the database<br>• website source code |
| TDP | Technical Data Package | Final Review | As defined Appendix 1 to the Draft Contract |
| FR | Final Report | Final Review | see above |
| CCD | Contract Closure Documentation | Contract Closure | see above |
| FP | Final Presentation | Final Review | |

2.5.2 Other Deliverables (Hardware, Software, Models, Data, etc.)

| Item Identifier | Title | Milestone | Quantity to be delivered | Format / Description |
|---|---|---|---|---|
| D204.1 | Computer algorithms | WP204 finished | 1 pc | Data set delivered in compressed archive file via esa-p SAP portal. |
| D301.1 | Experimental data | Mathematical models completed | 1 pc | Data set delivered in compressed archive file via esa-p SAP portal. |
| D302.1 | Dataset – output from calculations | WP 302 finished | 1 pc | Data set, which contains result of dose equivalent calculations for the flights, on which the dose equivalent was measured by the NPI CAS. The calculations in the data set are performed by the IEP SAS using the CARI code. |
| D404.2 | ESA SWESNET WEB PRODUCT | Web Product Source code | 1pc | ESA SWESNET WEB PRODUCT proof-of-concept source code |

NP-7 Status: Closed.

ESA's response:
The discussion on the output of the project will be included under NP-1.

**NP-8**: A list of key personnel is provided for the bidder and subcontractor with details regarding the key personnel function, responsibility, and position, but WP's areas of responsibility are missing. The bidder shall provide this information.

Response inputs provided before the negotiation meeting:

Responsibility of team members for work packages is indicated in the each work package description table. Due to your request, we added this information about key personnel responsibility for work packages into the Table 2.1 – Overall team composition.

| Name and surname | Organisation | Role in the project | WP responsibility |
|---|---|---|---|
| **Institute of experimental Physics SAS** | | | |
| Ján Kubančák | IEP SAS | • **key person**<br>• project manager<br>• scientist and nuclear engineer<br>• data processing and radiation protection specialist | **WP101, WP202, WP302, WP404** |

| Name and surname | Organisation | Role in the project | WP responsibility |
|---|---|---|---|
| Ronald Langer | IEP SAS | ● **key person**<br>● associated scientist<br>● head of the IEP SAS Lomnický štít observatory and cosmic rays measurements expert | **All workpages by the IEP SAS because he ensures realization of the project from the Lomnicky stit laboratory side.** |
| Igor Strhársky | IEP SAS | ● **key person**<br>● IT and electronics engineer<br>● web programming specialist | **WP 204** |
| Šimon Mackovjak | IEP SAS | ● **key person**<br>● scientist | **WP303** |
| Samuel Štefánik | IEP SAS | ● Lomnický štít observatory cosmic rays measurement instruments engineer<br>● associate engineer 1 | - |
| Dušan Truska | IEP SAS | ● Lomnický štít observatory cosmic rays measurement instruments engineer<br>● associate engineer 2 | |
| Administration specialist / Lomnický štít space physics laboratory | IEP SAS | ● administration specialist for tasks related to the ESADOS project | - |
| **Nuclear Physics Institute of the CAS** | | | |
| Ondřej Ploc | NPI CAS | ● **key person**<br>● senior scientist | **WP201, WP301, WP 304** |
| Martin Kákona | NPI CAS | ● postdoc researcher | - |
| Roman Dvořák | NPI CAS | ● student | - |

***Table 2.1 – Overall team composition***

Information about key personnel responsibilities for work-packages was added into the proposal.

Summary of the discussion:

Comments were accepted and project proposal modified accordingly.

NP-8 Status: Closed.

**NP-9**: The tenderer's key personnel's time dedication is considered acceptable except for the subcontractors' key personnel and Simon Mackovjak for which the low time dedication (7%-8%) shall be clarified. In addition, the percentage of time dedication to the project of all key personnel is given but the percentage does not match the number of hours presented in the PSS forms (e.g., for the PM 560 is declared in the time dedication table under section 2.1.1.3 against 572 in PSSA2). This shall be clarified or corrected.

Response inputs provided before the negotiation meeting:

The amount of working hours was distributed according to the best knowledge of the author of the project, based on the project needs and taking into account the working capacity that was offered for the project by the team members at that time. At the moment of wirting of the project, Simon Mackovjak could not offer more than 192 hours to the project.

**At the moment, Simon Mackovjak can offer higher capacity so we increased his capacity from 192 hours per project to 528 hours.**

On the subcontractor side, due to the budget restrictions, there is a change in the key personnel team. These changes will be explained by the subcontractors' key person Ondrej Ploc, who will finally take care of all tasks previously assigned to Iva Ambrozova.

The disagreement between the time dedication for the people in PSS forms and the project proposal is a result of paste/copy error. This will be fixed.

Here are the original working hours from the PSS sent together with project proposal. Please refer to NP-8 for team composition details and roles assignment.

| WP Title | | Management and reporting | Expertise, consultancy and review activities related to the heliocentric potential model creation | Creation of models for determination and forecast of heliocentric potential | Preparation of IT infrastructure for data processing, publishing and archiving | Implementation of automation of data processing, publishing and archiving processes | Preparation of experimental data from radiation ionizing radiation measurements on-board aircraft into required data format | Calculation of doses related to NPI CAS real flight measurements using the CARI code | Validation of models | Evaluation of the validation of the model | Creation of website product | Scientific outputs | Promotion of website product | ESA SWESNET proof – of - concept | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WP Number | | WP101 | WP201 | WP202 | WP203 | WP204 | WP301 | WP302 | WP303 | WP304 | WP401 | WP402 | WP403 | WP404 | | Total WBS-Level |
| Labour Hours per category | Hours | | | | | | | | | | | | | | | |
| Project manager & scientist | # | 72 | | 96 | 36 | 72 | | 56 | 48 | | 40 | 64 | 40 | 48 | | 572 |
| Scientist | # | | | 56 | | 56 | | 32 | 24 | | | | | 24 | | 192 |
| Associate scientist | # | | | | | 144 | | 160 | 54 | | 36 | 120 | 48 | | | 562 |
| IT engineer | # | | | | 280 | 158 | | 138 | | | 104 | | | 80 | | 760 |
| Associate engineer 1 | # | | | 80 | 96 | 80 | | 96 | 82 | | 96 | 100 | | 40 | | 670 |
| Associate engineer 2 | # | | | 48 | 72 | 40 | | 104 | 84 | | 96 | 90 | | | | 534 |
| Administration specialist / Technical writer | # | 800 | | 120 | 102 | 96 | | 96 | 96 | | 182 | 144 | 164 | 120 | | 1,920 |
| ... | # | | | | | | | | | | | | | | | |
| Total Labour Hours | # | 872 | | 400 | 586 | 646 | | 682 | 388 | | 554 | 518 | 252 | 312 | | 5,210 |

In the table below there are currently valid working hours data.

| WP Title | | Management and reporting | Expertise, consultancy and review activities related to the heliocentric potential model creation | Creation of models for determination and forecast of heliocentric potential | Implementation of automation of data processing, publishing and archiving processes | Preparation of experimental data from radiation exposure measurements on-board aircraft into requested formats | Calculation of doses related to NPI CAS real flight measurements using the CARI code | Validation of models | Evaluation of the validation of the model | ESA SWESNET WEB PRODUCT proof – of - concept | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WP Number | | WP101 | WP201 | WP202 | WP204 | WP301 | WP302 | WP303 | WP304 | WP404 | | Total WBS-Level |
| Labour Hours per category | Hours | | | | | | | | | | | |
| Project manager & scientist | # | 472 | | 152 | 96 | | 96 | 120 | | 160 | | 1,096 |
| Scientist | # | | | 96 | 120 | | 120 | 120 | | 72 | | 528 |
| Associate scientist | # | | | 80 | 120 | | 120 | 120 | | 80 | | 520 |
| IT engineer | # | | | | 112 | | 200 | | | 200 | | 512 |
| Associate engineer 1 | # | | | 80 | 120 | | 120 | 120 | | 80 | | 520 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Associate engineer 2 | # | | | 42 | 152 | | 120 | 120 | | 80 | | 514 |
| Administration specialist / Technical writer | # | 96 | | 96 | 96 | | 96 | 96 | | 48 | | 528 |
| ... | # | | | | | | | | | | | |
| Total Labour Hours | # | 568 | | 546 | 816 | | 872 | 696 | | 720 | | 4,218 |

Summary of the discussion:

The capacity of the Simon Mackovjak was increased to 30 % (i.e. more 2.5 times, FTE=0.3). The maximum price for the project will not change.

NP-9 Status: Closed.

ESA's response:
Still not in line, the number of hours in the PSS forms does not reflect the number of hours per key personnel, as presented in the proposal. Please clarify the number of hours for the following profiles: Project manager, scientist and scientist and IT engineer.

It is unclear where the increase of allocation was done and the justification for it. Please provide a table with the before and after the allocation update (with the changes highlighted in red or similar) and a justification for the extra allocation.

IEP response: The corresponding information was added into the text above.

**NP-10**: 872 hours will be dedicated to the WP1 by the Prime which is considered excessive representing approximately 17% of the Total Labour Hours (5,959). It is noted that out of 872, only 72 hours are actually dedicated by the Project Manager, which is considered too low and requires an explanation.

Response inputs provided before the negotiation meeting:

This was fixed. FTE of the administration specialist was decreased to 0.3, i.e. to 528 hours per project, what is approximately 35.2 hours per month of the project.

In the table below, one can find working hours distribution originally send together with the project proposal:

| | **LABOUR** | | | | |
|---|---|---|---|---|---|
| *Direct Labour cost centres or categories Code / Description* | | *No. of FTE (calculated)* ***U = W / V*** | *Sold Hours per ManYear* ***V*** | *Manpower Effort No. of Hours* ***W*** | *Gross Hourly Rate in NC* |
| | Project manager & scientist | 0.3 | 1,920 | 572 | 15.30 |
| | Scientist | 0.1 | 1,920 | 192 | 15.30 |
| | Associate scientist | 0.3 | 1,920 | 562 | 12.80 |
| | IT engineer | 0.4 | 1,920 | 760 | 15.30 |
| | Associate engineer 1 | 0.3 | 1,920 | 670 | 12.80 |
| | Associate engineer 2 | 0.3 | 1,920 | 534 | 12.80 |
| | Administration specialist / Technical writer | 1.0 | 1,920 | 1,920 | 13.50 |

The working hours distribution valid currently is presented in the following table:

| | LABOUR | | | | |
|---|---|---|---|---|---|
| *Direct Labour cost centres or categories Code / Description* | | *No. of FTE (calculated) **U = W / V*** | *Sold Hours per ManYear **V*** | *Manpower Effort No. of Hours **W*** | *Gross Hourly Rate in NC* |
| | Project manager & scientist | 0.6 | 1,920 | 1,096 | 15.30 |
| | Scientist | 0.3 | 1,920 | 528 | 15.30 |
| | Associate scientist | 0.3 | 1,920 | 520 | 12.80 |
| | IT engineer | 0.3 | 1,920 | 512 | 15.30 |
| | Associate engineer 1 | 0.3 | 1,920 | 520 | 12.80 |
| | Associate engineer 2 | 0.3 | 1,920 | 514 | 12.80 |
| | Administration specialist / Technical writer | 0.3 | 1,920 | 528 | 13.50 |

Summary of the discussion:

Proposal accepted and will be implemented in MoM and updated PSS forms.

NP-10 Status: Closed.

ESA's response:
In the received PSS A2, there are 572 hours allocated. Also, there is complete mismatch between the hours allocated to the profiles in PSS A2 and A8. Please provide the updated PSS forms.

**NP-11**: While the duration of the project is credible, the duration of individual tasks is not clear. For example, the procurement of IT infrastructure is allocated 6 months, whereas the key task of model development has only 4 months allocated and validation only 1 month. The planning needs to be clarified and/or re-balanced. The Gantt chart shall be updated.

Response inputs provided before the negotiation meeting:

The extensive amount of time for the procurement was defined on the base of our experience with duration of procurement processes in Slovakia. From this reason, this work-package was planned to start immediately at the beginning of the project.

Month for validation is OK as we will be comparing just numbers and charts. We do not expect difficulties in model development because the way how to determine the heliocentric potential from the neutron monitor response is described in scientific articles like e.g. in

"O'Brien, Keran, Burke, Gail de P.: Calculated cosmic ray neutron monitor response to solar modulation of galactic cosmic rays, Journal of Geophysical Research (1896-1977), J. Geophys. Res., Vol. 78, Issue 16, SN 0148-0227, https://doi.org/10.1029/JA078i016p03013"

Nevertheless, as the tasks WP 203, 401, 402, and 403 had to be excluded, duration of procurement is not relevant anymore.

Summary of the discussion:

Explanation accepted by ESA.

NP-11 Status: Closed.

**NP-12**: The bidder applies acceptable overheads with the exception of a 20% overhead for general expenses (cost el.5). This 20% shall be clarified or the price reduced accordingly. The PSS form A2 shall be updated.

Response inputs provided before the negotiation meeting:

**20% overhead for general expenses is a result of the internal policy of the Institute of Experimental Physics SAS.** This money cover costs related to the project that will the Institute pay for administrative support of the project team members and part of the operating costs of the Lomnicky stit high mountain observatory.

Summary of the discussion:

20% overhead for general expenses cover costs related to ensuring the support of the project team members during the project. The are no other overheads planned in the project.

NP-12 Status: Closed.

**NP-13**: The number of hours dedicated to technical writers is considered excessive and shall be considerably reduced. The PSS forms shall be updated.

Response inputs provided before the negotiation meeting:

Since the technical writing covers also preparation of respective work packages reports, we consider the time devoted to the writing of reports and deliverables adequate. If possible, please consider our point of view or propose the tie which should be devoted to technical writing according to you.

Summary of the discussion:
Related to NP-9. Fixed already.

NP-13 Status: Closed.

ESA's response:
Discussion on the allocation will be continued on NP-9 only.

**NP-14**: The following points regarding the PSS forms of the prime require clarification:

- The number of hours presented in the PSS forms do not match the hours declared in the time dedication per key personnel. In addition, the total number of hours presented in the PSSA2 is not consistent with the total number of hours in PSSA8.
- The subcontractor contribution is missing from the PSSA2. This shall be corrected..
- In the PSSA2, two elements are presented as Miscellaneous (cost el.3.10) amounting to 8,000 euros. Other Direct Cost elements are listed under Exhibit A to PSS A2 as infrastructure/IT costs (namely, main and backup servers), which are not acceptable according to condition 6 of the ITT.
- Exhibit B – Travel costs for the final presentation at ESTEC is considered overly high (1,540 euros) while the subsistence cost is considered underestimated and should be re-balanced.

Response inputs provided before the negotiation meeting:

PSS forms were updated correspondingly.

Summary of the discussion:

First bullet discussed as part of NP-12. Subcontractor price will be added. Exhibit A – IT procurement will be removed. Travel costs and subsistence costs were rebalanced with the subsistence costs not about 250 EUR per person / per day.

NP-14 Status: Closed.

ESA's response:
Discussion on the allocation will be continued on NP-9 only.

**NP-15**: The proposed Milestone Payment Plan is based on the completion of WPs and the delivery of specific deliverables. The Milestone Payment Plan is considered frontloaded. The amount per milestone should be reviewed taking into consideration the cost allocated per WP.

We believe that frontloading will allow us:

- **mitigate risks related to financing** and ensure that the project starts and progresses smoothly by providing upfront incentives,
- payment plan will boost our financial stability and
- we believe that frontloading can encourage faster progress of the project.

Hence, if possible, we would like to allow us the frontloading of the project.

Response inputs provided before the negotiation meeting:

| Milestone (MS) Description | Schedule Date | Payments from ESA to (Prime) Contractor (in Euro) | Country (ISO code) |
|---|---|---|---|
| Progress Payment (MS 1): Upon successful completion of WP201 and WP202 and successful review and acceptance by the Agency of all related deliverable items D201.1, D201.2, D202.3 and D202.4 | To + 4 months | 30 000.00 | SK |
| Progress Payment (MS 2): Upon successful completion of WP204 and successful review and acceptance by the Agency of all related deliverable items D204.1 and D204.2 | T0 + 9 months | 20 821.20 | |
| Final Settlement (MS 3): 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 Contract Closure Documentation | To + 15 months | 42 v000.00 | |
| **TOTAL** | | 92821.20 | |

Summary of the discussion:

MPP has been updated to be inline in PSS A8 form.

NP-15 Status: Closed.

**NP-16**: The request for the advance payment is not acceptable as the entity does not classify as an SME and there is no demonstration that a significant need for cash disbursement at the beginning of the execution of the work is required. This shall be corrected.

Response inputs provided before the negotiation meeting:

Request for the advance payment in project proposal was updated. As we are not SME, we require 10% advance payment.

Summary of the discussion:

ESA disagrees with the advance payment because there is no early cash disbursement.

NP-16 Status: Closed.

**NP-17**: The bidder states in the cover letter that BIPR have been identified, however, the proposal states that the bidder will not make use of any background or third-party Intellectual Property Rights. This shall be clarified.

Response inputs provided before the negotiation meeting:

All outputs of the project will be open-source / free for further use and no intellectual property will arise from this project. This probably occurred as our misunderstanding of this complicated legal system related to intellectual property rights.

Summary of the discussion:

In line with Article 6.3 of the Draft Contract, no Background Intellectual Property and no Third-Party Intellectual Property Rights will be used to achieve the objectives of the work. We will use only public general science knowledge and findings.

NP-17 Status: Closed.

**NP-18**: The request to provide details on the Foreground Intellectual Property Rights to be developed at the end of the activity has not been clearly understood and therefore not clearly identified in the proposal. The FIPR should be clarified.

Furthermore, it shall be confirmed that the Prime will own the developed IPR since it should own all FIPR developed under the activity: all FIPR developed under the frame of this call should remain within the country funding the program and any transfer outside of the country should be in line with the terms of the draft contract (Clauses 6.5) and in particular “The Contractor shall not transfer any Intellectual Property Rights arising from work performed under the Contract which the Contractor owns to any entity outside Slovakia without seeking the prior written authorisation of the Agency.”. It shall be clarified the details of the agreement to be reached (if any) between the prime and the participating subcontractors to the project, in relation to the Intellectual Property Rights and the principles for its exploitation, use and benefits.

Response inputs provided before the negotiation meeting:

We identified following FIP:

1. Computer algorithms developed for automated data processing, heliocentric potential calculation, and forecasting.
2. **ESA SWESNET WEBSITE** PRODUCT proof-of-concept source code and documentation.
3. **Long-term space weather data** collected from the Lomnicky stit high mountain observatory neutron monitor

Summary of the discussion:

*1) The Contractor will own all Intellectual Property Rights and have the right to apply for, and to own, any Registered Intellectual Property Rights arising from Work performed under this Contract in line with the clause Articles 6.2.1 the draft Contract and*

*2) The Agency shall have an irrevocable right to use the information used in that application, for its own requirements on the terms set out in Article 6.2.2 the draft Contract.*

NP-18 Status: Closed.

| Summary: |
| --- |
| RPA Progress Reporting: Every 2 months<br>Tentative Kick Off meeting date: 05 February 2025<br>Tentative Starting Date: 03 February 2024 or counter signature of the contract.<br>Tentative End of Contract: 27 April 2026 |

Any Other Business:

- The bidder confirmed the full registration in esa-star has been / will be completed.
- The negotiation meeting is considered successful subject to closure of all pending negotiation points, signature of the minutes and final signature of the contract by both parties.

ANNEX 1 - SUMMARY TABLE

| | |
|---|---|
| Proposal Title : | ESADOS (ESA Support for Aircrew DOsimetry Services) |
| Duration (months) : | 15 |
| Contractor's Name : | Institute of Experimental Physics SAS |
| Subcontractor's Name : | Nuclear Physics Institute of the CAS |
| Bidder/Vendor Codes of Contractor and Subcontractor(s) | IEP SAS ESA Entity Code 1000025275<br>NPI CAS ESA Entity Code: 1000003679 |
| Firm Fixed Price (€) : | 92774.64 EUR |
| Signatory + Position/title : | Doc. RNDr. Zuzana Gažová, DrSc. |
| Technical Representative : | Ján Kubančák, Ph.D. |
| Contractual Representative : | Ján Kubančák, Ph.D. |
| Start dates : | November 1, 2024 |
| Final delivery Date: | January 30, 2025 |
| Background IPR: | |

ANNEX 2 - MILESTONE PAYMENT PLAN (same as per contract)

| Milestone (MS) Description | Schedule Date | Payments from ESA to (Prime) Contractor (in Euro) | Country (ISO code) |
|---|---|---|---|
| | | | |
| **Progress Payment (MS 1): Upon successful completion of WP201 and WP202 and successful review and acceptance by the Agency of all related deliverable items D201.1, D201.2, D202.3 and D202.4** | **To + 4 months** | 30 000.00 | SK |
| **Progress Payment (MS 2): Upon successful completion of WP204 and successful review and acceptance by the Agency of all related deliverable items D204.1 and D204.2** | **T0 + 9 months** | 20 821.20 | SK |
| **Final Settlement (MS 3): 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 Contract Closure Documentation** | **To + 15 months** | 42 000.00 | SK |
| **TOTAL** | | 92821.20 | |

## ANNEX 3 – TABLES OF DELIVERABLES

Documentation

| Doc ID | Title | Milestone | Description of documents * |
|---|---|---|---|
| D201 | WP201 final report | WP201 finished | Document is the survey of all expertise, consultancy and review activities done by the NPI CAS. It will be logically divided into the following sections:<br>• introduction with description of the goals of the workpackage<br>• description of the models that were selected in D202.1<br>• review of the models and proposed methods by the the IEP SAS experts in D201.1<br>• proposal of methodology for validation of the model(s) for determination of cosmic rays and assessment of the models<br>• requirements on content and range of NPI experimental date from measurements of ambient dose equivalent onboard aircraft |
| D202.1 | Mathematical models for determination of heliocentric potential data from Lomnicky stit neutron monitor data | WP202 finished | Document contains the description of mathematical models that will be used for determination of heliocentric potential from Lomnicky stit neutron monitor data. The algorithms are based on scientific publications, i.e. on:<br>*K. O'Brien, W. Friedberg, Herbert H. Sauer, D.F. Smart, Atmospheric cosmic rays and solar energetic particles at aircraft altitudes, Environment International, Volume 22, Supplement 1, 1996, Pages 9-44, ISSN 0160-4120, https://doi.org/10.1016/S0160-4120(96)00086-4*<br>• introduction with description of the goals of the workpackage<br>• description of current status in the field and reasoning of model selection<br>• description of selected model, its parameters and way, how to use in in the Lomnicky stit neutron monitor conditions |
| D202.2 | Experimental input data range and format requirements | Mathematical models completed | Document contains a short survey of all requirements on format and range of experimental data from real flight measurements onboard aircraft that will be provided by NPI CAS in the work package WP301.<br>• introduction with description of the goals of the workpackage<br>• requirements on content and range of NPI experimental data from measurements of ambient dose equivalent onboard aircraft |
| D202.4 | WP202 final report | WP202 finished | Document contains overview of all tasks performed within the work package WP202 and results achieved, namely:<br>• introduction with description of the goals of the workpackage WP202 |

| Doc ID | Title | Milestone | Description of documents * |
|---|---|---|---|
| | | | • description of current status in the field and reasoning of model selection<br>• description of selected model, its parameters and way, how to use in in the Lomnicky stit neutron monitor conditions<br>• introduction with description of the goals of the workpackage<br>• requirements on content and range of NPI experimental data from measurements of ambient dose equivalent onboard aircraft |
| D204 | WP204 final report | WP204 finished | Document contains overview of all tasks performed within the work package WP204 and results achieved, namely:<br>• introduction with description of the goals of the workpackage<br>• proposal of automation processes and computer algorithms for determination of heliocentric potential from Lomnicky stit neutron monitor live data<br>• proposal of data processing, archiving and back-up of computed heliocentric potential data<br>• proposal of ESA SWESNET WEB PRODUCT web site for publication of heliocentric potential data |
| D301.2 | WP301 final report | WP301 finished | Document contains description of data from measurements of ambient dose equivalent onboard aircraft provided to IEP SAS by the NPI CAS in the data file (D301.1). |
| D302.2 | WP302 final report | WP302 finished | Document contains a description of dataset, which is the result of CARI calculations of H*(10) for the NPI measurements of ambient dose equivalent onboard aircraft. |
| D303 | WP303 final report | WP303 finished | Report will contain results of the validation process of the models. It will contain:<br>• description of workpackage goals<br>• comparison of experimentally measured radiation doses with those calculated<br>• statistical comparison and agreement evaluation<br>• chapter devoted to final decision about the accuracy and precision of the models, and eligibility for their further use |
| D304 | Report from evaluation of validation of heliocentric potential models | WP304 finished | Document will contain a review of validation of the models from WP303. It will independently evaluate:<br>• eligibility of used methods<br>• supplement the information contained in the D303, if necessary<br>• |
| D404.1 | ESA SWESNET WEB PRODUCT proof of concept | WP404 finished | Proof of concept of the module for ESA SWESNET space weather network web. This will contain:<br>• description of the technologies used for creation of website<br>• description of communication of the website with |

| Doc ID | Title | Milestone | Description of documents * |
|---|---|---|---|
| | | | the database<br>• website source code |
| TDP | Technical Data Package | Final Review | As defined Appendix 1 to the Draft Contract |
| FR | Final Report | Final Review | see above |
| CCD | Contract Closure Documentation | Contract Closure | see above |
| FP | Final Presentation | Final Review | |

Other Deliverables (Hardware, Software, Models, Data, etc.)

| Item Identifier | Title | Milestone | Quantity to be delivered | Format / Description |
|---|---|---|---|---|
| D204.1 | Computer algorithms | WP204 finished | 1 pc | Data set delivered in compressed archive file via esa-p SAP portal. |
| D301.1 | Experimental data | Mathematical models completed | 1 pc | Data set delivered in compressed archive file via esa-p SAP portal. |
| D302.1 | Dataset – output from calculations | WP 302 finished | 1 pc | Data set, which contains result of dose equivalent calculations for the flights, on which the dose equivalent was measured by the NPI CAS. The calculations in the data set are performed by the IEP SAS using the CARI code. |
| D404.2 | ESA SWESNET WEB PRODUCT | Web Product Source code | 1pc | ESA SWESNET WEB PRODUCT proof-of-concept source code |

ANNEX 4 – DESCRIPTION OF ALGORHITMS THAT ARE PLANNED TO BE USED TO ACHIEVE GOALS OF THE PROJECT.

Description of the algorithms that are planned to be used in the project is relatively comprehensive and hence we decided to place it into separated document, which will be an attachment of this MoM. The document will be named: ESADOS – Brief survey of algorithms and will be sent as the PDF file of the identical name:

ESADOS – Brief survey of algorithms.pdf

ANNEX 5 – SIGNED PSS FORMS

Respective signed PSS forms are located in pages below.

SLOVAK ACADEMY OF SCIENCES
INSTITUTE OF EXPERIMENTAL PHYSICS
LOMNICKÝ ŠTÍT HIGH MOUNTAIN OBSERVATORY

# ESADOS

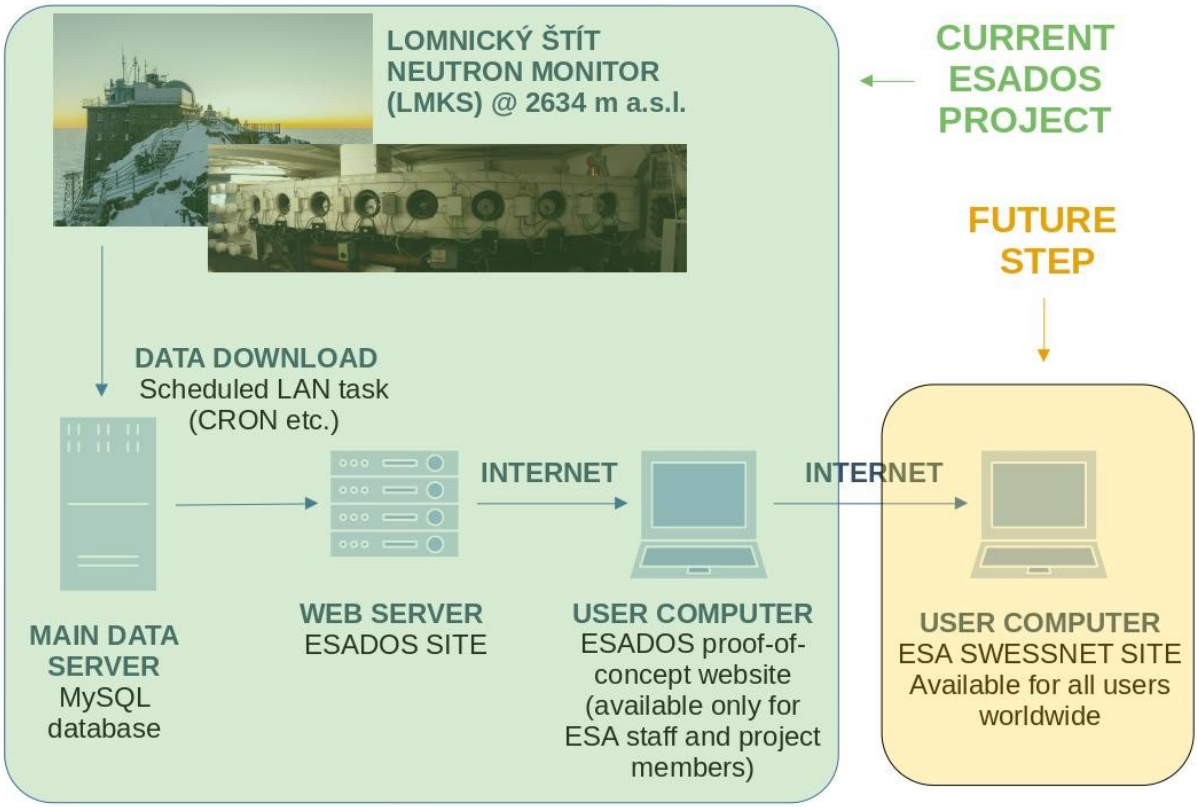
## BRIEF SURVEY OF ALGORITHMS

Elaborated by: Ján Kubančák, Ph.D.
Elaborated on: 12/28/2024
Version: 1.0
Number of pages: 9

# Table of Contents

# 1 Neutron monitor data retrieving algorithms

Neutron monitor data are stored on our data server in mysql database. Data will we periodically downloaded at the end of each month using the scheduled task script. For this purpose, we expect to use standard Linux scheduled task CRON scripts as a simpliest solution of the problem.




After data downloading, anothe script written will calculate the value of heliocentric potential using the calibration equation based (see section 2 of this document) and store it further into the back-end database related to the web-site frontend. Consequently, the website will display the new data in its user interface (see section 3).

# 2 Determination of heliocentric potential from neutron monitor response

The heliocentric potential is the result of a steady-state solution to the diffusion equation of cosmic rays through the solar wind. **The counting rate of any high-latitude, ground-level neutron monitor can be used to determine this potential, which will return cosmic ray spectra in real time. These spectra are routinely used to determine the radiation dose rate to which air crew are exposed during the precise hours of a flight, including the effects of quick decreases and Forbush decreases[1].**

## 2.1 Heliocentric potential during average solar conditions

Behavior of cosmic rays in the heliosphere is determined by following equation:

$$\partial D/\partial t + \nabla f \bullet \bar{S} + \left(\frac{1}{P^2}\right)\frac{\partial}{\partial P}\left(p^2\langle \dot{P}\rangle D\right) = 0$$

where

$$\bar{S} = 4\pi P^2 (C\bar{V}D - \bar{K}f \bullet \nabla)D$$

and where D is the cosmic ray phase-space density, P is the cosmic ray rigidity, S is the differential current density, V the solar wind velocity, K the diffusion tensor at some location r and time t in the heliosphere and <P> is the adiabatic rate of rigidity loss.

Following Caballero-Lopez and Moraal entering the flux and momentum loss terms int equations and imposing spherical symmetry on the resulting equations leads eventually (a long development is collapsed here to a few lines) to a partial differential equation for the stationary state:

$$V\frac{\partial D}{\partial r} - \frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\kappa\partial\frac{\partial D}{\partial r}\right) - \frac{1}{3r^2}\frac{\partial}{\partial r}(r^2 V)P\frac{\partial D}{\partial P} = 0.$$

Here, K has been reduced to a single radial coefficient, *k*, because of the imposition of spherical symmetry, the diffusion coefficient, κ= $4.38 \times 10^{22}\, \mathrm{P}^2/\sqrt{\mathrm{P}^2 + m^2}$,

wind velocity, V = 400 km $s^{-1}$. Equation has been solved numerically with these values, assuming that the heliopause is at 90 AU, and it has been compared with both the heliocentric potential model and the convection diffusion model.

The former is an approximate stationary solution to Equations 1 and 2 that arises under spherical symmetry when the adiabatic energy loss rate is assumed to be zero. Applying Liuouville's Theorem, one gets:

1 O'Brien K, Felsberger E, Kindl P. Application of the heliocentric potential to aircraft dosimetry. Radiat Prot Dosimetry. 2005;116(1-4 Pt 2):336-42. doi: 10.1093/rpd/nci090. PMID: 16604656.

$$\varphi(E) = \varphi(T)\left[\frac{P(E)}{P(T)}\right]^2$$

where φ(T) is the local interstellar flux and φ(E) is the local cosmic ray flux.

**Since**

$$U = \frac{V(r_b - r)}{3\kappa}$$

**where U is the heliocentric potential, $r_b$ is the location of the heliopause, r is the point of interest, i.e. the Earth's or 1AU, this combination of cosntants yields a heliocentric potential of 407 MV.**

## 2.2 Heliocentric potential during Forbush decreases and other solar events periods

The average value of heliocentric potential determined for average conditions varies with onset of various solar events. These events reflect in change of observed quantities of many instruments intended for observation of space weather with ground based neutron monitors among them.

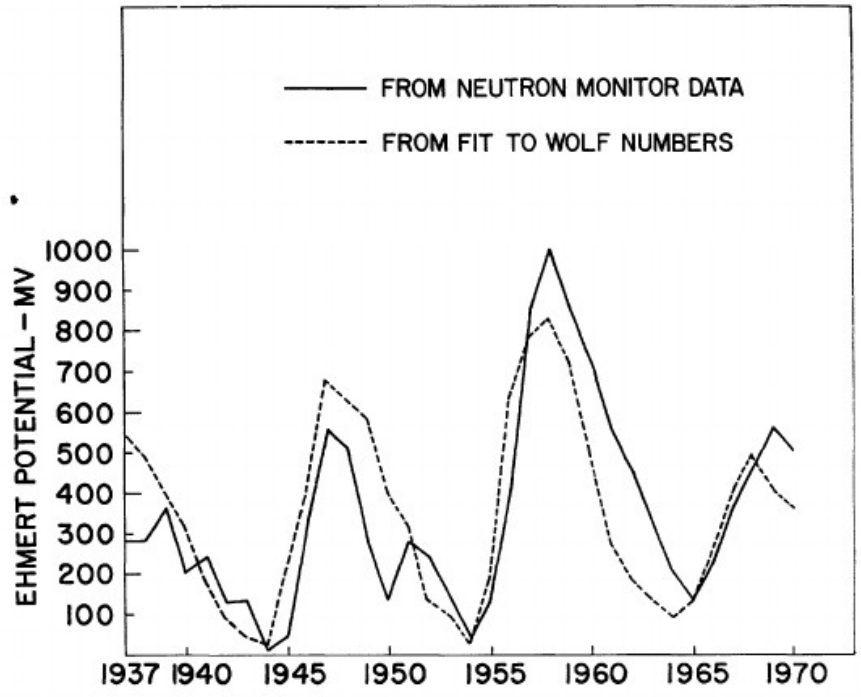
To find a relation between the current value of heliocentric potential and the response of the neutron monitor, one has to determine the neutron monitor response functions, i.e. to determine the relation beween the count rate and value of the neutron monitor count rate.

Such a work has been done e.g. by the Keran O'Brien and Gail de P. Burke[2]. In the table below (see footnote 2 for more details), there is a calibration function for Deep River, Alert, Goose Bay and Inuvik neutron monitors as a function of heliocentric (Ehmert) potential.

| Potential, Mv | Deep River | Alert | Goose Bay | Inuvik |
|---|---|---|---|---|
| 0 | $2.247 \times 10^5$ | $8.114 \times 10^5$ | $7.741 \times 10^5$ | $7.542 \times 10^5$ |
| 50 | $2.208 \times 10^5$ | $7.976 \times 10^5$ | $7.611 \times 10^5$ | $7.408 \times 10^5$ |
| 134 | $2.147 \times 10^5$ | $7.766 \times 10^5$ | $7.411 \times 10^5$ | $7.198 \times 10^5$ |
| 200 | $2.104 \times 10^5$ | $7.610 \times 10^5$ | $7.262 \times 10^5$ | $7.057 \times 10^5$ |
| 300 | $2.046 \times 10^5$ | $7.399 \times 10^5$ | $7.060 \times 10^5$ | $6.860 \times 10^5$ |
| 500 | $1.948 \times 10^5$ | $7.040 \times 10^5$ | $6.719 \times 10^5$ | $6.525 \times 10^5$ |
| 700 | $1.864 \times 10^5$ | $6.740 \times 10^5$ | $6.433 \times 10^5$ | $6.246 \times 10^5$ |
| 1000 | $1.769 \times 10^5$ | $6.377 \times 10^5$ | $6.087 \times 10^5$ | $5.905 \times 10^5$ |

*Calculated Neutron Monitor Counting Rates (counts/hr) as a Function of Solar Modulation Expressed in Terms of the Ehmert Potential. Table taken from O'Brien, K., and G. Burke (1973)[2]*

2 O'Brien, K., and G. Burke (1973), Calculated cosmic ray neutron monitor response to solar modulation of galactic cosmic rays, J. Geophys. Res., 78(16), 3013–3019, doi:10.1029/JA078i016p03013.




*Plot of Wolf number vs. Ehmert potential. Figure was taken from O'Brien, K. (1977)*[3]

## 2.3 Algorithms for determination of heliocentric potential from the Lomnicky stit neutron monitor response

As can be seen from previos sections, exact value of the heliocentric potential depends often on assumptions that were used to solve the force-field model differential equations. As the influence of the cosmic rays component with energies below 50 MeV can be neglected, we decided that we will determine the calibration function of our neutron monitor with cross-calibration with neutron monitors used by CARI code developers.

Hence, the algorithm for determination of the heliocentric potential from the Lomnicky stit neutron monitor data is as follows:

1. Download of historical month values of the heliocentric potential from the FAA website available for periods from 1958 until nowadays at:

   https://www.faa.gov/data_research/research/med_humanfacs/aeromedical/radiobiology/heliocentric

2. Selection of monthly heliocentric potential data for periods from 1981 until nowadays, i.e. for periods when our neutron monitor was working
3. Creation of a plot of a dependence of the heliocentric potential as a function of monthly averaged Lomnicky stit neutron monitor count rate.

3 Brien, K. (1977) Use of the Wolf number to estimate solar modulation (EML--335). United States

4. Determination of the relation between heliocentric potential and the Lomnicky stit neutron monitor function using the linear regression function f($x$) = a$x$ + b

# 3 Verification of the Lomnicky stit heliocentric potential data

The verification itself will be realized by calculating the effective doses for real flights with detectors from the past provided by the Nuclear Physics Institute of the Academy of Sciences of the Czech Republic. Algorithmic survey of this activity is as follows:

1. Selection from 50 – 100 flights with the detector
2. Determination of dose for these flights using the CARI code and the values of heliocentric potential
3. Comparison of measured and calculated values.

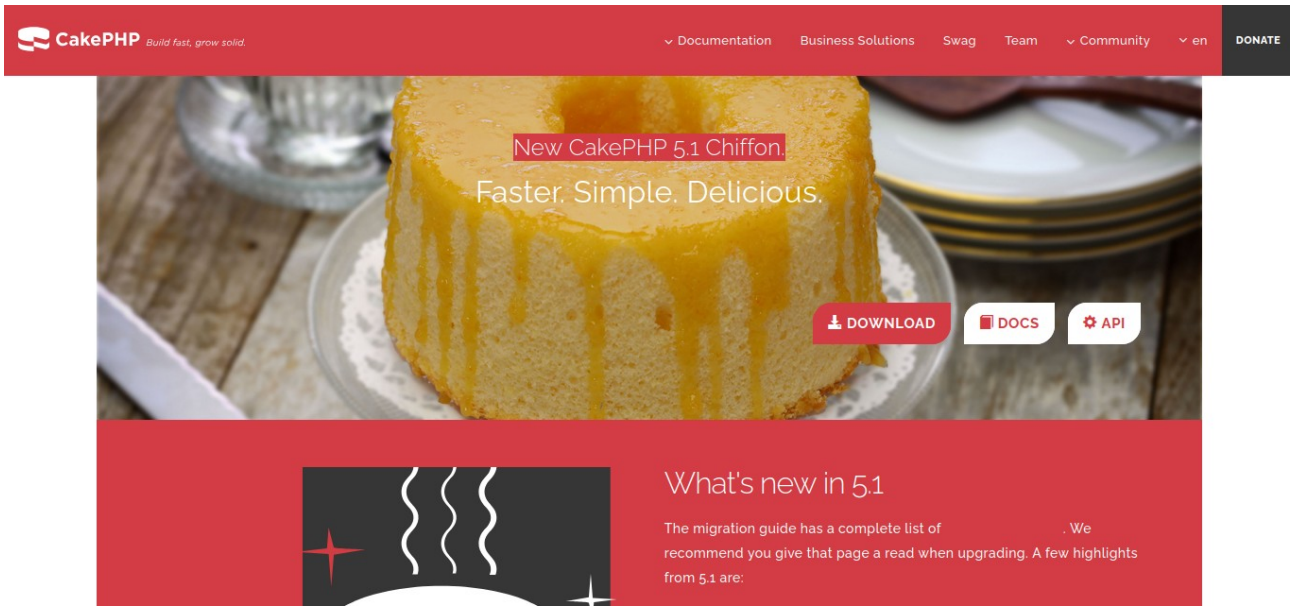
As the uncertainty of CARI code calculation is about 25%, the result of the verification will be consdered to be successful, if the agreement will be better than 25%.

# 4 Publication of data

Proof-of-concept available in the form of the website will be available only for ESA staff related to the ESADOS project and to the ESADOS project team members. The website frontend will be created using the CakePHP framework (https://cakephp.org/).

Reasons for selecting this framework are as follows:

- **our previous good experience with this framework**
- powerfull features and simplicity of the framework
- its availability under MIT License



| **COMPANY RATES AND OVERHEADS** | FORM No. **PSS A1** | Page no. | of | Issue 5 |
|---|---|---|---|---|
| | | COMPANY NAME: | Institute of Experimental Physics, Slovak Academy of Sciences | |
| RFQ/ITT no.: | ESA AO/5-50055/23/NL/MH/yd | | | |
| PROPOSAL no.: | | Name and title: | doc. RNDr. Zuzana Gažová, DrSc. | |
| ECONOMIC CONDITIONS: | 2024 | | | |
| NATIONAL CURRENCY (NC): | EUR | Signature: | Zuzana Gažová | Digitálne podpísal Zuzana Gažová Dátum: 2025.03.13 09:37:01 +01'00' |
| VALIDITY PERIOD : | From. XII/2024 To. II/2026 | | | |
| ESA Audit agreement reference / date | | | | |

Agreed by

Status (x when applicable)

1. LABOUR

| *Direct labour cost centres or categories Code and Name* | | *Basic Hourly Rate (NC)* | *Direct Overhead (% or Rate in NC)* | *Gross Hourly Rate (NC)* |
|---|---|---|---|---|
| | Project manager & scientist | 15,30 | 0,00 % | 15,30 |
| | Scientist | 15,30 | 0,00 % | 15,30 |
| | Associate scientist | 12,80 | 0,00 % | 12,80 |
| | IT engineer | 15,30 | 0,00 % | 15,30 |
| | Associate engineer 1 | 12,80 | 0,00 % | 12,80 |
| | Associate engineer 2 | 12,80 | 0,00 % | 12,80 |
| | Administration specialist / Technical writer | 13,50 | 0,00 % | 13,50 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

2. INTERNAL SPECIAL FACILITIES

| *Facility Code and Name* | | *Type of Unit* | *UNIT RATE (NC)* |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

3. OTHER COST ELEMENTS

| *Standard ESA type* | | *According to normal company type* | *OVERHEAD %* |
|---|---|---|---|
| 3,1 | Raw materials | | |
| 3,2 | Mechanical parts | | |
| 3,3 | Semi-finished products | | |
| 3,4 | Electric & electronic components | | |
| 3,5 | Hirel parts | | |
| | a) procured by company | | |
| | b) procured by 3rd party | | |
| 3,6 | External major products | | |
| 3,7 | External services | | |
| 3,8 | Transport, insurance | | |
| 3,9 | Travels | | |
| 3,10 | Miscellaneous | | |
| | | | |

GENERAL EXPENSES

| *According to ESA type* | *ording to normal company t* | *Applicable on cost element no.* | *OVERHEAD %* |
|---|---|---|---|
| 5. General & Administration expenses | | Whole project | 7,00 % |
| 6. Research & Development expenses | | Whole project | 12,00% |
| 7. Other (specify) | | | |
| | | | |

**COMPANY PRICE BREAKDOWN FORM** | **EXHIBIT "A" TO PSS A2** | Issue 5

Page No. | No. of Pages

| | |
|---|---|
| RFQ/ITT No.: | **ESA AO/5-50055/23/NL/MH/yd** |
| Proposal/Tender No.: | ESADOS |
| National Currency: | EUR |
| Contractual Phase | |

**Applicable to PSS-A2 elements: 3.1-3.4 - 3.6 - 3.7 - 3.10 - 10**

**Project / Work Packages**

COMPANY NAME: **Institute of Experimental Physics, Slovak Academy of Sciences**

Name and Title: **doc. RNDr. Zuzana Gažová, CSc.**

Signature

Zuzana Gažová

Digitálne podpísal Zuzana Gažová
Dátum: 2025.03.13 16:04:20 +01'00'

| Cost El. No. | ITEM DESCRIPTION | Type of Price | Purchase Currency | Purchase Amount | Exchange rate 1 NC = | Amount in NC |
|---|---|---|---|---|---|---|
| | | | | | | |

**TRAVEL PLAN AND COST DETAIL** **EXHIBIT "B" TO PSS-A2** Issue 1

| | | | |
|---|---|---|---|
| RFQ/ITT No.: | ESA AO/5-50055/23/NL/MH/yd | Project: | **ESADOS** |
| Proposal/Tender No.: | ESADOS | Company: | **Institute of Experimental Physics, Slovak Academy of Sciences** |
| Contractual Phase | | | |
| Economic Condition: | 2024 | Type of Price: | FFP |
| National Currency (NC)*: | **EUR** | Exchange (**X**): 1 EURO = | 1 EUR |

Zuzana Gažová

| WP Reference Number | WP Title | Purpose/Event | Departure | Destination | Nr. of Trips | Avg.People per Trip | Travel Cost p.p. (NC) | B / E | Avg.Days per Trip | Subsistence Cost p.d. (NC) | A / R | Total Cost (NC) | Total Cost (EURO) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WP101 | Management and reporting | Final meeting | Poprad, SK | ESTEC, Noordwijk, NL | 1 | 1 | 500 | E | 2 | 250 | A | 1 250 | 1 250 |
| WP202 | Creation of models for determination and forecast of heliocentric potential | Work meeting related to the heliocentric potential model creation | Poprad, SK | NPI CAS, Prague, Czech Republic | | 2 | 100 | | 2 | 150 | | 800 | 800 |
| WP302 | Calculation of exposures related to NPI CAS real flight measurements using the CARI code | Evaluation of results achieved within the work package, preparation of WP302 final report. | Poprad, SK | NPI CAS, Prague, Czech Republic | | 2 | 100 | | 2 | 150 | | 800 | 800 |
| | | | | | | | | | | | | | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
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| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
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| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
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| | | | | | | | | | | | | 0 | 0 |
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| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| | | | | | | | | | | | | 0 | 0 |
| **Total Cost, WBS level 1 (equal to the item 3.9 of PSS-A2)** | | | | | | | | | | | | **2 850** | **2 850** |

| COMPANY PRICE BREAKDOWN FORM | | Form No. PSS A2 | | Page no. | of | Issue 5 |
|---|---|---|---|---|---|---|
| RFQ/ITT No.: | ESA AO/5-50055/23/NL/MH/yd | | COMPANY | | | |
| Proposal/Tender No.: | ESADOS | | Name: | Institute of Experimental Physics, Slovak Academy of Sciences | | |
| Type of Price: | FFP | Firm Fixed Price | Country: | Slovakia | | |
| Economic Condition: | 2024 | | | | | |
| National Currency (NC): | EURO | | Representative | director | | |
| Exchange Rate (X): | 1 EURO = | 1,00000 EURO | Name and Title: | doc. RNDr. Zuzana Gažová, CSc. | | |
| Contractual Phase: | | | Signature: | Zuzana Gažová Digitálne podpísal Zuzana Gažová Dátum: 2025.03.13 11:39:17 +01'00' | | |
| Project/Work Package(s): | | | | | | |

| | | | | | | | TOTAL (NC) EURO | TOTAL (EURO) NC / X |
|---|---|---|---|---|---|---|---|---|
| | **LABOUR** | | | | | | | |
| *Direct Labour cost centres or categories Code / Description* | | *No. of FTE (calculated) U = W / V* | *Sold Hours per ManYear V* | *Manpower Effort No. of Hours W* | *Gross Hourly Rate in NC* | | | |
| | Project manager & scientist | 0,6 | 1 920 | 1 096 | 15,30 | | 16 768,80 | 16 768,80 |
| | Scientist | 0,3 | 1 920 | 528 | 15,30 | | 8 078,40 | 8 078,40 |
| | Associate scientist | 0,3 | 1 920 | 520 | 12,80 | | 6 656,00 | 6 656,00 |
| | IT engineer | 0,3 | 1 920 | 512 | 15,30 | | 7 833,60 | 7 833,60 |
| | Associate engineer 1 | 0,3 | 1 920 | 520 | 12,80 | | 6 656,00 | 6 656,00 |
| | Associate engineer 2 | 0,3 | 1 920 | 514 | 12,80 | | 6 579,20 | 6 579,20 |
| | Administration specialist / Technical writer | 0,3 | 1 920 | 528 | 13,50 | | 7 128,00 | 7 128,00 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| **1** | Total Direct Labour Hours and Cost | *2,2* | | *4218,0* | | **A** | *59 700,00* | *59 700,00* |
| | **INTERNAL SPECIAL FACILITIES** | | | | | | | |
| *Code* | *Description* | | *Type of unit* | *No. of units* | *Unit rates in NC* | | | |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| **2** | *Total Internal Special Facilities Cost* | | | | | **B** | *0,00* | *0,00* |
| | **OTHER DIRECT COST ELEMENTS** | *Base amounts in NC* | *+ OH %* | *OH amounts in NC* | | | | |
| 3,1 | Raw materials | | | | | | 0,00 | 0,00 |
| 3,2 | Mechanical parts | | | | | | 0,00 | 0,00 |
| 3,3 | Semi-finished products | | | | | | 0,00 | 0,00 |
| 3,4 | Electrical & electronic components | | | | | | 0,00 | 0,00 |
| 3,5 | HIREL parts | | | | | | | |
| | a) procured by company | | | | | | 0,00 | 0,00 |
| | b) procured by third party | | | | | | 0,00 | 0,00 |
| 3,6 | External Major Products | | | | | | 0,00 | 0,00 |
| 3,7 | External Services | | | | | | 0,00 | 0,00 |
| 3,8 | Transport and Insurances | | | | | | 0,00 | 0,00 |
| 3,9 | Travel and Subsistence | 2 850 | | | | | 2 850,00 | 2 850,00 |
| 3,10 | Miscellaneous | | | | | | 0,00 | 0,00 |
| *3* | *Total Other Direct Cost* | *2 850,00* | | | | **C** | *2 850,00* | *2 850,00* |
| **4** | **SUB-TOTAL DIRECT COST** | | | | **(A+B+C)** | **D** | **62 550,00** | **62 550,00** |
| | **GENERAL EXPENSES** | *Cost items to which % applies* | | *Base Amount in NC* | *OH %* | | | |
| 5 | General & Administration Expenses | A+C | | 62 550 | 19,0% | **E** | 11 884,50 | 11 884,50 |
| 6 | Research & Development Expenses | | | | | **F** | 0,00 | 0,00 |
| 7 | Other | | | | | **G** | 0,00 | 0,00 |
| **8** | **TOTAL COMPANY COST** | | | | **D+(E+F+G)** | **H** | **74 434,50** | **74 434,50** |
| | | *Cost items to which % applies* | | *Base Amount in NC* | *%* | | | |
| **9** | PROFIT | | | 0,0 | 0,0% | **I** | **0,00** | **0,00** |
| **10** | COST WITHOUT ADDITIONAL CHARGE | | | | | **J** | | 0,00 |
| **11** | FINANCIAL PROVISION FOR ESCALATION | | | | | **K** | | 0,00 |
| **12** | **TOTAL COMPANY PRICE** | | | | **(H+I+J+K)** | **L** | **74 434,50** | **74 434,50** |
| **13** | TOTAL SUB-CONTRACTOR PRICE | | | | | **M** | 18 386,70 | 18 386,70 |
| **14** | REDUCTION for COMPANY CONTRIBUTION | | | | | **N** | | 0,00 |
| **15** | **TOTAL PRICE FOR ESA** | | | | **(L+M-N)** | | **92 821,20** | **92 821,20** |

If insufficient space is available to identify all required information, please use additional sheet or insert lines

**COMPANY MANPOWER AND PRICE SUMMARY PER WP** Form no. **PSS A8** Issue 5

| | | | |
|---|---|---|---|
| ITT/RFQ: | ESA AO/5-50055/23/NL/MH/yd | Price Type: | |
| Proposal/Tender No.: | | Economic | |
| Company Name: | Institute of Experimental Physics SAS | National | EUR |
| Contractual Phase: | | Exchange Rate: | 1,00 EUR |
| WBS-Level (Number and Title): | | | |

Zuzana Gažová — Meno a priezvisko: Zuzana Gažová; Dátum: 2025.03.13 09:22:02 +01'00'

| WP Title | | Management and reporting | Expertise, consultancy and review activities related to the heliocentric potential model creation | Creation of models for determination and forecast of heliocentric potential | Implementation of automation of data processing, publishing and archiving processes | Preparation of experimental data from radiation exposure measurements on-board aircraft into requested formats | Calculation of doses related to NPI CAS real flight measurements using the CARI code | Validation of models | Evaluation of the validation of the model | ESA SWESNET WEB PRODUCT proof – of - concept | | Total WBS-Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WP Number | | WP101 | WP201 | WP202 | WP204 | WP301 | WP302 | WP303 | WP304 | WP404 | | |
| Labour Hours per category | Hours | | | | | | | | | | | |
| Project manager & scientist | # | 472 | | 152 | 96 | | 96 | 120 | | 160 | | 1 096 |
| Scientist | # | | | 96 | 120 | | 120 | 120 | | 72 | | 528 |
| Associate scientist | # | | | 80 | 120 | | 120 | 120 | | 80 | | 520 |
| IT engineer | # | | | | 112 | | 200 | | | 200 | | 512 |
| Associate engineer 1 | # | | | 80 | 120 | | 120 | 120 | | 80 | | 520 |
| Associate engineer 2 | # | | | 42 | 152 | | 120 | 120 | | 80 | | 514 |
| Administration specialist / Technical writer | # | 96 | | 96 | 96 | | 96 | 96 | | 48 | | 528 |
| ... | # | | | | | | | | | | | |
| Total Labour Hours | # | 568 | | 546 | 816 | | 872 | 696 | | 720 | | 4 218 |
| 1. Total Labour Cost | NC | 8 517,60 | | 7 676,00 | 11 332,00 | | 12 268,80 | 9 576,00 | | 10 329,60 | | 59 700,00 |
| 2. Internal Special Facilities Cost | NC | | | | | | | | | | | |
| 3.1-3.4 Material Costs | NC | | | | | | | | | | | 0,00 |
| 3.5 High Rel Parts Costs | NC | | | | | | | | | | | |
| 3.6 External Major Products Cost | NC | | | | | | | | | | | |
| 3.7 External Services Cost | NC | | | | | | | | | | | |
| 3.8 Transport/Insurance Cost | NC | | | | | | | | | | | |
| 3.9 Travel and Subsistence Cost | NC | 1 250,00 | | 800,00 | | | 800,00 | | | | | 2 850,00 |
| 3.10 Miscellaneous Cost | NC | | | | | | | | | | | |
| 3. Total Other Costs (sum of above 3.x) | NC | | | | | | | | | | | |
| 4. Sub-Total Direct Cost | NC | | | | | | | | | | | |
| 5.- 7. General expenses | NC | 4 378,50 | | 1 501,20 | 1 501,20 | | 1 501,20 | 1 501,20 | | 1 501,20 | | 11 884,50 |
| 8. Sub-Total Company Cost | NC | | | | | | | | | | | |
| 9. Profit Fee | NC | | | | | | | | | | | |
| 10. Cost without additional charge | NC | | | | | | | | | | | |
| 11. Financial Provision for escalation | NC | | | | | | | | | | | |
| 12. Total Company Price | NC | 14 146,10 | | 9 977,20 | 12 833,20 | | 14 570,00 | 11 077,20 | | 11 830,80 | | 74 434,50 |
| | EURO | 14 146,10 | | 9 977,20 | 12 833,20 | | 14 570,00 | 11 077,20 | | 11 830,80 | | 74 434,50 |
| 13. Total Sub-Contractors Price | NC | | 122 113,53 | | | 195 533,58 | | | 123 711,33 | | | 441 358,44 |
| | EURO | | 5 087,17 | | | 8 145,79 | | | 5 153,74 | | | 18 386,70 |
| 14. Reduction for Company contribution | NC | | | | | | | | | | | |
| 15. Total Price for ESA | NC | 14 146,10 | | 9 977,20 | 12 833,20 | | 14 570,00 | 11 077,20 | | 11 830,80 | | 74 434,50 |
| | EURO | 14 146,10 | 5 087,17 | 9 977,20 | 12 833,20 | 8 145,79 | 14 570,00 | 11 077,20 | 5 153,74 | 11 830,80 | | 92 821,20 |

If more than 12 WPs are to be reported, then duplicate the form as necessary, do not add columns.

If Labour Categories require more lines, please add as necessary.

| COMPANY RATES AND OVERHEADS | FORM No. **PSS A1** | Page no. 1 of 1 | Issue 5 |
|---|---|---|---|
| | | COMPANY | Nuclear Physics Institute of the CAS |
| RFQ/ITT no.: | ESA AO/5-50001/22/NL/SC | | |
| PROPOSAL no.: | ESADOS | Name and title: | Ing. Ondřej Svoboda, Ph.D. |
| ECONOMIC CONDITIONS: | 2024 | | Director |
| NATIONAL CURRENCY (NC): | CZK | Signature: | Digitálně podepsal Ing. Ondřej Svoboda, Ph.D. Datum: 2025.03.17 11:42:02 +01'00' |
| VALIDITY PERIOD : | From. 2024-10-01 To. 2025-12-31 | | |
| ESA Audit agreement reference / date | | | |

Agreed by

Status (x when applicable)

1. LABOUR

| *Direct labour cost centres or categories Code and Name* | | *Basic Hourly Rate (NC)* | *Direct Overhead (% or Rate in NC)* | *Gross Hourly Rate (NC)* |
|---|---|---|---|---|
| LC1 | Senior researcher | 503,11 | 44,80% | 728,50 |
| LC2 | Junior researcher | 402,22 | 44,80% | 582,41 |
| LC3 | PhD student | 303,83 | 44,80% | 439,95 |

2. INTERNAL SPECIAL FACILITIES

| *Facility Code and Name* | | *Type of Unit* | *UNIT RATE (NC)* |
|---|---|---|---|

3. OTHER COST ELEMENTS

| *Standard ESA type* | | *According to normal company type* | *OVERHEAD %* |
|---|---|---|---|
| 3,1 | Raw materials | Raw materials | 0 |
| 3,2 | Mechanical parts | Mechanical parts | 0 |
| 3,3 | Semi-finished products | Semi-finished products | 0 |
| 3,4 | Electric & electronic components | Electrical & electronic components | 0 |
| 3,5 | Hirel parts | HIREL parts | 0 |
| | a) procured by company | a) procured by company | 0 |
| | b) procured by 3rd party | b) procured by third party | 0 |
| 3,6 | External major products | External Major Products | 0 |
| 3,7 | External services | External Services | 0 |
| 3,8 | Transport, insurance | Transport and Insurances | 0 |
| 3,9 | Travels | Travel and Subsistence | 0 |
| 3,10 | Miscellaneous | Miscellaneous | 0 |
| | | | 0 |

GENERAL EXPENSES

| *According to ESA type* | *According to normal company type* | *Applicable on cost element no.* | *OVERHEAD %* |
|---|---|---|---|
| 5. General & Administration expenses | | | |
| 6. Research & Development expenses | | | |
| 7. Other (specify) | | | |
| | | | |

| COMPANY PRICE BREAKDOWN FORM | | | | Form No. PSS A2 | | Page no. 1 of 1 | | Issue 5 |
|---|---|---|---|---|---|---|---|---|
| RFQ/ITT No.: | ESA AO/5-50001/22/NL/SC | | | COMPANY | | | | |
| Proposal/Tender No.: | ESADOS | | | Name: | Nuclear Physics Institute of the CAS | | | |
| Type of Price: | FFP | Firm Fixed Price | | Country: | Czech Republic | | | |
| Economic Condition: | 2024 | | | | | | | |
| National Currency (NC): | CZK | | | Representative | | | | |
| Exchange Rate (X): | 1 EURO = | 24,00430 | CZK | Name and Title: | Ing. Ondřej Svoboda, Ph.D. | | | |
| Contractual Phase: | | | | Signature: | Digitálně podepsal Ing. Ondřej Svoboda, Ph.D. Datum: 2025.03.17 11:40:22 +01'00' | | | |
| Project/Work Package(s): | WP201, WP301, WP304 | | | | | | | |

| | | | | | | | TOTAL CZK | TOTAL NC / X |
|---|---|---|---|---|---|---|---|---|
| | **LABOUR** | | | | | | | |
| *Direct Labour cost centres or categories Code / Description* | | *No. of FTE (calculated) U = W / V* | *Sold Hours per ManYear V* | *Manpower Effort No. of Hours W* | *Gross Hourly Rate in NC* | | | |
| LC1 | Senior researcher | 0,142 | 1 792 | 255 | 728,50 | | 185 768,34 | 7 738,96 |
| LC2 | Junior researcher | 0,140 | 1 792 | 250 | 582,41 | | 145 603,64 | 6 065,73 |
| LC3 | PhD student | 0,140 | 1 792 | 250 | 439,95 | | 109 986,46 | 4 581,95 |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| **1** | Total Direct Labour Hours and Cost | *0,4* | | *755,0* | | **A** | *441 358,44* | *18 386,64* |
| | **INTERNAL SPECIAL FACILITIES** | | | | | | | |
| *Code* | *Description* | | *Type of unit* | *No. of units* | *Unit rates in NC* | | | |
| | 0 | | 0 | 0 | 0 | | 0,00 | 0,00 |
| | 0 | | 0 | 0 | 0 | | 0,00 | 0,00 |
| | 0 | | 0 | 0 | 0 | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| | | | | | | | 0,00 | 0,00 |
| **2** | *Total Internal Special Facilities Cost* | | | | | **B** | *0,00* | *0,00* |
| | **OTHER DIRECT COST ELEMEN** | *Base amounts in NC* | *+ OH %* | *OH amounts in NC* | | | | |
| 3,1 | Raw materials | | 20,0% | 0 | | | 0,00 | 0,00 |
| 3,2 | Mechanical parts | | | | | | 0,00 | 0,00 |
| 3,3 | Semi-finished products | | | | | | 0,00 | 0,00 |
| 3,4 | Electrical & electronic components | | | | | | 0,00 | 0,00 |
| 3,5 | HIREL parts | | | | | | | |
| | a) procured by company | | | | | | 0,00 | 0,00 |
| | b) procured by third party | | | | | | 0,00 | 0,00 |
| 3,6 | External Major Products | | | | | | 0,00 | 0,00 |
| 3,7 | External Services | | | | | | 0,00 | 0,00 |
| 3,8 | Transport and Insurances | | | | | | 0,00 | 0,00 |
| 3,9 | Travel and Subsistence | | | | | | 0,00 | 0,00 |
| 3,10 | Miscellaneous | | | | | | 0,00 | 0,00 |
| *3* | *Total Other Direct Cost* | *0,00* | | *0,00* | | **C** | *0,00* | *0,00* |
| **4** | **SUB-TOTAL DIRECT COST** | | | | **(A+B+C)** | **D** | **441 358,44** | **18 386,64** |
| | **GENERAL EXPENSES** | *Cost items to which % applies* | | *Base Amount in NC* | *OH %* | | | |
| 5 | General & Administration Expenses | | | | | **E** | 0,00 | 0,00 |
| 6 | Research & Development Expenses | | | | | **F** | 0,00 | 0,00 |
| 7 | Other | | | | | **G** | 0,00 | 0,00 |
| **8** | **TOTAL COMPANY COST** | | | | **D+(E+F+G)** | **H** | **441 358,44** | **18 386,64** |
| | | *Cost items to which % applies* | | *Base Amount in NC* | *%* | | | |
| **9** | PROFIT | | | 0,0 | 0,0% | **I** | **0,00** | **0,00** |
| **10** | COST WITHOUT ADDITIONAL CHARGE | | | | | **J** | 0,00 | 0,00 |
| **11** | FINANCIAL PROVISION FOR ESCALATION | | | | | **K** | 0,00 | 0,00 |
| **12** | **TOTAL COMPANY PRICE** | | | | **(H+I+J+K)** | **L** | **441 358,44** | **18 386,64** |
| **13** | TOTAL SUB-CONTRACTOR PRICE | | | | | **M** | 0,00 | 0,00 |
| **14** | REDUCTION for COMPANY CONTRIBUTION | | | | | **N** | 0,00 | 0,00 |
| **15** | **TOTAL PRICE FOR ESA** | | | | **(L+M-N)** | | **441 358,44** | **18 386,64** |

If insufficient space is available to identify all required information, please use additional sheet or insert lines

**COMPANY MANPOWER AND PRICE SUMMARY PER WP**



| | | | | | |
|---|---|---|---|---|---|
| ITT/RFQ: | ESA AO/5-50001/22/NL/SC | | | Price Type: | FFP |
| Proposal/Tender No.: | ESADOS | | | Economic Conditions: | 2024 |
| Company Name: | Nuclear Physics Institute of the CAS | | | National Currency (NC): | CZK |
| Contractual Phase: | | | | Exchange Rate: 1 EUR = | 24,00430 |
| WBS-Level (Number and Title): | 1 | ESADOS | | | |

| WP Title | | Expertise, consultancy and review activities related to the heliocentric potential model creation | Preparation of experimental data from radiation exposure measurements on-board aircraft into requested formats | Evaluation of the validation of the model | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WP Number | | WP201 | WP301 | WP304 | | | | | | | | | | Total WBS-Level |
| | | LS | LS | | | | | | | | | | | |
| Labour Hours per category | Hours | | | | | | | | | | | | | |
| LC1 Senior researcher | # | 75 | 100 | 80 | | | | | | | | | | 255 |
| LC2 Junior researcher | # | 66 | 120 | 64 | | | | | | | | | | 250 |
| LC3 PhD student | # | 66 | 120 | 64 | | | | | | | | | | 250 |
| | # | | | | | | | | | | | | | 0 |
| ... | # | | | | | | | | | | | | | 0 |
| ... | # | | | | | | | | | | | | | 0 |
| ... | # | | | | | | | | | | | | | 0 |
| ... | # | | | | | | | | | | | | | 0 |
| Total Labour Hours | # | 207 | 340 | 208 | | | | | | | | | | 755 |
| 1. Total Labour Cost | NC | 122 113,53 | 195 533,58 | 123 711,33 | | | | | | | | | | 441 358,4 |
| 2. Internal Special Facilities Cost | NC | | | | | | | | | | | | | 0 |
| 3.1-3.4 Material Costs | NC | | | | | | | | | | | | | 0 |
| 3.5 High Rel Parts Costs | NC | | | | | | | | | | | | | 0 |
| 3.6 External Major Products Cost | NC | | | | | | | | | | | | | 0 |
| 3.7 External Services Cost | NC | | | | | | | | | | | | | 0 |
| 3.8 Transport/Insurance Cost | NC | | | | | | | | | | | | | 0 |
| 3.9 Travel and Subsistence Cost | NC | | | | | | | | | | | | | 0 |
| 3.10 Miscellaneous Cost | NC | | | | | | | | | | | | | 0 |
| 3. Total Other Costs (sum of above | NC | 0,00 | 0,00 | 0,00 | | | | | | | | | | 0 |
| 4. Sub-Total Direct Cost | NC | 122 113,53 | 195 533,58 | 123 711,33 | | | | | | | | | | 441 358 |
| 5.- 7. General expenses | NC | | | | | | | | | | | | | 0 |
| 8. Sub-Total Company Cost | NC | | | | | | | | | | | | | 0 |
| 9. Profit Fee | NC | | | | | | | | | | | | | 0 |
| 10. Cost without additional charge | NC | | | | | | | | | | | | | 0 |
| 11. Financial Provision for escalation | NC | | | | | | | | | | | | | 0 |
| 12. Total Company Price | NC | 122 113,53 | 195 533,58 | 123 711,33 | | | | | | | | | | 441 358,44 |
| | EURO | 5 087,15 | 8 145,77 | 5 153,72 | | | | | | | | | | 18 386,64 |
| 13. Total Sub-Contractors Price | NC | 0,00 | 0,00 | 0,00 | | | | | | | | | | 0,00 |
| | EURO | 0,00 | 0,00 | 0,00 | | | | | | | | | | 0,00 |
| 14. Reduction for Company | NC | | | | | | | | | | | | | 0,00 |
| 15. Total Price for ESA | NC | 122 113,53 | 195 533,58 | 123 711,33 | | | | | | | | | | 441 358,44 |
| | EURO | 5 087,17 | 8 145,79 | 5 153,74 | | | | | | | | | | 18 386,70 |

If more than 12 WPs are to be reported, then duplicate the form as necessary, do not add columns.

If Labour Categories require more lines, please add as necessary.

Digitálně podepsal Ing. Ondřej Svoboda, Ph.D.
Datum: 2025.03.17 11:36:49 +01'00'