European Radiation Facilities Network
ERFNet

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for the ERFNet collaboration
Noordwijk, 27 November 2017

Subject: Request for Quotation RFQ/3-15226/17/NL/GE

Title: EXPERT : EUROPEAN RADIATION FACILITY NETWORK STUDY (ERFNET)

Ref: Item no. 17.339.04
Item: E1X2-006 European Radiation Facility Network
ESA/IPC (2017)69

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February 2nd, 2018
Background Needs

Research on radiation effects on living tissues, radiation environment in space habitats, as well as development of radiation protection technologies and systems, needs:

• combined and coordinated approaches to exploit knowledge.  
  radiobiology, space systems engineering, life support and habitability, materials science and technology, computing science, space mission and operations engineering, ...

• integrated approaches for implementation of physical and virtual facilities: a network of facilities.  
  • demonstrators of Habitat infrastructural elements  
  • human exploration oriented irradiation facilities
  should provide adequate development environment for most intended applications to test advanced design solutions and operations in the frame of radiation mitigation in space habitats
Key Requirements

1) broad access to related information, including data;
2) smart support in the modelling and design of experiments;
3) optimized use of the facilities involved;
4) modular structure, easy to be upgraded;
4) synergy with similar realities around Europe and worldwide;
5) a risk model, to be used as radiation mitigation optimization tool;
6) applicability to space flight (i.e. whenever possible the moduli could be seeds for similar moduli to be use during deep space missions)

This presentation is going to briefly mention the approach we are going to use to study the ERFNet feasibility and the needs it should respond to. We are therefore seeking suggestions to further improve the approach. We are also proposing a synergy between ERFNet and WRMISS.
ERFNet Objectives

• Support users in the design and optimization of their scientific and technological activities in the field of radiation applied to human space exploration.
  • a single access point to the information including links to the leading institutions in the field
  • an easy access to the information to
    i) assess the feasibility, novelty and relevance of a new concept,
    ii) design and optimize the best strategy for its development,
    iii) provide indications how to optimally test it.
• guided links to relevant irradiation and habitat (physical and/or virtual) facilities

• Suggestions for needed and optimized upgrades of these facilities

• A smart system to manage all radiation-related inputs, to suggest strategies to optimize the habitat, and optimal irradiation validation strategies, etc.
ERFNet Objectives

- Use radiation risk as optimization parameter
  - develop a structure to efficiently pair the radiation risk to the optimization routines
    - maintaining the highest degree of upgradability to be able to follow future developments
- Study, in the ERFNet developing stage, a risk assessment model, based on the knowledge and expertise in Europe
  - accordingly and in synergy with similar worldwide efforts
  - providing a first input for the optimization endpoints
- Be easy to access and user friendly,
  - to facilitate newcomers in the field,
- Provide a valid knowledge-base and physical tools to the experienced researcher.
Knowledge Gaps

- Space Agencies:
  - ESA
  - National

- Space Industry:
  - LSI
  - SMEs / start-up's

- Stakeholders list
- Meetings
- Interviews
- Workshop

Gap Analysis

- Exploration roadmaps:
  - GER
  - DSG

- Scientific roadmaps: THESEUS

- Review

- Knowledge Gaps:
  - Specific Facility Requirements

- Radiation Effects
- Risk modelling
- Shielding
- Monitoring

- Space environment
- Pharma countermeasures

- Space Radiation SoA
Important Reference Documents

Recommendations for ESA-supported ground-based research on space radiation protection

Application of the FAIR Facility to Space Radiation Research
Final Report

ASI Supported Irradiation Facilities (ASIF) initial assessment report
Players for ERFNet Feasibility Study

**SCIENTIFIC ADVISORY BOARD**

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Chairied by PI
- Decisions, Strategy, Supervision
- Synergy Team
  - Common language and synergy

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Workflow - Worklogic
ERFNet concept

The core nodes of the ERFNet are:
- the facilities for
  - irradiation testing
  - habitation-related development
- the ERFNet Knowledge Base (EKB) as the key knowledge management system
Another point of view: COMPUTATIONAL MODELS

Knowledge → Computational Models

Environment → Shielding → Radiation Flux → Risk

Most appropriate Monte Carlo or/and Deterministic Tools

1 For example: SWHeliosviewer, VSWMC, SEPEM, Spenvis, SAWS, IPRAM/ NewTRP, Geant4, PHITS, Fluka, HZETRN, SpaceTRIP... etc.
The ERFNet Integrated Approach

“One of the ERFNet pillars is the integrated approach for implementation in full scale of **demonstrators** of selected Habitat **infrastructural elements**, providing the adequate **physical** and/or **virtual** development environment for most intended applications, to test advanced design solutions and operations.”
Therefore, once developed, ERFNet should provide ...

1) A single access point to the information related to radiation and human exploration:
   - scientific and technological free data,
   - guided links to the leading institutions in the field
   - guided links to the pertinent existing databases.

2) Habitat models, physical and/or virtual mock-ups and simulators of the habitation elements focused on radiation protection-related features: shielding and sheltering,

3) A smart system to manage the optimization of the user questions, handling the radiation-related inputs

4) Suggestions for optimal irradiation validation strategies and support for consequent ‘best’ access to the irradiation facilities

5) An easy upgradable risk model modulus, to provide risk assessments as EKB optimization endpoints.
   also support, in synergy with similar worldwide efforts, for the development of a novel advanced space radiation risk assessment model, based on the knowledge and expertise in Europe, and worldwide.
Time Chart

Legend:
KO: Kick Off  
ESoAR: ERFNet State of the ART Review  
ECR: ERFNet Concept Review  
EFR: ERFNet Feasibility Review  
FP: Final Presentation

July 13th 2018
July 2019
Jan 2020
• Suggestions (questionnaire)

• Coordination/collaboration with WRMISS
Thank you for your attention