**SUB-PROGRAMME: BASIC SCIENCES AND INFRASTRUCTURE**

**Guidelines: Review and evaluation of high-end infrastructure proposals and award of funding allocations**

## 1. Introduction

The Department of Science and Technology (DST) adopted a research, development and innovation (RDI) infrastructure framework with five categories being identified. The five categories with their associated subcategories are:

I. Scientific Equipment: well-founded laboratory equipment, large equipment, and advanced equipment;
II. Specialised Facilities: Advanced Specialised Laboratories, Technology Development Platforms for the Health and Biological Sciences, and National Research Facilities of the NRF;
III. High-end infrastructure: small, large and mega projects;
IV. Global Infrastructure: inbound and outbound international and global infrastructure; and
V. Cyberinfrastructure: communication networks, high performance computing, and data storage and management systems.

## 2. Funding Mechanisms and Instruments

Cyberinfrastructure (excluding ICT Roadmap elements, DIRISA and capacity development components of NICIS) is supported through ring-fenced funding and will not form part of this set of guidelines.

The other four categories are funded from the single National Treasury allocation via the R&D Infrastructure budget. This budget is distributed among the four categories in accordance with an agreed resources allocation model (annually approved by EXCO) – which in turn is based on historical data, nature of the infrastructure, amongst other criteria. Furthermore, it was agreed that the NRF will implement and manage the

Scientific Equipment, Specialised Facilities (currently only the National Facilities) and Global Infrastructure categories.

Given the technical nature and complexity of the high-end infrastructure, the DST, through an internally managed process will review, evaluate, award and manage high-end infrastructure grants in this category. However, given that the DST does not have the necessary technical expertise or knowledge of the research infrastructure in this category, an external expert review committee (EERC) will be established to fulfil this function.

The recommendations from EERC will be presented to EXCO for approval and subsequent award of funding. The Terms of Reference (ToR) for the review and evaluation of the proposals and awards of funding grants for high-end infrastructure are outlined below.

## 3. Process for managing and implementation of high-end infrastructure

**High-end Infrastructure** refers to the infrastructure category needed to bridge the "innovation chasm". It refers to infrastructure, in the form of specialised platforms or laboratories (referred to collectively as "facilities") at the interface between R&D and innovation. This type of infrastructure is required to demonstrate reproducibility and scalability (up-scaling) of innovation products, processes and services as a necessary prerequisite prior to full-scale manufacturing and commercialisation. It is also a crucial and necessary step to the players in this space to mature the technology, mitigate risks and help secure follow-on funding including venture capital. Examples in this category include pilot plants, incubators, technology demonstrators and semi-commercial test facilities.

Given the nature and complexity of high-end infrastructure, the high-end infrastructure is subdivided according to the National Treasury guidelines, namely: small projects, large projects and mega projects. This classification for infrastructure from National Treasury is based on the cost implications associated with the infrastructure projects.

The key criteria for the provision of infrastructure funding in this category are as follows:

- Alignment and impact on government initiatives initiatives/programmes, particularly those of the DST;
- User requirement statement (URS) for the facility, including why the facility is required, what the functional capability is and who the stakeholders/beneficiaries will be; and whether the facility is only applicable for a single "project" or whether it will find application for multiple-projects over time;
- Innovation (or novelty) possible through utilisation of the facility;
- A detailed management plan indicating:
    - Physical infrastructure required to house the equipment;
    - Location of the facility, that is, the appropriate geographical setting for the nature of the high-end infrastructure;
    - Availability of support and/or feeder equipment to ensure that the equipment is optimally utilised, including back-up generators;
    - Data management and integrity;
    - Accessibility of the facility to collaborators, other researchers, students and industry;
    - Plan and budget for preventative and routine maintenance, including skilled personnel to maintain and operate the equipment; and
    - Training of users, namely, researchers and students;
- A clear market analysis and a roadmap to commercialisation and industrialisation (due diligence) of the product/process, as applicable;
- A strong business case including a cost recovery plan, user charge-out rates; fixed, operating and maintenance costs, with a comprehensive breakeven analysis;
- High economic impact potential such as job creation, as applicable;
- Industry partnership (co-funding or shared facilities); and
- Alignment to national industrial development priorities (e.g. Beneficiation of raw materials; drug development, etc.)

### 3.1 Submission of Proposals

High-end infrastructure proposals from research institutions (science councils, HEIs, etc) must be submitted to DST Programmes. The specific programme within DST then pre-

screens proposal(s) against the programme-specific objectives and primary criteria listed in Section 3 (above). The programme then makes a recommendation to the internal DST Infrastructure Working Group (DIWG) - consisting of nominated Chief Directors from Programmes 3, 4 and 5. The DST infrastructure unit subsequently submits the pre-screened and shortlisted (by DIWG) proposals to the EERC, who is responsible for reviewing and evaluating the proposals against the set criteria. The EERC is also required to make funding recommendations, which is submitted to the DIWG. The DIWG report based on the recommendations of the EERC is submitted via the P4 Infrastructure Unit to the EXCO for approval. The EXCO may request additional information from EERC or DST Programmes to facilitate their decision-making.

Once a decision has been reached at the EXCO level, the infrastructure unit will communicate the EXCO outcomes to the DST programmes, and then manage the process for a submission to the DG for final approval and funding allocations of the successful proposals. Each programme is responsible for providing feedback to all applicants.

All allocations to programmes not spent by end of December as a result of the delay in finalisation and approval of submissions will automatically revert back to the scientific equipment category pool for transfer to the NRF.

### 3.1.1 Deadline for submission of proposals

All proposals must be pre-screened and shortlisted by the respective programmes and submitted to the DIWG via the P4 Infrastructure Unit no later than the end of August of a particular financial year. Shortlisted proposals are to be reviewed and evaluated by the end of August or early September. The EXCO approval/disapproval process needs to be completed by end of October.

### 3.1.2 Proposal Requirements

In alignment with the primary criteria listed in Section 3 (page 3), the required information for a proposal is:

- Executive summary;
- Technical motivation: Context for proposal and overview;
- User Requirement Statement (URS) – what is required, etc.;

- Feasibility study and market analysis;
- Business case including break-even analysis, up-scaling and sustainability;
- List of partners and respective roles, including lead individuals (as applicable);
- Anticipated outputs, outcomes and impacts, linked with DST strategic objectives and proposed key performance indicators;
- If appropriate, a declaration of the Technology Readiness Level (TRL) of the R&D or technology under development at the point of project commencement, and what the expected TRL level is at the end of the project;
- Details of project phases, deliverables and timelines;
- Details of project budget and sources of income (full budget, including all salaries and overheads to be paid);
- Long-term sustainability plan: technical and non-technical support, financial requirements, maintenance, upgrade and placement of programme;
- Complete risk register and an additional stage-gate approach (with identifiable exit/decision points); and
- Contact details of project leader/anchor, and of representatives of all partner institutions.

### 3.2 Review of Proposals

#### 3.2.1 The External Expert Review Committee (EERC)

The EERC will consist of the following members:

- Four (4) experienced industry reps from the primary (mining, forestry, etc.), secondary (manufacturing, construction, etc.) and tertiary (services, etc.) sectors of the economy.
- Three (3) experienced researchers from the natural and social sciences, and from engineering.
- Two (2) representatives from TIA;
- One (1) representative from NRF;
- All DIWG members as observers.

Additional member(s) might be co-opted to provide support in the evaluation of specific proposals, outside the stated areas of expertise mentioned above.

The specific Terms of Reference for the EERC:

- To evaluate the proposals for completeness against the agreed criteria and verify that they meet the minimum criteria;
- To evaluate the proposals according to the proposed scorecard (Appendix A);
- To gather additional information, primary proposers are expected to make presentations to the EERC panel on day of evaluation. Recommendation: proposers provided with the same presentation template. 15 min presentation and 15 min Q+A
- To consolidate the outcome of the proposal evaluations and to formally submit the recommendations to the DST EXCO via the DWIG (and P4 Infrastructure Unit); and
- To make recommendations to the DIWG and DST at large on how the proposal evaluation process and content can be improved.

The required skills of an EERC member are defined as:

- Demonstration of strong organisational and project management skills;
- Be appropriately qualified with sufficient background of the sector or research area;
- Provide evidence of having conducted similar work in the past;
- Have good strategy development skills;
- Have good knowledge of systems integration;
- Have good knowledge of techno-economic model development;
- Have good business analyst skills;
- Have a good understanding of the National System of Innovation (NSI); or
- Have a good understanding of technology development (greater emphasis on engineering than on pure R&D).

The P4 Infrastructure Unit will provide secretarial support to the EERC.

### 3.2.2 Timelines for review process

The review process should be completed within one month after submission of pre-screened proposals.

### 3.2.3 Pre-screening Criteria

Pre-screening needs to be conducted in accordance with the primary criteria listed in Section 3 (page 3) in conjunction with the specific and additional requirements required below:

**I. Continuing Projects**

(1) Summary of the original proposal including the objectives, problem statement, deliverables and project timelines.

(2) Submission of reports (in the case of continuing projects) including:

- Approved expenditure report;
- Technical progress report, with achieved KPIs in accordance with the contracted deliverables. The motivation and rationale for continued or additional funding should be aligned with the new set of deliverables of the project. Technical review report; and
- Risk register, including a stage-gate (or similar, appropriate) approach (with identifiable exit/decision points) for the development of the project.

(4) (3) Proposal with requirements for continued support in line with Section 3.1.2. Budget within guidelines of the Infrastructure Resources Allocation Model (based on the principle that commitments could only be made on available funding).

(5) Alignment to DST principles/strategic objectives and national priorities.

(6) Alignment to programme specific objectives.

(7) Proposals were subjected to at least two external and independent postal peer reviewers to endorse the motivation for ongoing support. This requirement is necessary given that EERC (as well as EXCO) members will not be content specialists in all sectors. The external review reports must form part of the documents to be submitted to EERC.

## II. New Projects

All new projects must fulfil requirements (3) to (7).

### 3.2.4 Review and Evaluation Criteria

The EERC will use the following scorecard to evaluate all the submitted proposals.

**Evaluation Criteria:**

| | Evaluation Criteria | Descriptors | Weight (%) | *Not highly recommended for funding* | *Not recommended for funding* | *Conditionally recommended for funding* | *Recommended for funding* | *Highly Recommended for funding* | Final score |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **1** | **2** | **3** | **4** | **5** | |
| 1. | **Impact** | • Strategic importance;<br>• Socioeconomic impact;<br>• Scientific impact;<br>• International alignment;<br>• Return on the investment | **15** | | | | | | |
| 2 | **Scientific excellence, novelty and innovation** | Uniqueness of RI;<br>Excellence;<br>Alignment of proposed research to the RI or facility;<br>Inter-disciplinarity of RI;<br>Size of the user community | **10** | | | | | | |
| 3 | **Management Plan** | Feasibility and effectiveness of management plan (*clear articulation of the planning life-cycle*):<br>• Appropriate geographic location for the proposed project;<br>• Appropriate skilled technical staff;<br>• Access policy<br>• Appropriate infrastructure to house the project i.e. *availability of required services and utilities, alternate power supply and safety and security issues addressed;*<br>• *Data access and sharing model- data management plan;*<br>• *Safety and security;*<br>• *Contingency plan;*<br>• *Timelines;*<br>• *Quality assurance systems* | **15** | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 4 | **Implementation** | • Feasibility of project plan;<br>• State of readiness for implementation | **10** | | | | | | |
| 5 | **Governance structure** | • Feasibility of the proposed governance structure;<br>• Stakeholder engagement plan | **10** | | | | | | |
| 6 | **Business Case** | Soundness of the technology and innovation (*How sound is the Business model that supports the science and technology and technical case*):<br>• Market analysis and positioning in the market i.e. *is there a need for the proposed technology, what gap are you filing in the market? Who are the potential customers? Who are potential partners including industry? and is there innovative potential? Feasibility of the financial plan;*<br>• *Potential to attract third stream support or income* | **15** | | | | | | |
| 7 | **Capacity development and transformation** | • Training and up-skilling operators and technicians;<br>• Training of postgraduate students | **15** | | | | | | |
| 8 | **Definition of KPIs and M&E** | • Clear articulation/description of KPIs<br>• Sound M&E instruments/structure;<br>• Risk management;<br>• Stage-gate process to manage the implementation of the RI;<br>• Reporting | **5** | | | | | | |

Score values are described in Appendix A

*Details of the TRLs are given in Appendix B.

### 3.2.5 Framework for Recommendation Report to DST EXCO

A report (not more than 5 pages) that contains the following:

- An executive summary;
- Background to the project;
- Alignment to programme specific objectives and DST strategies;
- Alignment to broad national priorities;
- Feedback on external review of content;
- Response to evaluation questions;
- Recommendations on the:
  (i) viability (technical, financial, capability) of project;
  (ii) approval/non-approval of requested, recommended funding; and
  (iii) strengths and deficiencies of project.

All supportive documents should be included as Appendices.

## 4. Contracting and M&E Requirements and Processes

The contracting and M&E requirements and processes will be included in the contract between the DST and the specific entity or institution. This includes reporting on financial expenditures, red flags, successes and progress against milestones. The period of investment is for three-years at a time.

## APPENDIX A: Score definitions and ratings

| Score | Descriptor | General guiding notes |
|---|---|---|
| **5** | **Excellent** | This is an exceptionally strong proposal that is well thought through and strongly motivated, as well as exceeds all the requirements in this section.<br>• Project recommended for funding |
| **4** | **Good** | This is a strong proposal that fully addresses all the requirements in this section. However, there are minor issues that the institution is advised to bear in mind.<br>• Project recommended for funding |
| **3** | **Satisfactory** | The proposal meets all necessary requirements in this section. However, there are some issues that should be addressed by the institution before an award is made.<br>• Project recommended for funding subject to submission of additional information |
| **2** | **Unsatisfactory** | The proposal partially addresses the requirements in this section. However, some key issues have not been addressed.<br>• Project not recommended for funding |
| **1** | **Poor / Inappropriate** | The proposal provided insufficient information, and/or numerous inconsistencies. Therefore a fair evaluation cannot be conducted. As such this is considered a high risk project.<br>• Project not recommended for funding |

## APPENDIX B: Technology Readiness Levels (TRLs)

Technology Readiness Levels (TRLs**)** are used to guide disciplined decision-making throughout the technology development pipeline. TRLs are a systematic metric/measure system that supports assessments of the maturity of a particular technology and the consistent comparison of maturity between different types of technology. This rigorous approach makes possible to track the progression of each project and activity, from applied research to commercialisation.

TRLs 2 through 8, the high technical risk associated with this phases may deter private investment. At TRL 9, market risks displace technical risk.

- TRL 1 – **Basic Research:** Initial scientific research begins. Principles are qualitatively postulated and observed. Focus is not on applications;
- TRL 2 – **Applied Research:** Initial practical applications are identified. Potential of material or process to satisfy a technology need is confirmed;
- TRL 3 – **Critical Function or Proof of Concept Established:** Applied research continues and early-stage development begins. Studies and initial laboratory measurements validate analytical predictions of separate elements of the technology;
- TRL 4 – **Lab Testing/Validation of Alpha Prototype Component/Process:** Design, development and lab testing of components/processes. Results provide evidence that performance targets may be attainable based on projected or modelled systems;
- TRL 5 – **Laboratory Testing of Integrated/Semi-Integrated:** System component and/or process validation in relevant environment;
- TRL 6 – **Prototype System Verified:** System/process prototype demonstration in an operational environment (beta prototype system level);
- TRL 7 – **Integrated Pilot System Demonstrated:** System/process prototype demonstration in an operational environment (integrated pilot system level);
- TRL 8 – **System Incorporated in Commercial Design:** Actual system/process completed and qualified through testing and demonstration (pre-commercial demonstration);

- TRL 9 – **System Proven and Ready for Full Commercial Deployment:** Actual system successfully proven in operating environment and ready for full commercial deployment.

The TRLs could be clustered into four stages:

**Stage 1: Innovation**

TRL 1 – Basic Research

TRL 2 – Applied Research

TRL 3 – Critical Function or Proof of Concept Established

**Stage 2: Emerging Technologies**

TRL 4 – Laboratory Testing/Validation of Component(s)/Process(es)

TRL 5 – Laboratory Testing of Integrated/Semi-Integrated System

TRL 6 – Prototype System Verified

**Stage 3: Systems Integration**

TRL 7 – Integrated Pilot System Demonstrated

TRL 8 – System Incorporated in Commercial Design

**Stage 4: Market Penetration**

TRL 9 – System Proven and Ready for Full Commercial Deployment

Reference: U.S. Department of Energy

**APPENDIX B: PROPOSAL TEMPLATE*:** DST SUPPORTED HIGH-END INFRASTRUCTURE PROPOSALS

1. Executive summary
2. Technical motivation: Context for Proposal and Overview
3. User Requirement Statement
4. Feasibility Study and Market Analysis
5. Business Case
6. List of Partners and Respective Roles
7. Anticipated outputs, outcomes and impacts
8. Technology Readiness Level (TRL) of the R&D or Technology
9. Details of Project Phases, Deliverables and Timelines
10. Details of project budget and sources of income
11. Long-term sustainability plan
12. Complete risk register and an additional stage-gate approach
13. Contact details of project leader/anchor and of representatives of all partner institutions.

**(* Descriptions of headings are given on page 5)**