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**PRACE Third Implementation Phase Project**

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**Report on the Technical Specification and Evaluation Criteria for  
PRACE-PCP Phase 3**

*Final*

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**D8.1.3 Report on the Technical Specification and Evaluation Criteria for PRACE-PCP Phase 3**

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#### List of Acronyms and Abbreviations

AC	Assessment Committee
CINECA	Consorzio Interuniversitario, the largest Italian computing centre (Italy)
CSC	Finnish IT Centre for Science (Finland)
DoW	Description of Work
EC	European Commission
EPCC	Edinburgh Parallel Computing Centre (represented in PRACE by EPSRC, United Kingdom)
EU	European Union
FP7	7 <sup>th</sup> Framework Program
FTE	Full-time equivalent
FA	Framework Agreement
FZJ	Forschungszentrum Jülich (Germany)
GENCI	Grand Equipement National de Calcul Intensif (France)
GoP	Group of Procurers; a subset of PRACE-3IP partners committed to the PCP
HPC	High Performance Computing; Computing at a high performance level at any given time; often-used synonym with Supercomputing
HPL	High Performance Linpack benchmark
IP	Intellectual Property
IPR	Intellectual Property Rights
JSC	Jülich Supercomputing Centre (FZJ, Germany)
MoU	Memorandum of Understanding.
NDA	Non-Disclosure Agreement. It is typically signed between vendors and customers working together on products prior to their general availability or announcement
NRE	Non-Recurring Engineering
PCP	Pre-Commercial Procurement
PE	Procuring Entity
PRACE	Partnership for Advanced Computing in Europe
PRACE aisbl	PRACE Association Internationale Sans But Lucrative
PRACE-3IP	PRACE 3 <sup>rd</sup> Implementation Phase project
R&D	Research and Development
RUP	Responsabile Unico del Procedimento
SME	Small and Medium Enterprise
TED	Tenders Electronic Daily (online version of the 'Supplement to the Official Journal of the European Union', dedicated to European public procurement)
Tier-0	Denotes the apex of a conceptual pyramid of HPC systems. In this context the Supercomputing Research Infrastructure would host the Tier-0 systems; national or topical HPC centres would constitute Tier-1
TRL	Technology Readiness Level
USA	United States of America
WP	WorkPackage

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### Executive Summary

This deliverable reports the further progress on the PRACE-3IP Pre-Commercial Procurement (PCP) “Whole System Design for Energy Efficient HPC” for the third phase of its execution, including the preparation of the tender documents. The PCP entered Phase II<sup>1</sup> of its execution on 15 June 2015. This second phase will end 10 months after this date, i.e. on 14 April 2016. Shortly before the end of Phase II we plan the publication of the tender for Phase III. This final phase of the PCP is planned to start on 15 June 2016 and last for 16 months. All three Contractors in Phase II will be invited to submit a bid for Phase III. Based on the evaluation of these bids we anticipate awarding two of the Phase II contractors with a contract to provide further R&D services within this PCP.

## 1 Introduction

In this document the preparation of the tender for Phase III focusing on the evaluation criteria is described. Section 2 provides necessary background information on this PCP, its organisation and the relevant rules which had been defined, in particular in the Tender Regulations, and how the evaluation process will be organised. The main part of this deliverable, sections 3 and 4, provides a rationale for the technical documentation, which the bidders have to provide, and the evaluation criteria. Both are defined in the current draft for the tender for Phase III, added in the Appendix.

## 2 Implementation of the PRACE-3IP PCP

### 2.1 Background of the PRACE-3IP PCP

Within the PRACE-3IP project an international consortium of six partners has been setup to form a Group of Procurers (GoP) for procuring R&D services through means of a Pre-Commercial Procurement. It is the first time that this instrument is used for promoting innovation in the field of High Performance Computing (HPC) in Europe. The budget available to contractors within this PCP is € million.

The GoP currently comprises the following members:

- CINECA (Italy)
- CSC (Finland)
- EPCC (UK)
- FZJ (Germany)
- GENCI (France)
- PRACE aisbl as observer

The GoP nominated CINECA as the Procuring Entity (PE) with the responsibility to carry out the entire procurement in the name and on behalf of the members of the GoP.

Through this PCP, PRACE-3IP targets one of the main obstacles for further increases in the performance of high-end HPC systems towards the Exaflop/s scale, namely energy efficiency.

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<sup>1</sup> In this deliverable we use the notation “Phase I”, “Phase II”, ... instead of “Phase 1”, “Phase 2”, ... to be consistent with the tender documents.

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Given that the available budget is small compared to the costs of developing a next generation of high-end HPC systems, this PCP expects contractors to target their R&D efforts on specific components such that maximum impact on improving energy efficiency of the whole system is achieved. This improvement must be demonstrated by delivering pilot systems in Phase III of this PCP. A pilot system is a fully functional HPC system, which will be operated in a production-like environment at the site of one of the GoP members. The PCP hence focusses on “Whole System Design for Energy Efficient HPC”.

One of the key technical goals, which have been formulated for this PCP, is to develop the energy-efficiency of future HPC architectures, such that they are suitable to become part of the future PRACE infrastructure. These architectures thus must support a broad range of applications. This PCP does, however, not cover the full design of pre-exascale or exascale architectures, as this involves significantly higher development costs.

A PCP is organised as a competitive process. Three phases are foreseen as required in the PCP process specified in [19]. In this PCP we have aimed for 5, 3, and finally 2 contractors to compete Phases I, II, and III, respectively. Within the different phases of the PCP the work is expected to be organised as follows:

- Phase I (solution exploration): During this phase, contractors are expected to work on a design specification for the new technologies and solutions to be developed within the PCP, a high-level design specification for the final system architecture solution, an application porting strategy, and an energy efficiency analysis.
- Phase II (prototyping): In this follow-up phase contractors will start to work on lab prototypes, write a detailed specification of the overall architecture as well as the pilot system, and work on performance and energy consumption models.
- Phase III (original development of a limited number of first products/services): The final phase focusses on implementing first versions of the final architecture and their deployment as pilot systems. These pilot systems will allow PRACE to verify the technology readiness and to prove the progress in terms of energy efficiency.

The following contractors started their work in Phase II on 15 June 2015:

- Bull SPA (France)
- E4 Computer Engineering Spa (Italy)
- Maxeler Technologies Limited (UK)

## 2.2 Tender Regulations

All relevant procedural aspects of the PCP are governed by the Tender Regulation [20]. It describes the transition from Phase II to III and lays out rules for defining the criteria for evaluating the bids for Phase III.

Clause 2.4.3 of the Tender Regulation [20] states that the call for tenders to perform services within the scope of Phase III will be published one month prior to the completion date of Phase II (see Appendix: Phase III Tender Document) The contractors of Phase II are invited to submit a bid within one month plus three weeks. The criteria used for evaluating the bids and awarding contracts for Phase III are to be set forth in this call. The evaluation of the bids must be performed after assessing the performance of the contractors of Phase II based on their deliverables. While assessment of these deliverables and evaluation of the bids are strictly separated, the contractors are expected in Phase III to build on the solutions designed in Phase II.

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In clause 3.6.3 of the Tender Regulation [20] we defined a set of evaluation criteria including weight factors, which will both remain the same throughout all phases of the PCP. In this way the bidders are provided with a certain amount of consistency during this multi-phase process, while it leaves the GoP the opportunity to steer the PCP by defining specific evaluation subcriteria for each phase.

The overall technical criteria and their weights as defined in the Tender Regulation [20] are the following:

	<b>Criteria</b>	<b>Description</b>	<b>Weight</b>
I	Quality of R&D and level of innovation	Quality of the offered R&D services and the solution's ability to innovate and improve substantially the scope of operation in which it is intended to be inserted.	30%
II	Technical requirements compliance	Level of compliance of the solution (in terms of quality and completeness) to the functional and performance requirements.	20%
III	Progress in terms of energy efficiency	Solution's ability to progress energy efficiency beyond state-of-the-art.	30%
IV	Project quality and feasibility	Quality of the project (work planning, risk management etc.) as well as feasibility and reproducibility of the solution using an industrial process proper respect to the reference market.	20%

Clause 3.6.3 furthermore defines the overall weight of the technical criteria to be 90. After having performed the technical evaluation, an evaluation of the financial offer will be performed with a maximum score of 10. The bids will be ranked according to the sum of the score obtained from the technical evaluation and the evaluation of the financial offer. This bias towards technical quality is by design and in line with the aims of PCP.

### 2.3 Organisation of the evaluation process

The evaluation of the bids for Phase III will be performed by the Assessment Committee (AC), a panel of experts, nominated by the GoP Committee and appointed by the PE.

The AC, in accordance to Italian regulation, is chaired by the Deputy Coordinator (appointed by CINECA as the PE). In addition, it includes one person per GoP member (none of them can be a delegate to the GoP Committee) and one representative of the PE's administrative department with a consultative voice only, and without voting powers. The chair of the AC is the unique reference for the procurement procedure (Responsabile Unico del Procedimento). Additionally, PRACE aisbl is entitled to attend AC meetings with a consultative voice only, and without voting powers.

The appointment of the AC must only take place after the reception of all tenders. However, as legal and technical expertise might already be required before that time in order to answer questions from the contractors, the GoP will ensure that suitable experts are available.

Exactly the same organisational approach was chosen for evaluating the initial two rounds of bids for this PCP. As reported in deliverables D8.2.1 [2] and D8.3.1 [24] this approach has been proven capable of producing an excellent result.

### 3 Technical Documentation

As part of their bid the contractors have to provide technical documentation, which should contain all information that is needed to apply the technical evaluation criteria. More specifically, the contractors are requested to submit the documents described below. A more detailed description is in the tender document supplied as an Appendix to this deliverable:

**Technology design specification update (TD-3-01):** The suppliers are expected to give an updated and comprehensive technology specification as well as an explanation of how the specification exceeds the state-of-the-art.

**Updated architecture and pilot system design specification (TD-3-02):** This document is expected to contain a detailed description of the architecture of the planned pilot system. The description should address all technology readiness (TR-01, TR-02, TR-03) compliance requirements and any non-conformities should be explained. Furthermore, information with regard to any datacenter requirements that are needed for hosting the system should be provided. Any non-conformance should be clearly explained and documented in a table according to the following template:

Technical requirement	Pilot design specification	Explanations

**Specification of execution time and energy consumption (TD-3-03):** This document is expected to contain the upper limits of time-to-solution and energy-to-solution for all PRACE application benchmarks, using the “large input deck” as defined in Annex 2 - Benchmark Documentation of the Tender Phase III, that the suppliers will commit to on the pilot system. Details of the methodology of how the limits were derived should also be included. The document must comprise a table that matches the following template:

Application benchmark	Max. time-to-solution [s]	Max. energy-to-solution [J]
BQCD		
NEMO		
Quantum Espresso		
SPECFEM3D		

**Detailed work plan for phase III (TD-3-04):** The work plan should be sufficiently detailed to allow for an assessment of the quality of the work organisation and thus create confidence in the targets being attainable.

**Pilot system deployment plan (TD-3-05):** The initial plan for the deployment procedure of the pilot system to the site where it will be operated.

**Risk analysis for reaching targets at end of Phase III (TD-3-06):** Updated risk analysis for achieving the final goals at the end of Phase III. This analysis should allow an assessment whether the supplier has a good understanding of all major risks involved in his approach and is able to provide mitigation strategies.

**Market analysis from 2018 onwards (TD-3-07):** Updated market analysis that focuses on the technologies developed within the PCP.

**Human resources and place of performance documentation (TD-3-08):** Description of the planned human resources for the R&D as well as their location.

### 4 Evaluation Criteria for Phase III

In this section we discuss the evaluation criteria which are defined in clause 3.5.2 of the tender for Phase III (see Appendix: Phase III Tender Document).

#### 4.1 Quality of R&D and level of innovation

During the first two phases contractors will have converged on a detailed technology specification of potential technologies and are ready to commit to a specific technology path for the final phase.

A PCP aims to develop technology which is new, i.e. one where the technology readiness level (TRL)<sup>2</sup> cannot be too high at the beginning of the PCP, but should increase from phase to phase. Still, the technology could become available as a product, or part of a product, soon after the PCP ends. Therefore the technology should be realistically deployable into a prototype for on site verification during the final phase i.e. the TRL cannot be smaller than 6.

The technology developed in this PCP must be innovative and thus constitute progress beyond the state-of-the-art. Progress will be assessed in comparison to solutions and products available today and progress may be achieved by integrating recently developed technology in future solutions. This also includes the case, where existing solutions are adapted for use in HPC, resulting in a significant improvement of energy efficiency. Ideally, the result can be considered as a break-through, and thus for this case the highest score is foreseen.<sup>3</sup> The architecture specification (TD-3-01) must clearly explain how the proposed solution will allow to progress beyond the state-of-the-art.

For this final phase, the weighting of the maximum scores of this category has been adjusted from previous phases to promote innovative, break-through solutions.

#### 4.2 Technical requirements compliance

The outcome of the PCP should result in a whole system design where new technologies developed within this PCP are integrated. The next set of criteria allow PRACE to evaluate the quality of the provided documentation concerning overall system design, its performance target and, most importantly, compliance with the technical requirements formulated in the original tender (Technical Requirements document [21]).

The first criterion concerns the comprehensiveness of the specification of the architecture of the pilot system (TD-3-02 tender for Phase III Appendix), which should be deployed during Phase III.

In order to assess compliance with the technical and performance requirements, a comprehensive and detailed description of all sub-components is expected (TD-3-01 and TD-3-02 tender for Phase III Appendix). Due to the constraint that at least 50% of the project value must be R&D services there is a risk, that the bidder is not able to meet the performance requirements within the given budget. This criterion will allow the AC to assess this aspect and to assigning a score depending on how well the pilot system will meet the originally defined criteria.

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<sup>2</sup> See [4] and [5]

<sup>3</sup> We expect most suppliers go for an evolutionary approach.

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Energy efficiency measured according to an energy-to-solution metric could be improved by reducing clock speed. To avoid compromising on time-to-solution, the technical requirements defined for this PCP mandate that time-to-solution is not reduced. Suitable reference numbers had been provided to all contractors of Phase I for all application benchmarks. The contractors are expected to provide commitments on performance of the pilot system based on the testing on the prototypes developed in Phase II. The criterion concerning time-to-solution targets also involves an assessment of the ability of the supplier to meet the technical requirement as well as the quality of their analysis. The latter is to avoid suppliers setting overly optimistic performance targets which are not likely to be reached. The quality of the analysis will be assessed by checking for completeness of the analysis in different aspects as well as for documentation of assumptions and risks.

Compared to the previous phase, the weighting of the maximum scores in this category has been adjusted to give more weight to the pilot system technical requirement compliance to promote the goal that the system meets the originally outlined requirements.

#### **4.3 Progress in terms of energy efficiency**

For Phase III the bidders are expected to commit to a minimum gain in energy efficiency that can be realised through the solution which they propose. For this end they will have to define upper limits for energy-to-solution for all of the provided application benchmarks (TD-3-03 Tender for Phase III in Appendix). To avoid assigning a high score to those bidders which are more optimistic than others about the feasibility of their targets, the quality of the energy efficiency analysis for the given benchmarks is taken into account. This involves an evaluation of the level of detail of the provided analysis as well as the documentation of assumptions and risks. Furthermore, the evaluation will consider whether the virtual data centre model was applied to assess the overall power consumption.

#### **4.4 Project quality and feasibility**

The final set of evaluation criteria is related to the quality of project organisation, which is important to assess whether it will be feasible to reach the targets through the foreseen R&D services. Different criteria are foreseen for evaluating the following technical documents:

- Work plan (TD-3-04 Tender for Phase III in Appendix): This should provide a sufficient level of detail to provide a specific and tangible list of objectives and necessary resources to realistically realise the final design and perform the benchmarking.
- Deployment plan (TD-3-05 Tender for Phase III in Appendix): This should have a clear initial plan and related infrastructure and other requirements for deploying the system at a PRACE partner site.
- Risk analysis (TD-3-06 Tender for Phase III in Appendix): Any ambitious R&D project involves significant risks, which are typically larger when less conventional solutions are explored. The criterion is formulated such that bidders are not penalised for approaches which involve higher risks, but rather check for risk analysis being comprehensive with suitable mitigation strategies being defined.

The last criterion will be used for evaluating the market analysis document (TD-3-07 Tender for Phase III in Appendix) that is provided. Higher credits should be given for comprehensive analysis of the market opportunities which arise because of the new solutions developed

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within the PCP. This document should not just comprise a general analysis of how the HPC market evolves.

The weighting in this category promotes the risk assessment and deployment plan as these are important in realising the final goal of a functional pilot system within the project schedule.

#### **4.5 Financial criterion**

The financial offer is evaluated following a very similar approach as for previous phases. The Tender Regulation (clause 3.5.3) [20] sets the maximum score of the financial offer to 10. This reflects our opinion that the technical quality of the offer should have more weight than the financial aspects. The score is again assigned using a formula which linearly interpolates between a floor price and a maximum price. Zero point is assigned if maximum price is requested, while the maximum score is assigned if the price is equal or lower than the floor price. The maximum price is fixed through the budget. The minimum price is difficult to assess. The resources spent on R&D services within Phase III and the costs of the pilot system may differ significantly for different solutions. We therefore again chose a minimum price that is 50% of the maximum price. This choice is consistent with the assumption that a successful bidder will at least foresee 3 FTE over 16 months at a cost rate of €120,000 per person year and at least €1,000,000 for building and deploying the pilot system.

## **5 Conclusions**

In this document we reported on our work on preparing the transition from Phase II to Phase III of the PRACE-3IP PCP. We provided an overview of this PCP, including its goals, organisation and timeline. A more detailed description recapitulated the rules for this transition as it has been presented in the original tender documents.

We provided a detailed rationale for all the technical documents, which the contractors of Phase II are expected to attach to their bids for Phase III, and for all evaluation criteria including the foreseen weights per criterion.

The criteria are formulated such that an absolute evaluation is performed, in contrast to a relative evaluation of different bids. The foreseen criteria will allow for a fair and individual assessment of each bid and take the experience made while evaluating the initial bids for the Framework Agreement into account.

## **6 Appendix: Phase III Tender Document**

See attached document “PRACE-3IP PCP Tender Phase III”.