

pláňatũm

# EMPLOYER'S REQUIREMENTS

**LED projection system II.**

version: 230921

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This document sets out the binding requirements on the Works (part II) and requirements on the Contractor's Proposal (part III).

The Employer's Requirements, in the content and scope described in this document, are the basis for the preparation of the Contractor's Proposal and the design, execution and completion of the Works.

## 1 GENERAL PROVISIONS

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The Contractor shall design, execute and complete the Works in accordance with the requirements on the Works listed below.

The purpose of the Works is the new LED projection system of Planetarium in Prague <https://www.planetum.cz>

## 2 REQUIREMENTS ON PARTICULAR COMPONENTS

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### 2.1 DOME

The dome must meet the following requirements:

- (a) the spherical light emitting surface has base diameter 22 m;
- (b) the surface covers upper half dome with zero tilt with front negative elevation extension (hyperdome). The extension covers the area of  $100^{\circ} \times -15^{\circ}$  in the front of the audience seamlessly extending the upper half dome; the dimension tolerance of the front extension design is  $\pm 1^{\circ}$ . The dimension of the dome (top) part must be at least  $180^{\circ}$
- (c) the dome structure is self-supporting.
- (d) the dome structure must be a solid construction capable of supporting all mounted equipment in addition to supporting additional weight (for example, speakers, LED spotlights, a person servicing or replacing equipment) without degradation;
- (e) all electronics (power supplies, cables, etc.) must be hidden behind viewing area.
- (f) the dome structure has built-in ladders to provide reasonable and safe access to the entire structure if not accessible from the ground.
- (g) the dome structure must have a maximum weight of 40 tons.
- (h) all the weight of the LED dome construction must be completely supported by the dome ring without any extra supporting spots (see the scheme as part of the current state documentation, file: A\_2\_fixing.pdf).

### 2.2 DISPLAY

The display must meet the following requirements:

- (a) the light emitting surface is made of solid, compact and user replaceable LED modules.
- (b) the LED modules must be made of black mat perforated backing material. The perforation ratio of the panels must be at least 19 %;
- (c) the modules must be designed to match and follow the spherical structure and follow the dome diameter;
- (d) the LED modules must be user-serviceable, including the ability to replace a module from the front or back by hand and/or using provided tools;

- (e) dome structure, LED modules and all other components of the display system must not produce cross reflection (Tenderer/Contractor must be able to clearly show how cross reflection is avoided under any dome content display at the reference project or prototype site);
- (f) the Contractor must supply the LED modules layout and a description of the LEDs layout on each module;
- (g) the pole of the LED module pattern must be in zenith.
- (h) the total number of display's physical LED pixels (including the dome and the front extension) must be at least 45 300 000; pixels must be evenly spaced across the display surface;
- (i) display system must have a uniform resolution and pixel pitch over the overall display surface. It must consist of an array of uniformly dense pixels across the entire display surface;
- (j) the image processing pipeline must include a system to minimize visibility of LED module edges. There must be no easily visible "grid pattern" with the system active;
- (k) the image processing pipeline must work completely in 12-bit per color depth at least;
- (l) display system must include an advanced level light control to provide high detail control of the LEDs and to expose subtle details and tones in low light, low contrast scenes;
- (m) display system must include a frame accurate synchronization across multiple inputs including video streams and external digital video sources. The synchronization module/device must handle frame-rates up to 120 Hz and provide sufficient frame buffering capability;
- (n) display system must include a per pixel camera-based calibration that corrects brightness and color uniformity across the entire dome;
- (o) at full brightness, display system must be capable of delivering brightness of at least 300 nit (the Contractor must specify the maximum brightness possible without compromising colours in the Contractor's Proposal);
- (p) display has to deliver flicker-free and moire-free image of any content including special testing visual patterns like angled line grids or slow moving dim starfields;
- (q) display system must offer uniform colour across the entire display at every brightness level; LEDs corresponding to pixels displaying a true black (RGB = #000000) must emit no light;
- (r) display system lifespan is at least 80,000 hours based on dimming of 10% or less over that period;

## 2.3 OTHER SYSTEM REQUIREMENTS

The system must meet the following requirements:

- (a) the system must have full image-processing pipeline working at 120 fps frame rate (non interlaced) both for video playback and real-time interactive content;
- (b) the system must support streaming content playback using NDI as well as external content display delivered via HDMI/DP physical connection both up to 4K resolution; NDI streaming should be at least 3840x2160 at 30fps. External HDMI/DP input should be at least 3840x3840 at 30fps;

- (c) the projection system must be equipped with the professional grade spatial audio system at least at 7.1.4 speaker setup including hardware spatial audio processor; the system must support 3D audio. The audio system must be able to reproduce directional feeling (in the range of projection surface) of any sound played. The audio processor should support 32 DANTE channels for interactive positioning. 3D sound must be fully supported by planetarium software both interactively and via scripting engine;
- (d) audio system must have DANTE connection for digital audio I/O as well as 16 balanced line inputs and 16 balanced line outputs (XLR or TRS) available via patch-bay at FOH or nearby. All the line ins/outs must be freely routable across the audio system using remotely controlled digital matrix mixer;
- (e) audio system must deliver audio pressure at least 100dBA to every seat of the audience area; the required acoustic pressure (100dBA) is measured as RMS of pink-noise (12 dB crest-factor) in the 35 Hz -18 kHz frequency range. The pressure level has to be delivered in the free-field simulation (zero room reflections);
- (f) the system must include 2 handheld and 2 headset professional wireless microphones; the transmitter frequencies must follow all the local spectrum regulations and consider their future proposals;
- (g) the projection system FOH must be equipped with at least two flat screen monitors, standard console (mouse, back-lit keyboard), tablet for remote wireless control and gaming device for flight control (joystick, gaming wing);
- (h) FOH must have physical controller for (at least) the master volume of the audio system (knob, fader) and physical panic button (mute all, dim all);
- (i) Total peak power consumption of the system including the LED display at full brightness 300 nit, servers, audio rig and other related systems shall not exceed 180 kW.

## 2.4 SOFTWARE

Full-feature version of professional planetarium software must be part of the solution - Works and must meet the following requirements:

- (a) smooth fulldome film playback at the full true resolution of the dome;
- (b) interactive visualization engine featuring:
  - real starfield visualization including star names, constellations and simulated interstellar flight,
  - solar system visualization including observing point and time setting,
  - visualization of planet and moon surfaces in hi resolution,
  - realistic hi-res Earth surface visualization using satellite imagery and 3D terrain model supporting interactive flight mode,
  - atmosphere and volumetric clouds rendered above the Earth surface,
  - comet and asteroid visualization in actual and/or computed positions,
  - artificial satellites visualization including realistic 3D models of ISS, HST, JWST,
  - support of database data plotting; system must be able to 3D plot a custom dataset represented by a local text file (plain, CSV, XML etc.) or remote

online source. System must be able to query database objects(s) and identify them visually and present data of the visually identified object. Plotting data of moving objects (defined by ephemeris) is also required.

- custom 3D object inclusion in any position, time and scale,
  - powerful scripting engine featuring automation of any rendered object and camera,
  - zoomable and flyable model of the near universe able to render interactive seamless flight from the Earth to the large scale structures of the universe;
- (c) integration of one of the major gaming engines (Unreal, Unity, Steam) for interactive content creation and playback is required. Objects and/or scenes must play along or inside the live/script controlled universe visualization; the gaming engine must be an integral part of the planetarium software. It has to be able to use its controllers (mouse, keyboard, joystick, gaming wing, tablet) and image processing pipeline (channel and frame synchronization, blending, grid pattern processing, brightness and colour uniformity and colour grading). The gaming engine should run along the pre-rendered content playback or universe visualization to make one compound, full-size and seamless visual output on the screen. The gaming engine objects and environment has to be fully scripted from the planetarium software console.
- (d) the user interface of all the software must be in English;
- (e) all the labels and texts rendered on the dome must have multilingual capabilities supporting at least English and Czech languages;
- (f) the software must have option of wireless remote control using handheld device like a tablet;
- (g) the planetarium software must be able to stream 360-degree video to the live video platforms;
- (h) the planetarium software must support full integration of NDI streams and content captured from HDMI/DP wired sources. Full integration must include interactive and scripted positioning in the virtual space model and smooth playback along with interactive space visualizations (as required above);
- (i) NDI support must come with the NDI streaming software installable on third party Windows 10+ devices;
- (j) 4K capture video input must be able to process input resolution of 3840 x 3840 pixels at 30 fps for unlimited time and with latency up to 200 ms.

## 3 SPARE PARTS AND TECHNICAL SUPPORT

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### 3.1 SPARE PARTS

The Contractor must provide at least 10% spare LED modules of each size and shape installed in the system. Light emitting semiconductors (LEDs) installed must be from the same manufacturing batch as the installed ones.

The Contractor must provide at least 10.000 spare light emitting semiconductors (LEDs) of the same manufacturing batch as the installed ones for future panel repairs.

### **3.2 TECHNICAL SUPPORT**

Throughout the duration of the Defects Notification Period (see Sub-Clause 1.1.3.7 of the Appendix to Tender) the Contractor must provide warranty covering

- (a) 24/7 technical phone support of trained technician and remote support with online service ticketing system in Czech or English;
- (b) "next business day" support for all the computing gear.

## **4 REQUIREMENTS ON THE CONTRACTOR'S DOCUMENTS**

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### **4.1 CONTRACTOR'S DOCUMENTS**

4.1.1 The Contractor must, in accordance with Sub-Clause 5.2 [Contractor's Documents] of the Conditions, prepare (inter alia) the following documents:

- (a) Design documentation;
- (b) As-Built Documents;
- (c) Operation and Maintenance Manuals.

### **4.2 DESIGN DOCUMENTATION**

4.2.1 With regard to the preparation of the design documentation, the Contractor must:

- (a) prepare all technical inputs, calculations, drawings, models necessary for the execution of Works;
- (b) involve and coordinate special professions;
- (c) define all requirements for ensuring construction readiness by the Employer;
- (d) provide assistance to the Employer and persons designated by the Employer to ensure construction readiness.

4.2.2 Design documentation must be submitted in editable (\*.odt/docx, \*.dwg, \*.xlsx etc.) and also not editable form (PDF/A).

4.2.3 Design documentation must be submitted for review in accordance with Sub-Clause 5.2 [Contractor's Documents] of the Conditions; review period shall not exceed 14 days.

### **4.3 AS-BUILT DOCUMENTS REQUIREMENTS**

4.3.1 As-Built Documents must be submitted in editable (\*.odt/docx, \*.dwg, \*.xlsx etc.) and also not editable form (PDF/A).

4.3.2 As-Built Documents must be submitted for review in accordance with Sub-Clause 5.2 [Contractor's Documents] of the Conditions; review period shall not exceed 14 days.

### **4.4 OPERATION AND MAINTENANCE MANUALS**

4.4.1 With regard to the obligation of the Contractor to supply the Operation and Maintenance Manuals in accordance with Sub-Clause 5.7 [Operation and Maintenance Manuals], the Operation and Maintenance Manuals must be supplied in digital and hard copy versions.



## 5 REQUIREMENTS ON TRAINING

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### 5.1 TRAINING

- 5.1.1 Training of Employer's Personnel must be carried out on Site before taking-over.
- 5.1.2 Training shall be provided in 2 to 3 days and must include:
- (a) general training in operating and functionalities of the Works,
  - (b) training in operating shows in planetarium,
  - (c) training in show development,
  - (d) training in general maintenance.
- 5.1.3 For training purposes and creation of specific content the Contractor must provide 2 production and training workstations to the Site (one laptop and one server including monitor) within 60 days after the Commencement Date.
- 5.1.4 Both workstations should run full licence of the planetarium software in same data-resource configuration as the LED projection system.
- 5.1.5 Provided production workstations must be equipped with software tools for 3D sound design, 3D sound rendering into the physical channels (for later non-interactive use on the system) and 3D sound emulation/monitoring on headphones.
- 5.1.6 Contractor shall also provide necessary training documentation.

## 6 INFORMATION AND SITE REQUIREMENTS

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### 6.1 IDENTIFICATION OF THE SITE

The Employer shall provide the Contractor with the following plots of land forming the Site for the duration of the Works (the necessary lease agreements with the owners shall be concluded by the Employer before handing over the Site) in the municipality of Prague, cadastral area Bubeneč [730106]:

Plot no.	Owner	Note
1832/1	City of Prague	north-eastern areas adjacent to the planetarium building - access through the rear wing
1832/2	City of Prague	planetarium building, no. 233
1834	City of Prague	access road

### 6.2 DOCUMENTATION OF THE EXISTING CONDITION OF THE BUILDING

The Employer provides the following documentation of the existing condition of the building:

- (a) current state documentation, file: current\_state\_documentation.zip
- (b) photo documentation of the current state, file: photodocumentation.pdf

## **6.3 ACCESS TO THE SITE**

### **6.3.1 Access road**

The Site is accessible for vehicles up to 36 tonnes and standard trailer height via an asphalt access road in the Stromovka Park. Entry permits will be provided by the Employer.

### **6.3.2 Access to the building**

- (a) rear wing: on a paved path with limited travel (entrance to the workshop);
- (b) access ramp 18 x 3.5 metres: on an unpaved road with a slope of 25° directly to the entrance of the building;
- (c) paved area in front of the building: at a distance of 18 m from the edge of the building envelope.

### **6.3.3 Manipulation areas**

- (a) External:
  - (i) building plateau:
    - Area: 2 x 15 x 15 m
    - unguarded, unsecured, accessible from the paved area in front of the building
  - (ii) Rear of building:
    - area: 6,7 x 14 m
    - unguarded, unsecured
  - (iii) Planetarium terrace on the 2nd floor:
    - area: 20 x 8 m
    - max. permissible load: 50 kg/m<sup>2</sup>
    - space locked and not accessible within the building
  - (iv) two fenced spaces on the 1st floor under the terrace within the built-up area
    - area: 3,2 x 29 m and 3,2 x 35 m
    - both spaces fenced and locked within the building
- (b) Internal:
  - (i) space on the 1st floor:
    - Accessible from the plateau and from an unpaved ramp
    - area: 6,5 x 6 m
    - max. permissible load: 1 tonne/m<sup>2</sup>

### **6.3.4 Entrance openings**

- (a) from the building slab: external staircase with an opening into the building of 1.75 x 2.35 m to the former cloakroom area, followed by an internal staircase 2.45 m wide to the hall
- (b) from the enclosure: without staircase through a 1.75 x 2.35 door opening into the former cloakroom, then an internal staircase 2.45 m wide to the hall

- (c) from the rear wing of the building: entrance to the workshop 2.2 x 2.05 m, followed by a gap of max. 0.9 m.
- (d) from the terrace: entrance to the building 2.15 x 1.95 m, then only one leg of the staircase 2.45 m wide to the hall via a door opening of 2.45 x 1.95 m.

## 6.1 TEMPORARY TAKINGS

The Contractor shall take into account local conditions and consult with the Employer on the possible location of Site facilities.

The relevant lease agreements for the areas required as temporary takings shall be secured by the Employer.

All areas of temporary takings shall be properly reclaimed by the Contractor after completion.

## 6.2 ELECTRICITY, WATER AND GAS

The Employer sets out below details of the sources of electricity, water and gas available at the Site:

Service	Note
electricity 220/380V	provided and the costs are borne by the Employer
water	provided and the costs are borne by the Employer
gas	provided and the costs are borne by the Employer

## 6.3 OTHER SITE RESTRICTIONS

### 6.3.1 Temporal:

- (a) external works may be carried out from 07:00-20:00
- (b) internal works may be carried out without restriction, except for noisy works (07:00-20:00 hours only)

### 6.3.2 Spatial: no encroachment into green spaces.

# PART III REQUIREMENTS ON THE CONTRACTOR'S PROPOSAL

## 7 GENERAL PROVISIONS

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### 7.1 BINDING NATURE OF THE CONTRACTORS'S PROPOSAL

The Contractor shall design, execute and complete the Works in accordance with the Contractor's Proposal.

The Contractor's Proposal must fully respect the Client's Requirements. If there is a conflict between the Employer's Requirements and the Contractor's Proposal (or any further development thereof), the Employer's Requirements shall prevail.

### 7.2 CONTRACTOR'S PROPOSAL FORM AND CONTENT

The Contractor's Proposal forms part of the Letter of Tender and must include at least the following:

- (a) descriptions and drawings proving/showing that all Employer's Requirements are met;
- (b) requirements for ensuring construction readiness by the Employer;
- (c) structured calculation of the Tender price;
- (d) draft of the time programme prepared in accordance with Sub-Clause 8.3 of the Conditions [Programme].

- current state documentation, file: current\_state\_documentation.zip
- photo documentation of the current state, file: photodocumentation.pdf