

Dansens Hus – Studio stage

Specification for over stage machinery

Introduction

This project involves the replacement of the upper machinery in the Studio stage at Dansens Hus in Oslo. The current system is close to the end of its lifetime. In addition, the system is limited in scope, lacks positioning and load monitoring, and does not meet current safety requirements. Other objectives for the upgrade include:

- Additional options/points for suspension.
- Simpler modifications and shorter turnaround time between productions.
- Improved working environment. It should not be necessary to use a lift to move hoists or suspension points.
- Opportunities for movement during performances.

The planned solution is based on a system of traditional fly bars with the addition of point hoists.

In the following specification, required items are numbered (X) and identified with the words “shall” or “must”. Other items will be part of the evaluations for quality and, where relevant, sustainability. In addition to confirming that required elements are included, the bidder should describe how they plan to achieve each item. This will help show that the bidder is capable of achieving the requirements and will be used in the evaluation of quality.

To assist in the evaluation of the offer with respect to both quality and sustainability, the bidder should provide descriptive texts and examples that relate directly to the project. References to certifications only are not sufficient.

General description

The arrangement of the new stage machinery is shown in the attached drawings. There are 16 fly bars, generally spaced between 600 and 750 mm apart. The bars above the audience have wider spacing due to limited capacity in the roof at axis 12. Two side bars are positioned about 400 mm inside the existing curtain tracks.

The fly bars are supported by four wire ropes or steel bands. Winches are to be placed in a machine room above the existing gallery (1). Due to limited space, we suggest “pile wind” winches, although other solutions that fit the space available and functional specifications are acceptable. The fly bars are constructed as ladders and fitted with extensions at each end.

One to three movable point hoists are installed in each of four beams designated for this purpose. The wire ropes / bands from the point hoists can be pulled forward from the back wall and then routed to winches placed in unused spaces between the fly bar winches. In addition to supporting point hoists, these beams can be equipped with trolleys for suspending chain motors.

As the number of fly bars or point hoists may need to be adjusted with respect to the budget. The bidder shall provide the costs for single fly bars or point hoists (2).

A steel structure dedicated to the stage machinery will be installed by another contractor. The existing HEA beams will be dismantled. Eight new beams will be installed in the longitudinal

direction of the hall, positioned so that four are used for stage hoists and four for point hoists and/or other temporary equipment. The beams consist of two steel channels spaced about 400 mm apart, with bracing between to provide sufficient stiffness.

Machinery will be situated above the balcony to one side of the stage. A partition will be added to effectively create a machine room and provide some sound installation between the winches and the stage.

As the load on the theater roof is limited, equipment that is lighter in weight will be an advantage. The bidder shall provide the estimated weights of system components with the tender (3).

Performance requirements

The system shall be designed, produced and tested to meet the following requirements:

- The working load for fly bars (ELL) shall be 400 kg (4)
- The working load for point hoists (ELL) shall be 250 kg (5)
- The vertical speed for all hoists shall be 0 to minimum 0,6 m/s (6)
- The stroke shall be from 100 mm over the floor to as high as possible, ca 8.2 meters (7)
- Maximum noise level in the central area of the stage area is 32 dB (single axis) (8). The planned partition between the machine room and the stage provides only about 35 dB insulation and contains openings for ropes. Any required damping between the winches and the steel structure must be included in the offer (9).
- Acceleration and deceleration shall be programmable up to 1 m/s² (10)
- Repeatability of position shall be to less than 1 mm (11)
- Synchronous motion shall be to within 5mm (12)
- Horizontal motion for point hoists shall be manual, operated from the floor (13), with an option for automated motion at variable speed from 0 to 0,3 m/s. The tender should include a description of how undesirable horizontal motion of the point hoists is prevented.

Mechanical construction

Fly bars shall use a ladder construction (14) and meet the following specifications:

- The lower tube shall have a diameter of 48.3 mm (15)
- The total height of the ladder shall not exceed 180 mm (16)
- The expected weight of the offered bar shall be noted in the tender (17). Solutions that are lighter in weight are preferred.
- The length of the lower tube shall be 13.2 meters, for the side bars, 13.5 meters (18).
- The length of the upper tube shall be between 12.8 and 13.2 meters, for the side bars, between 13.0 and 13.5 meters (19).
- It must be possible to extend the bars by 50 cm on both ends using inserts (20). It is advantageous to have a system that allows the insert to be locked.
- The attachment of the wire ropes must be constructed so that height adjustment occurs laterally, in order to achieve maximum lifting height (21)
- Maximum deflection with a point load of 150 kg is 1:200 (22)
- Maximum point load anywhere on the bar between the outer suspension points shall be at least 150 kg (23)

- Outside the outer suspension points, the fly bar shall be dimensioned for a point load (ELL) of 75 kg (24)
- When flown without load, errors in alignment against the vertical plane must not exceed 5mm per 2000mm locally or 25mm over the bar's total length (25)
- When flown without load, errors in alignment against the horizontal plane must not exceed 10 mm over the bar's total length (26)
- The fly bars shall be painted black (RAL 9005) (27)

Point hoists shall:

- Have enough self-weight to allow for safe slack rope handling (28)
- Use non-rotating rope (or steel band) (29)
- Be painted black (RAL 9005) (30)
- Point hoist trolleys must have enough friction in the horizontal direction to avoid unwanted motion when loaded (31)

For all rigging:

- Rope routing and pulleys shall be designed such that the ropes are properly supported and do not rub against other objects even at low loads with high accelerations (32)
- The bidder should describe how they plan to keep noise levels from running rig to a minimum (33)

Machine room

Winches and cabinets shall be mounted with consideration for access for service and inspection (34). It is acceptable, and actually preferable, to have the winches over head height so as to save space for other equipment. Cabinets should be mounted in front of the outer wall, so they do not reduce available floor space. The bidder should provide a description or sketch showing the proposed layout for the machine room with the tender. This will be evaluated as part of the score for quality.

Safety and standards

The Studio stage is an active performance space with a busy schedule of technical work, rehearsals and performances. Turnovers between productions happen often and may involve extensive changes in rigged equipment. Motion over performers and audience as well as performer flying is to be expected.

The system will be operated by a professional staff with suitable training.

The complete system, hoists and control system, including safety functions, shall be designed with respect to the standard NO-EN 17206 "*Entertainment technology, Machinery for stages and other production areas, Safety requirements and inspections*" (35). The design shall meet relevant EU directives including the Machinery, Low Voltage and EMC directives (36).

Based on the above the supplier shall provide a risk analysis with specification of resulting safety functions and safety integrity levels (SIL) as part of the design documentation (4). Monitoring of synchronous motion is required (37) (load monitoring is not sufficient).

Load monitoring – extra functions

The control system shall monitor the total estimated load on each roof truss, using information from load cells on the hoists (38). To better calibrate these values, it shall be possible for the user to enter the horizontal positions of point hoists and to manually add other loads and their positions (for example, from chain motors) to the calculation (39).

The control system

Control cabinets should be placed in the machine room in close proximity to the winches. All cables and cable ladders or channels shall be included in the delivery (40).

The system shall be controlled by a small, mobile operator desk that can be placed anywhere in the room (41). Likely connection points are at either end of the room at floor level and at the gallery level. The system is ideally operated via a joystick equipped with an integrated hold-to-run button, providing the operator with precise control over speed and direction.

The operator desk shall limit access by the use of username and password or by key switch (42). The desk shall clearly present the functions and equipment available.

The system shall allow for synchronous operation of at least 16 axes and simultaneous operation of any number of axes (43) (total load may be limited by incoming power). As a minimum, both speed synchronous and position (goal) synchronous motions shall be supported (44).

When synchronous groups are created, the operator shall be warned of attempts to move axes in conflict with the group synchronization (45). One method is to require (temporary) unlocking of the group. Other methods may be acceptable. Whatever method is selected must allow for simple and effective operation.

The system shall allow for programming and storage of multiple motions, cues and productions (46). It shall be possible to document work by entering texts attached to motions, cues or productions (47). The system shall provide good diagnostic information in clear text (48). The system texts shall be in the Norwegian language, or it must be possible for the owner to translate and update the texts (49). The ability to switch between English and Norwegian would be an advantage.

A backup solution shall be provided that, as a minimum, can operate an individual hoist in case of any critical failure of the control system (50).

The control system should allow for an internet connection to be used for off-site faultfinding and support and should include a firewall or other necessary hardware to make the connection. In the event of faults, telephone support should be available 24/7.

Load monitoring

To support the load monitoring functions described above, a graphical representation of the actual loading would be an advantage.

Interface

Mechanical

As noted above, the steel structure will be provided by another contractor. The preliminary design for the load bearing beams is attached. The selected supplier will have an opportunity to discuss modifications that might better fit with the supplier's components.

Smaller steel components that may be necessary to support pulleys, winches or cabinets are the responsibility of the stage machinery contractor (51).

The building contractor will supply scaffolding for the installation. The scaffolding will be removed after the installation of hardware, including adjustments to lighting and ventilation, in time for commissioning of the machinery.

The partition wall separating the machine room from the remainder of the balcony will be built after the installation of the stage machinery.

Electrical

Power is standard 400V TN-S. The builder will supply a direct 63A connection to the stage machinery power cabinets.

Training

Training in use and service of the system shall be included with the delivery (52). This includes training in preventive maintenance, faultfinding and the exchange of parts (53).

Documentation

The design documentation shall be delivered as noted in the schedule and shall include:

- Complete drawings and schematics (54)
- A risk analysis along with descriptions of the resulting safety functions, their safety integrity levels and performance (55)
- Static and dynamic calculations (56)
- A functional description of the control system (57)
- Test plans for FAT and SAT and safety functions (58)
- A time schedule for production, installation and testing (59)

The “as built” documentation shall include complete drawings of mechanical parts and complete schematics of the system, detailed such that components can be repaired, replaced or manufactured even if the contractor is no longer available (60). All documentation shall be delivered in electronic format (61).

The user manual and service instructions shall be delivered in Norwegian (62). Other documentation shall be delivered in any Scandinavian language or English (63).

Completeness

The delivery shall be complete: all necessary components shall be delivered and installed (64), and all components shall be properly finished or painted (65). All packing materials and other refuse shall be removed from the premises (66). The system shall be commissioned and tested in accordance with the test plans delivered with the design documentation (67). The supplier shall also confirm that there are no missing elements in the interface to the building structure.

Offers shall be complete and include all costs related to a complete installation (68), such as:

- Detailed engineering and design
- Provision for meetings in Oslo in design and build phases
- Production
- FAT

- Installation
- SAT
- All travel expenses
- Training
- Complete documentation

The warranty shall be 5 years, in accordance with NS8407 (69).

Drawings

- 1093-003 Layout fly bars section
- 1093-004 Stage machinery long section
- 1093-005 Layout fly bars plan
- PF 126-101 ÖversiktPlan
- PF 126-102 ÖversiktTvärsnitt
- PF 126-103 ÖversiktLängdsnitt

Alternatives

Alternative solutions that meet the functional and safety requirements may be proposed. While it is possible to offer only the mechanics (point hoists and winches) or only the control system (control desk and electrical cabinets), bidders who offer a complete installation will receive a higher evaluation for quality.

Installation dates

The theater stage will be closed for this installation from November 30, 2026, to February 26, 2027. The first month is reserved for the building reconstruction so that installation of the stage machinery will start on January 1. See the attached schedule for more details.

Inspection and approval

The system must be inspected and certified by an independent authority before takeover. The costs for the inspection will be covered by the owner. The supplier is otherwise responsible for meeting the requirements of the inspection (70).

Evaluation of quality

The evaluation of the quality of the delivery as described in the tender will be based on the factors listed below. To allow for this evaluation the bidder should include relevant descriptive information with the bid. The buyer may also consider the experience of referenced installations and other venues with similar installations from the bidder when evaluating quality.

Technical performance and quality

Evaluating technical execution and quality includes the company's ability to comply with the specified performance parameters and the standard of the offered equipment.

The bidder's ability to understand the scope of the installation, the company's ability in designing specified technical systems and ability to carry out the agreed contractual work will also be evaluated. Professional qualifications and the capacity to carry out the project together with the bidder's adherence to the referenced standards are also part of the evaluated quality. General

quality of the mechanical and electrical installations offered, including painting, finishing, component quality, noise levels, and ease of service are also important.

The bidder's offer and technical description should support this evaluation by describing how the various demands of the specification will be met. The description may refer to examples from similar installations. The bidder should also include examples from the documentation of other projects to show the bidder's ability to fulfil the requirements for design and as-built documentation.

Functionality and operator accessibility, including safety

One important parameter when evaluating functionality is the design of the control system and its ability to meet the specified performance functions. It is also important that operators understand the system and feel confident with the operator interface.

Safety features and other functions that ease technical work during rehearsals and performances are evaluated aspects of the offered systems.

User friendliness of the control system with respect to ease of use, documentation, faultfinding and service will be evaluated.

The bidder's description of the control system along with the user manual will be used to evaluate "Functionality and operator accessibility".

Safety features with respect to the considerations described above and relevant European standards will be evaluated here. The bidder does not need to supply a risk assessment with the offer but should explain how the risk assessment and safety functions will be developed and describe how the safety functions will be implemented based on the supplier's experience with similar installations.

Support, availability and maintenance

How the supplier assures continuous operation of the system and the resources available when support or service is required. The extent of the spare parts included in the offer and the time required to exchange parts is an important part of this point, as well as the bidder's ability to respond to faults or disruptions to the delivered systems.

Systems for active support, including availability by telephone on evenings and weekends and the ability to connect to the system over the Internet will be evaluated.

The supplier's ability to offer expert after sales service and regular maintenance will also be evaluated. The quality and completeness of the documentation, based on examples from other projects, will be an important factor in this evaluation.

The supplier should provide an estimate of annual service costs.

Evaluation of sustainability

The buyer places strong emphasis on ensuring that the contract is carried out in a sustainable manner, taking into account environmental, social, and economic factors throughout the entire project lifecycle.

The supplier should describe how the proposed solution and the implementation of this project contribute to:

- Reduced climate and environmental impact, including through careful selection of materials, responsible resource consumption, energy efficiency, and comprehensive waste management practices.
- Responsible and ethical working conditions, such as the safeguarding of health, safety, and welfare (HSE), adherence to ethical guidelines, and strict requirements for the supplier chain.
- Cost-effective and robust solutions designed for long service life, minimal maintenance needs, and optimal operating conditions that support reliability and durability.

Some specific points to consider with respect to stage machinery:

- System and component lifetimes. Older stage machinery had lifetimes of 50 to 75 years. Most newer installations have much shorter lifetimes. The bidder should show how their solution can achieve a longer lifetime. Possible methods include clear interfaces between mechanical, electrical and control parts and flexibility in design, such that the system can be maintained and upgraded without complete replacement.
- Efficiency in the design of electronics, avoiding the use of fans and turning off power to electronics when not in use. Returning braking energy to the grid might be considered, although this must be evaluated with respect to possible reduction in heating costs due to heat generated by the machinery.
- Choice of materials. Avoiding plastics and other materials that are difficult to recycle. Selecting components with high efficiencies to reduce energy consumption.
- Keeping service and maintenance costs to a minimum.