

# Lighting & Sound INTERNATIONAL

January 2000

The Entertainment Technology Monthly

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***On 1st December, Royal Opera and Royal Ballet opened the doors of their new Covent Garden home for the first time in over two years. Mike Mann went backstage to see what it takes to build a world-beating opera house.***

The rebuilding of one of Europe's finest opera and ballet houses has attracted a great deal of public controversy. However, no-one who has ever set foot behind the proscenium of the original 1855 house could be in any doubt that a re-fit was urgently needed. The crumbling Victorian structure, coupled with woefully inadequate stage systems and cramped rehearsal facilities, made Covent Garden an expensive and inhospitable place in which to stage a production.

#### ***New Covent Garden***

Project director John Fairclough was an executive with property developers Stanhope in 1993, when an outline plan was submitted for a new opera house which was to be the envy of Europe. Having already advised on the successful Glyndebourne opera house project, and with a solid background in commercial development, Stanhope quickly revisited the original concept of adding 200,000sq.ft of office accommodation to help pay for the theatre rebuild.





## THEATRE

In the post-1991 property slump in London, it was reasoned that office space could not attract the sort of revenue needed to keep the project afloat. Fairclough was seconded as project caretaker in August 1994, and appointed as project director later that year, working alongside John Seekings who was to represent the client. "The final scheme revolved around two things," he explained. "The first was to make the design as flat as possible, with a minimum number of changes in levels, and the second was to maintain a clearance of 11 metres over the stage and the side stages."

This in itself was no mean feat, since the original auditorium, a Grade 1 listed structure, was to be left standing, as was the 'Phase One' building that makes up the rear third of the Covent Garden site. Added to which, the land on which the theatre is built slopes from North to South (across the stage) and East to West.

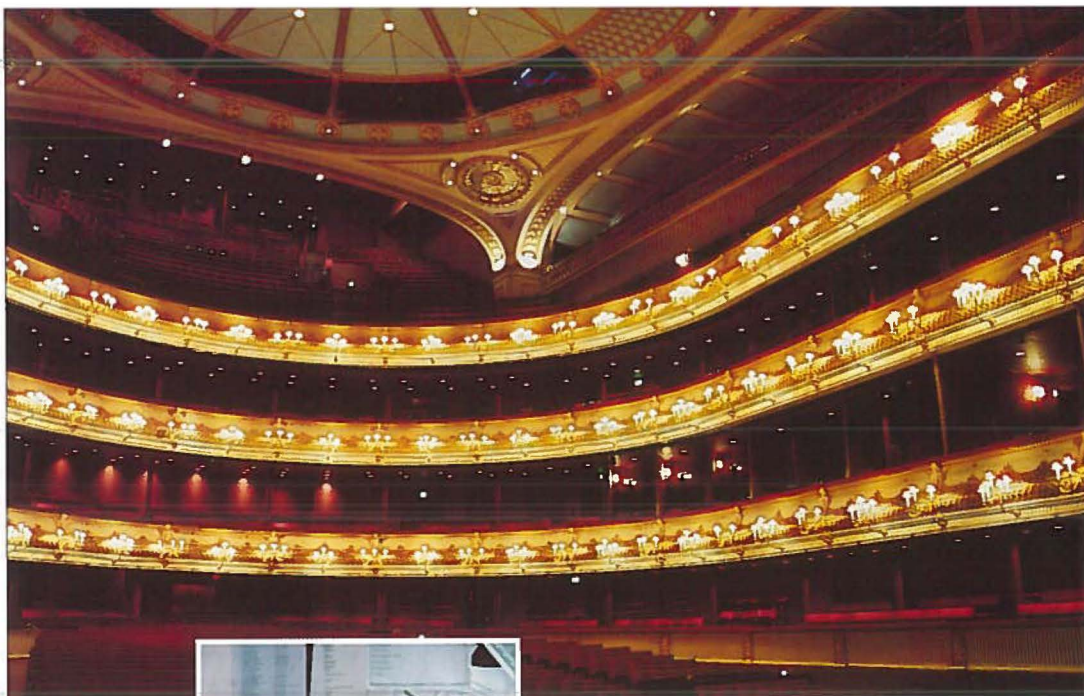
### Ballet Moves

One of the main aims of the redevelopment was to incorporate the Royal Ballet company, which had previously occupied a separate building in West London. The final building project, on a 2.5 acre site, is more than a theatre; it is a vast opera and ballet production village. As well as the main 2,257 capacity auditorium, there is a 420-seater studio theatre, a ballet studio theatre with seating for 200, two full-scale opera rehearsal rooms (which can take complete sets for pre-production work) and a further six studios. The mixed opera and ballet repertoire staged at Covent Garden requires not just the usual theatrical departments, but also the more specialised trades - gents' and ladies' opera shoes, for example, and an in-house wigmaker. For the audience, apart from the addition of air conditioning to the auditorium, the elegant Floral Hall (previously used as the main scenery store) has been rebuilt and the facilities and access through the building have been greatly improved.

### Unseen Work

Sadly, the less inquisitive opera or ballet-goer will never see the incredible transformation that has happened backstage. Upstage of the luxurious new red house tabs and Royal Crest (supplied by Gerriets and stitched by the Royal School of Needlework), there is barely a single reminder of the creaky old stage. Even the proscenium itself is new, and movable; the opening can now be varied by two metres in width and five metres in height, to a maximum of 15.5m wide by 9.5m high. The flytower, which now forms a completely independent structure, is 50m high with a triple-hung grid height of 37m above stage level. Support for this structure comes from four giant 3.3m diameter piles, sunk 35m into the ground, and widening to six metres at the bottom. Below the fixed galleries on each side of the stage is a rise-and-fall fly floor, which can be dropped to within three metres of the stage, while a huge (26m wide by six metres deep) mobile gantry is used to hang cloths and focus lighting without the need to fly the bars in to the stage.

Until the late 1980s, manual counterweight flying was still the norm at Covent Garden, but



Above, the rebuilt 1858 auditorium, Inset, project director John Fairclough

following a limited motorised installation before the closure of the house, German lifting giant Krupp was commissioned to supply a new flying system. The resulting installation offers a staggering 106 24m flown bars (all Triple E UniTruss), plus three up/downstage bars per side and six lighting pipes. The bars are rated at 1000kgs each and are set on 150mm pitch - just enough to allow them to pass each other. In

addition, 30 point hoists are installed, each with a capacity of 500kgs. Small wonder, then, that the main plate girder across the top of the tower weighs in at a mighty 56 tonnes!

Triple E collaborated with James Thomas Engineering (JTE) on the production of the UniTruss, which is designed to make the reviled task of hanging of drapes completely painless. The new product was originally specified for Covent Garden by Clive Odam, stage systems manager for the ROH. Odam needed a complete system - as opposed to just a track - that was able to accommodate a range of accessories and could speed up set-up times and increase scenery safety. The UniTruss resembles a ladder beam, but has an in-built track running along the bottom instead of just a normal barrel tube. Soft goods can then be attached via standard Triple E rollers, or if desired, lighting instruments can be clamped on via hook clamps.

JTE has been supplying the ROH for over 10 years, and other recent Thomas equipment to make its stage debut there has included a space-saving cloth truss with storage



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bins, allowing rolls and large quantities of drapes and softs to be flown up and stored in the roof. JTE also supplied a 15m by 6m box grid of SuperTruss, available for when the venue stages concert-style productions. The UniTruss, cloth bins and SuperTruss grid were all supplied via Stattec Bühnentechnik GmbH who motorised the flybar system.

#### Nomadic Tribes

London-based Stage Technologies was called upon by Krupp to provide the Opera House stage crews with a control installation that met their requirements for quick (twice-daily) repertoire change-overs, pin-point accuracy and a high degree of safety. The system is based on the company's Nomad portable consoles, which are used to control and monitor all flying, as well as handling the stage elevators (of which there are six), pit elevator and the wagon-based stage system. 10 Nomad

controllers are used, with fly staff receiving visual feedback on the fly floors via a 3D representation of the various objects under each person's control. The consoles, mounted on wheeled dollies, can connect to 24 strategically located points around the stage and galleries, which allows their operators to position themselves for the best possible view. The Nomad consoles and handheld Solo controllers connect to a server and a series of 24-axis control racks via Ethernet, while motor synchronicity and monitoring is assured by a CANBus network. As with any overhead system, crew and cast safety is of paramount importance, and rules concerning line-of-sight operation of equipment are strictly enforced. A total of 216 'axes' of movement are controlled by the ROH Nomad system, with the ever-changing repertoire making the storage, modification and accurate repetition of cues a major task for the system.

#### Quick Change

One of the most pressing reasons behind the technical refit was a need to reduce changeover times. The original manual flying system and lack of stage mechanisation meant that to go from a morning rehearsal on stage into an evening performance of a different production would take up to five-and-a-half hours. A full-time overnight crew was also required to repeat the process after the evening performance finished - and an average week of opera and ballet activity would see three different shows in performance and one or two in rehearsal - all sharing the same stage.

The original Covent Garden configuration had a single rear stage on which to store scenery required for an individual production, whereas the new theatre has a rear stage, side stage, rear-side stage, plus space between the scenery building dock and the main stage. Geoff Wheel, head of the Royal Opera House's technical department, explains how the system will improve changeovers: "With our old system, we had to use a 10ft by 8ft lift to the Floral Hall store - and this had a maximum height of only 24ft.

## Cyrano wins it by a nose...

The Cyrano produces 50% more light than other followspots from Robert Juliat.

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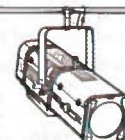


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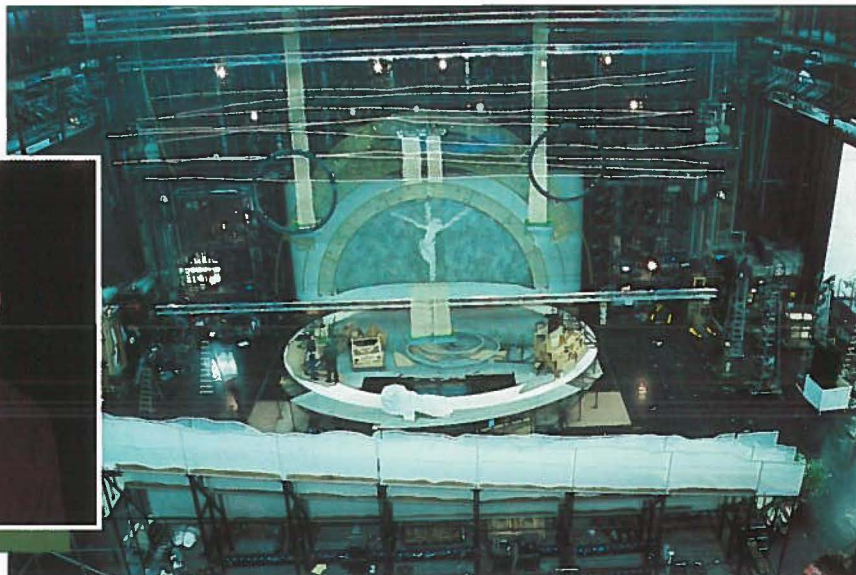
Right, the stage viewed from the overhead gantry. Inset, Geoff Wheel, head of the Royal Opera House's technical department

Now we have a wagon-based system which means that once a set is packed and the edges cleared, it now takes probably two minutes to roll the whole thing away to either the rear or side stage."

#### Rollers

The wagon system itself was custom-designed for Covent Garden by Clarke Chapman, an engineering subsidiary of Rolls Royce, and comprises a jigsaw of 14.8m by 4.8m mobile decks, which move orthogonally at a speed of up to 0.27m/s and can support 10 tonnes of set. Each wagon is propelled by static motors mounted on the edges of the surrounding floor sections, which use a caterpillar drive to engage with ribbed tracks fitted to their sides.

A total of 27 of these wagons are used at Covent Garden, with compensating elevators fitted to the entire storage area, allowing wagons to sit flush with immobile sections of floor. "We have two wagon types," adds Wheel. "The ballet company wagons are fitted with a fully-sprung dance floor, while a different wagon type offers a solid hardwood base for more substantial opera scenery. The original five-section stage was a compromise that was far from ideal for either application." A full opera set or ballet floor comprises three wagons: though these can be locked



together for transportation, the proximity of the stage to Covent Garden's famous piazza means that there is a restriction of two wagons' depth to gain access to the dock and rehearsal room.

#### Scene but not Heard

Once sets are no longer required in active rep, they must be stored off-site - the space required for the Royal Opera and Royal Ballet scenery alone is far greater than central London can offer. Part of the redevelopment project was the construction of a 10,000sq.m high-density storage facility in Aberdare, about 20km from Cardiff.

Technical manager Gary Mardon explained the system now being used to handle this potential logistical headache: "We



**"UniTruss is more than just another track: a complete system which accepts an extensive range of accessories, it will speed our set-up times and increase the safety of our flown scenery."**

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use a system of 'pallets' - these are 9.7 by 2.1 by 2.3 metre cages that have a capacity of 4.5 tonnes. We use three custom-built Fruehauf Megadeck trailers which have built-in conveyors so that they can load and unload at each end."

At the House itself, a 24-tonne lorry lift drops both trailer and tractor to three floors below stage, where a carousel system is used to store and locate up to 30 pallets. This kind of materials handling technology is rare in theatres, but is commonplace in the motor industry. In fact, the system used at the House (a Fredenhagen system) has previously been used in the UK by Ford.



Above, lighting control with the ETC Obsession II.

Right, Lighting consultant John B Read

Below, Technical manager Gary Mardon

The system is designed for one-man operation - though HSE regulations required a second staff member to be present at the remote Aberdare site. The Welsh warehouse holds 720 pallets, providing long and short-term storage for ROH productions as well as co-productions and rentals. Mardon is keen to see some standardisation between European opera houses: "We are trying to encourage more houses to work in this way, and to adopt a similar pallet system. If this happens, getting productions from other parts of the world will be much easier and more cost-effective."

In addition to the three pallet trailers, ROH has also invested in an orchestral trailer, which is custom-fitted on a 10m step-frame chassis to take the wide variety of instruments required for any production.

### Light on its Feet

With so much new technology being installed at the Royal Opera House, one might expect the lighting rig to be full of highly specialised gear. However, this is not every designer's cup of tea, as John B. Read, lighting consultant at Covent Garden, explained. "The system has to accommodate a broad range of designers who

need to feel that it's their own. It has to be flexible enough to light classical and modern opera and ballet. Read has worked at Covent Garden since 1981, having previously lit Contemporary Dance Theatre and Ballet Rambert.

Though a fan of moving lights as a way of speeding up the production process, he is aware that practical considerations limit their usefulness in this application. "Our noise levels on stage are less than those found in many recording studios," he explained. "The acousticians

[Arup] vetoed the use of fan-cooled moving lights from a noise point of view. Also, with the physically larger automated luminaires we would have to cut down the numbers - which is a problem when we need sheer power. The lighting pipes trim at 11.5m above the stage, so the throw is a minimum of 12-15 metres. That's a long way for a moving light to throw with a saturated colour."

Read adds, however, that the VL7 will be added to the house inventory as soon as it can be made quieter. "I'm a firm believer that every type of luminaire is necessary for an opera house. A fixture where we can focus and choose colour at a whim is a necessity."

Read's lighting concept reflects the shift in emphasis away from purely traditional designs, where overhead fixtures were almost unheard of: "When I joined the Opera House, there were only 16 spotlights over the stage. By the time we closed, there was always a minimum of 250. The rig is slightly bigger now, with six

pipes providing high, side, cross and backlighting, and using a conventional portal bridge to give front light positions. All major opera houses now need this kind of bridge, with stage perch positions at three or four levels."

Read had originally considered using walk-on bridges across the stage

for better access - however, the extra space required would have meant losing a complete pipe or most of the scenery flying space. A workable compromise was reached, with some fixtures being fitted with City Theatrical AutoYokes, and the addition of a two-man cherry-picker to the high-level gantry. "This is very useful for focusing standard and conventional luminaires," pointed out Read.

"At the moment we have about 60 instruments that are capable of being remotely panned, tilted and focused. The AutoYokes reduce our production and changeover time, but are used

purely as a means of focusing for static light. We're not in the business of moving light around the stage."

ETC was awarded the contract to supply and install the control and dimming systems, as well as a large number of Source 4 fixtures. The main house console, an Obsession II, is installed in the rear-stalls control room,

along with a Unison system for house and working lights. Dimming is provided by no less than 15 Sensor CE racks, each giving 96 outputs of mixed 3kW and 5kW power. The diminutive size of these racks, as with other venues, had taken the Opera House by surprise; the cavernous dimmer rooms situated above the FOH dome were clearly designed with much larger equipment in mind! The Obsession, as well as receiving constant information from the racks about load status and any failures, is provided with dual processors (both on UPS feeds), and is networked to the Unison control system. In this way, even a catastrophic problem would not result in a darkened stage.

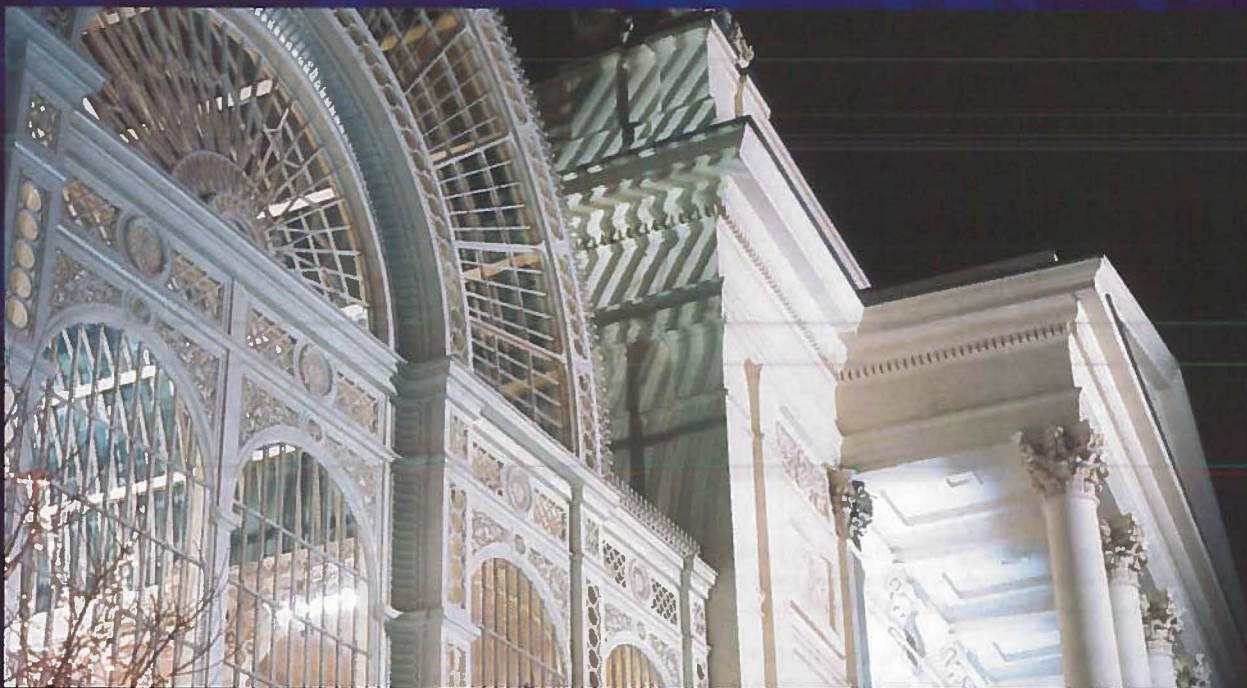
Over 1,700 luminaires, plus colour scrollers and ancillary items have been supplied to ROH by Lighting Technology in West London. As well as the ETC fixtures mentioned above, there were large quantities from Strand Lighting, Robert Juliat, James Thomas, CCT Lighting and ADB included in the inventory, plus Rainbow colour scrollers and various equipment from Smoke Factory, MDG, Doughty Engineering, Rope Assemblies, SES and projector lamps from all the major manufacturers. Batches of equipment were supplied in stages during the three months preceding the opening, being stored until required in LTG's Park Royal warehouse, as secure storage for the £500,000 order was not available at Covent Garden.

The ROH has been using Robert Juliat fixtures for some years, and is familiar with the reliability and performance of the brand. Because of this, Juliat profiles and fresnels were chosen to form a large part of the basic rig: 48 2.5kW profiles are used front-of-house, on the ballet booms and on the side bridges, as well as 92 1.2kW profiles and 52 2.5kW fresnels on the portal bridge, overheads and stage perch positions. Of the fresnels, 16 are also used in Lichttechnik moving yokes supplied by The Moving Light Company, and mounted in the overhead battens. The Moving Light Company was also responsible for the supply and commissioning of the City Theatrical AutoYokes. A service contract has been set up that will see MLC looking after the automated elements of the Royal Opera





# ETC ENTERTAINMENT



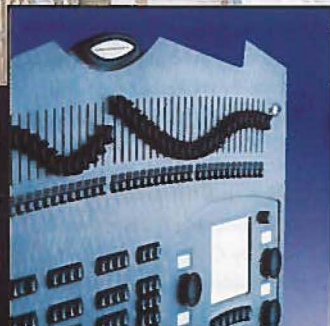
Royal Opera House, Photo: Rob Moore



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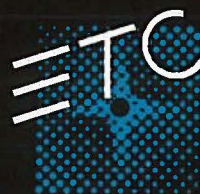
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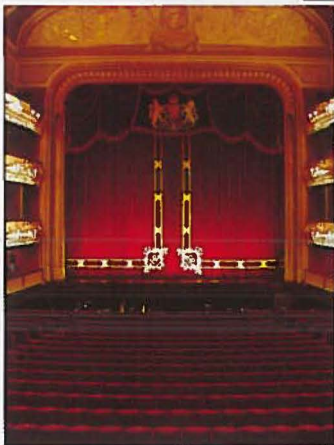
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Main picture shows one of the six lighting pipes. Inset, the house tabs, designed and supplied by Gerriets



House's lighting rig - as well as providing emergency call-out and support services to ensure that the show goes on as plotted, even given the Opera House's hectic schedule of constant changeovers between shows.

Despite the comprehensive nature of the lighting spec, the ROH team still felt they had a hole in their system and were looking for a high brightness, HMI zoom luminaire with as many automated features as possible but, top of the list for all the obvious reasons, it had to be quiet in performance. In the spring of 1999, technical consultant Mark White, together with John B. Read, John Charlton and David Harvey among others, paid several visits to Wynne Willson Gottelier's (WWG) London Studio.

What brought them to WWG was the knowledge that the design company are behind the twin axis, double mirror, beam positioning system as used on their own RazorHead searchlight project and by Coemar on their NATs. "The advantage of the system was immediately evident," says Mark White. "We have very restricted room for the hang, so there can be no question of an automated yoke in those positions. Furthermore, within reason, the WWG orbital head gives us the flexibility to choose any luminaire on which to put it. Another crucial factor is that, unlike other mirror systems, this one will always give us a symmetrical beam-field."

The luminaire selected for this treatment was the Juliat 2.5kW HMI zoom profile, and by the time the design process had run its course, a whole new automated light emerged from the shadows - Fantôme. To global positioning, were added the following remote attributes: zoom/focus, iris, framing and scrolling colour. Naturally, all these attributes will run on DMX and they are provided on top of the DMX controlled dower and remote ignition already resident in the luminaire. The first Fantômes will be installed shortly.

### **Cue Lights!**

Cueing the vast number of potential operations in an opera or ballet is a complex task; the ROH's previous cue light system, while sophisticated, did not allow the level of flexibility required by the new stage systems, and has been replaced by a touch-screen system from Northern Light. The control panel presents the SM with a heavily programmable display, with monitoring of outstations to detect failures, as well as 'acknowledge' functions from each remote position. The system is being installed in two phases; the final version will allow software patching of the 24 'keys' on the touchscreen panel to the 285 remote outstations, complete with lamp detection (a custom modification for ROH). This application represents only a fraction of the potential of the Northern Light system, which can be used to control and link virtually any element of a production.

### **In Translation**

One unusual requirement of opera is Surtitles. The provision of a simultaneous translation of foreign-language operas (called Supertitles in the US) was started in the mid-eighties at Covent Garden amid much controversy. The opera cognoscenti claimed that this was 'dumbing-down' opera, while Royal Opera management stuck doggedly to their guns, and now the Surtitles facility is seen as a key factor in persuading new audiences through the doors. The first system at Covent Garden was based on a trio of Kodak 35mm carousels with high-power lamp bases, controlled by an Electrosonic dissolve unit. These were located in an amphitheatre projection box and fired at a 4.8m wide screen flown below the royal crest downstage of the house tabs. The requirement to crossfade subtly between one pair of lines of text and the next was established; whereas television subtitles may be seen to 'cut', this was unacceptable when the characters were so much bigger. Mechanical unreliability, coupled with the inflexibility and cost of a slide system, resulted in a change to a video projection system in 1989, with a custom-designed event control system used alongside a two-channel caption generator and Hughes monochrome projector.

The new Surtitles system is the third generation of video systems to be used by Royal Opera, and with the increase in throw caused by an extended amphitheatre, the possibility of an active screen was investigated. Despite experiments with plasma technology and the increasing number of LED-based products available, the unique display requirements of the Surtitles system meant that a projection system was once again selected. A Digital Projection 5gv 5000 lumens projector now fills the diminutive projection box, throwing the image 39m to the gauze-covered screen. Two floors below, the Surtitles control room resembles a broadcast suite; TFT monitors from Sony and Melford Electronics are used for programme output, conductor camera, stage camera and the Courtyard Electronics Credit caption system. In addition to visual feedback, the isolated control room also receives show relay in stereo via an Allen & Heath GR-1, with an overriding paging feed in the event of any critical calls.

### **Sound Connections**

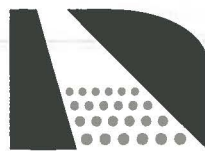
Sound, as with Surtitles, is a potentially controversial subject in an operatic environment. Unlike arena productions, however, Covent Garden remains faithful to tradition and does not reinforce on-stage singers - except where it is specifically required by the composer or designer. The precise requirements for effects, off-stage choruses and other aural trickery necessitate an immensely flexible sound system. So flexible, in





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*The balcony sound position with Calrec console*

While this is far from ideal acoustically, it has the commercial advantage of not using up paying seat space for a mix position. For more complex productions, an area of removable seating has been constructed near the centre of the balcony tier, where a temporary FOH position may be set up. The custom-configured Calrec Q-series console used for this purpose was chosen, in part, for its compact dimensions - given the need for up to 48 inputs and 40 outputs. Elsewhere, much custom-built equipment is in evidence; Pressley's own loudspeaker designs are used for all but the smallest enclosures (though Ethos Acoustics and ATC both supplied midfield and nearfield designs as part of the re-fit).

Amplification is by Chord - a name associated with the studio market, but not previously seen in any number in theatres. The ROH

requirement for over 200 mono amplifiers gave rise to a custom design that delivers 280W RMS continuous into 8W - but a burst power of over 1kW into 2W if required. Amplification is routed to loudspeaker positions by a distributed speaker jackfield - supplied, like the other audio and video patchbays, by Ghielmetti.

#### **Programme Mode**

The full opera and ballet programme kicked off in early December as scheduled with a new production of Verdi's *Falstaff*. Final commissioning and debugging, however, has slipped by about three months and will continue for the next few months as the various systems are exercised by their new owners. John Fairclough expects to vacate his project director's seat by April as the last of the building handovers are completed, and his praise for the in-house development team is unequivocal: "To have got here on time after five years is amazing," he confesses. "All credit to the house staff - much of this was a totally foreign activity to them. There has been a huge learning curve for everyone, with new ways of working and a much higher level of technology than before."

Fairclough also points out that this was no ordinary development project: "The Opera House is an amazingly complex environment - more akin to an aircraft carrier than a normal building. It's full of a myriad of different cottage industries that go to make up the opera and ballet companies, each of which has its own very specific set of needs. I'm very proud to have seen this project through from checking the first drawings to buying the last teaspoon."

**"It's full of a myriad of different cottage industries that go to make up the opera and ballet companies, each of which has its own very specific set of needs."**

fact, that no part of the Sound Department's system is permanently installed. Instead, ROH has installed an infrastructure of mind-boggling complexity, designed to manage the transition from analogue to digital equipment while coping with the needs of operas spanning nearly three centuries.

As well as front-of-house and on-stage sound, the infrastructure provides connections for video (stage and conductor pictures, house sync, Surtitles), communications (talkback, paging, show relay, cuellights, IR, RF) and allows for future control applications that do not form a part of the house IT network. A total of nearly half a million metres of cable has been run between the 3,000 connection panels and the three rack rooms located two floors below stage level. Canford Audio was appointed as overall infrastructure supplier, and teamed up with AVS to install and terminate the system. ROH head of sound Eric Pressley has applied an 'infrastructure-led, rather than equipment-led' philosophy to avoid tying himself to one type of equipment in any location. The stringent HSE regulations now placed on the Royal Opera House make it a complex job to plan for cabling to moving elevators, across doorways and the hundreds of stage-related locations, and staffing limitations dictate that changeovers should be as swift as possible.

Though most locations around the house have a selection of audio, video, control and data connections (generally provided on patch panels), two positions are earmarked for mixing and have to cope with rather heavier traffic. The Staff Box - the most upstage of the house-left Grand Tier boxes - has been divided to allow a mixing position.

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