

National Theatre on the South Bank - Photo credit: National Theatre

THE OLIVIER THEATRE AND L-ACOUSTICS

NATIONAL THEATRE,
LONDON, UK



ED FERGUSON
Sound Manager -
Oliver Theatre

National Theatre on London's South Bank houses three theatres, including the Olivier Theatre, the largest of the three; the Lyttelton Theatre, seating 890 and The Shed, seating 225, a temporary pop-up theatre in operation while the Cottesloe Theatre is renovated (when it reopens it will be named the Dorfman Theatre). The Olivier Theatre, named after its first director Laurence Olivier, is one of the most prestigious producing theatres in the world.

In 2013 the National celebrated its 50th anniversary. Over the last ten years, under the helm of Director Nicholas Hytner (2003-2015), the theatre has gone from strength to strength, with internationally acclaimed productions such as *The History Boys*, *War Horse* and *One Man, Two Governors* helping to fund an ambitious £80m redevelopment of the building.

National Theatre Live, a groundbreaking project broadcasting live NT productions to cinemas across the UK and worldwide, was launched in 2009 with a broadcast of the production of *Phèdre*, starring Helen Mirren. The National have since broadcast over 20 productions which have been experienced by over 1.5 million people in over 500 venues around the world.

The Olivier Theatre hosts an eclectic mix of shows. In recent years, these have included blockbuster shows like *War Horse*, which started its stratospheric success in the Olivier, and *Frankenstein*, directed by Danny Boyle with the team that would go on to create the Opening Ceremony of the London 2012 Olympic Games.

The Olivier is a unique space based upon a Greek amphitheatre design, with seating for 1100 over a 120° slope in its fan-shaped auditorium. The idea is that whilst standing in any position on the stage, using your peripheral vision, the whole house can be viewed. Two main tiers of raked seats — flanked by raised side-banks — sweep down to the stage. In spite of its size, the Olivier has a concentrated intimacy. No seat is far from the actor's point of command.

A unique piece of stage engineering, the drum revolve, is at the centre of the Olivier's stage. It is five storeys high, contains several elevators and enables exciting changeovers like towers or boats rising out of the stage or objects suddenly disappearing from view.

REVISITING SOUND

The existing Olivier sound system was an amalgamation of different equipment bought from both capital and show budgets dating back over many years. This 'ad hoc' approach to the Olivier system design meant the existing structure was comprised of an unmatched combination of ageing components, which, over recent years, had begun to fail to meet the artistic teams' needs. A common complaint was that the system was not capable of high 'sound pressure levels' required for certain dramatic effects whether it be music, sound effects or voice. Another issue was the systems' inability to distribute the sound evenly throughout the whole auditorium.

When the Olivier was in a position to upgrade the existing sound system in 2011, primary considerations included selecting a system flexible enough, powerful enough and of sufficiently high quality to be reconfigured for each new production, as well as to deliver the artistic vision of the many guest sound designers. Paul Arditti, frequent sound designer at the Olivier Theatre, believed the task would not be easy, "as the Olivier Theatre is an extremely tricky theatre for sound."

“THE OLIVIER THEATRE IS A VERY TRICKY THEATRE FOR SOUND. I WAS KNOCKED OUT WHEN I FIRST HEARD THE KARAS IN THIS SPACE. THE SOUND IS SUPERBLY DETAILED, AND THE SYSTEM IS EXTREMELY POWERFUL.”

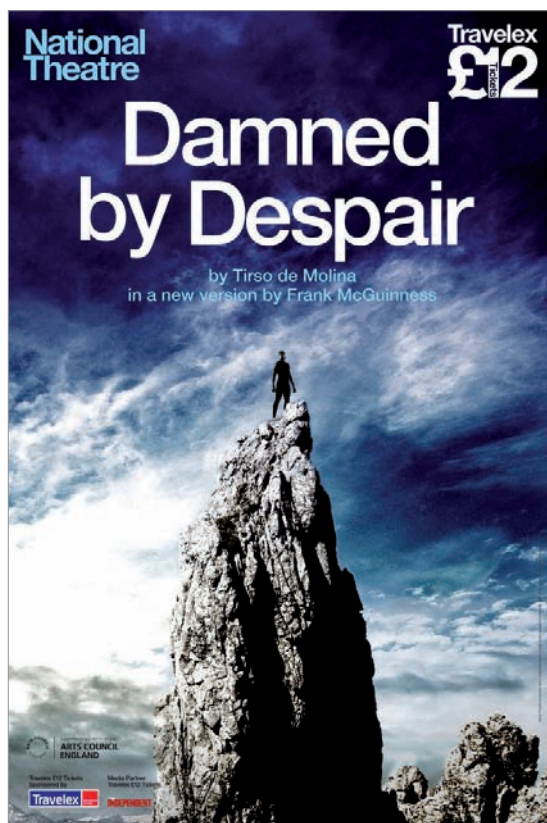
Paul Arditti, Sound Designer, UK

Ed Ferguson, Sound Manager at the Olivier Theatre with a team of four full-timers, explains, "The way the system had grown in the Olivier Theatre was very organic. A sound designer would often come in and say, 'oh I need to something to fix that hole' and we'd stick a speaker up there then the speaker would stay up for 12 years".

"We started looking to price a new speaker system. At the same time our analogue desk was coming to the end of its useful life and had been superseded by digital technology. It was a unique situation, looking at the whole system and wondering what we could do. We are not just a producing house but also a repertory theatre – we can do two or three shows in the rep, and need to be able to change over from one show to another show in a matter of hours. We needed a flexible system."

"I talked to a number of different sound designers. A lot of them fed back to me that they wanted to have a more flexible system. The way the old system worked was very fixed. We wanted to put the onus back on to the designer, offering them a kit of parts to design a system specifically for the needs of their production rather than having to fit their requirements round an existing house system."

The Olivier decided to replace the speaker system and the speaker management system as a whole, addressing first the vocal system and the band system (or the main system), followed by the surround system and the on-stage speakers.



Damned by Despair by Frank McGuinness, directed by Bijan Sheibani, sound design by Dan Jones

KEY OBJECTIVES DESIGN PROPOSALS

In autumn 2011, three established audio manufacturers were chosen to put forward their design proposals and to demo on-site at the theatre. Both line source array and point source technology options were investigated. The system needed to offer maximum flexibility to deal with all aspects of the theatre's needs.

Functionally, it had to be capable of:

- voice reproduction for both non-musical and musical theatre
- stereo music and special effects reproduction

Requirements notably included:

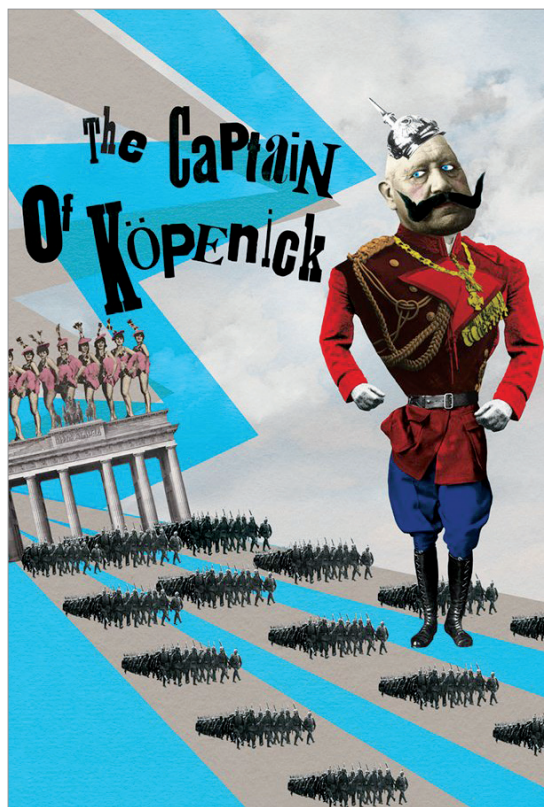
- intelligibility, high SPL and even coverage for voice reproduction
- high SPL, excellent stereo imaging and dynamic range for music
- homogeneous frequency response for musicals and plays
- adequate low-end reinforcement
- capacity to be quickly reconfigured

The National Theatre also wished to ensure that their investment would be provided by companies with long-term prospects. Whichever system was chosen was going to be in the theatre for a long time, so it was important that they get it right. Ed Ferguson explains, "It was a big criterion to ensure that whoever we were going with would not only be relevant now but would still be relevant in ten to fifteen years."

SOUND DESIGN PROPOSAL L-ACOUSTICS

Voice reproduction

It was decided to deploy a central cluster for vocal reproduction. A single and central point source ensures high intelligibility figures within the audience. The fan-shaped audience geometry and the medium throw coverage requirement from the first rows to the last upper rows and the high SPL requirement called for an ARCS® II constant curvature line source.

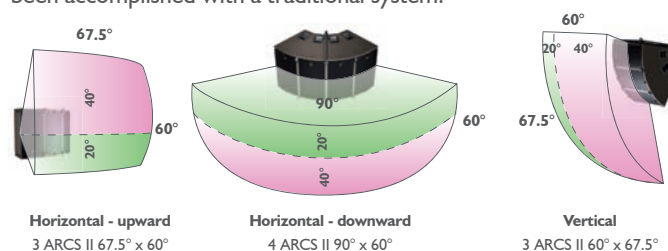


The Captain of Köpenick by Carl Zuckmayer, directed by Adrian Noble, sound design by Mic Pool



The **ARCS® II** constant curvature enclosure features a DOSC® waveguide which morphs the spherical wavefront of the HF driver into a toric, isophasic wave. As a result, ARCS® can be arrayed with a perfect acoustic coupling as opposed to classic trapezoidal

enclosures which interfere with each other and produce comb filtering degrading sound quality outside of the array axis. When compared to conventional line source systems, ARCS® has the advantage of offering a perfect control over horizontal coverage and a smooth tonal balance over all frequencies. The wavefront emitted horizontally by the enclosure allows uniform coverage in increments. An ARCS® II system can be deployed with a total coverage angle proportional to the number N of ARCS® enclosures in the array. ARCS® can fit applications requiring 22.5° to 360° for in-the-round designs. This exceptional scalability made ARCS® an obvious choice as an extended horizontal coverage could not have been accomplished with a traditional system.



The ARCS® II central cluster consists of an array of 6 ARCS® II enclosures deployed horizontally. The array generates 135° (6 x 22.5°) of horizontal coverage and 60° in the vertical plane. The array is flown above the proscenium arch at 9m above the stage, thus contributing to a discreet integration and an even SPL across the auditorium by reducing the distance ratio between the front and the back of the audience.

A few additional fills were also needed. L-ACOUSTICS Application Engineer Chris Vass explains: "It was initially noticed on the SOUNDVISION model and confirmed later in the tests that the ARCS® II weren't quite getting around to the horizontal extremities of the raised stalls, a challenge within the venue – so it was decided to look into a fill box there. 12XTi outfills were added to the design to cover this space. This also helped with the imaging of the system out to the seats at the extremities of each side of the audience, as you are almost looking side-on to the stage. This 12XTi helped draw focus back to the upstage area. We also added a row of 8XTi delays to the circle to cover beyond the ARCS® II."

Music and effects

L-ACOUSTICS design proposal featured a variable curvature line source deployed in a left/right configuration. A KARA modular line source fulfilled the need to maximize the stereo imaging, offer a constant tonal balance and a high and even SPL. The principle of a modular line source is to offer a full-range active line source system into a compact, lightweight enclosure and its complementary subwoofer. These modular combinations of L-ACOUSTICS line sources (such as KIVA or KARA) covering the HF/MF region and their complementary subwoofers (SB15m, or SB18, respectively) deliver an acoustic performance comparable to a larger system, but with added flexibility in terms of physical configuration between top cabinets and their LF extensions. Whenever possible, subwoofers are typically flown closely coupled to the KARA elements for the best coherence. Otherwise, subwoofers are ground stacked.

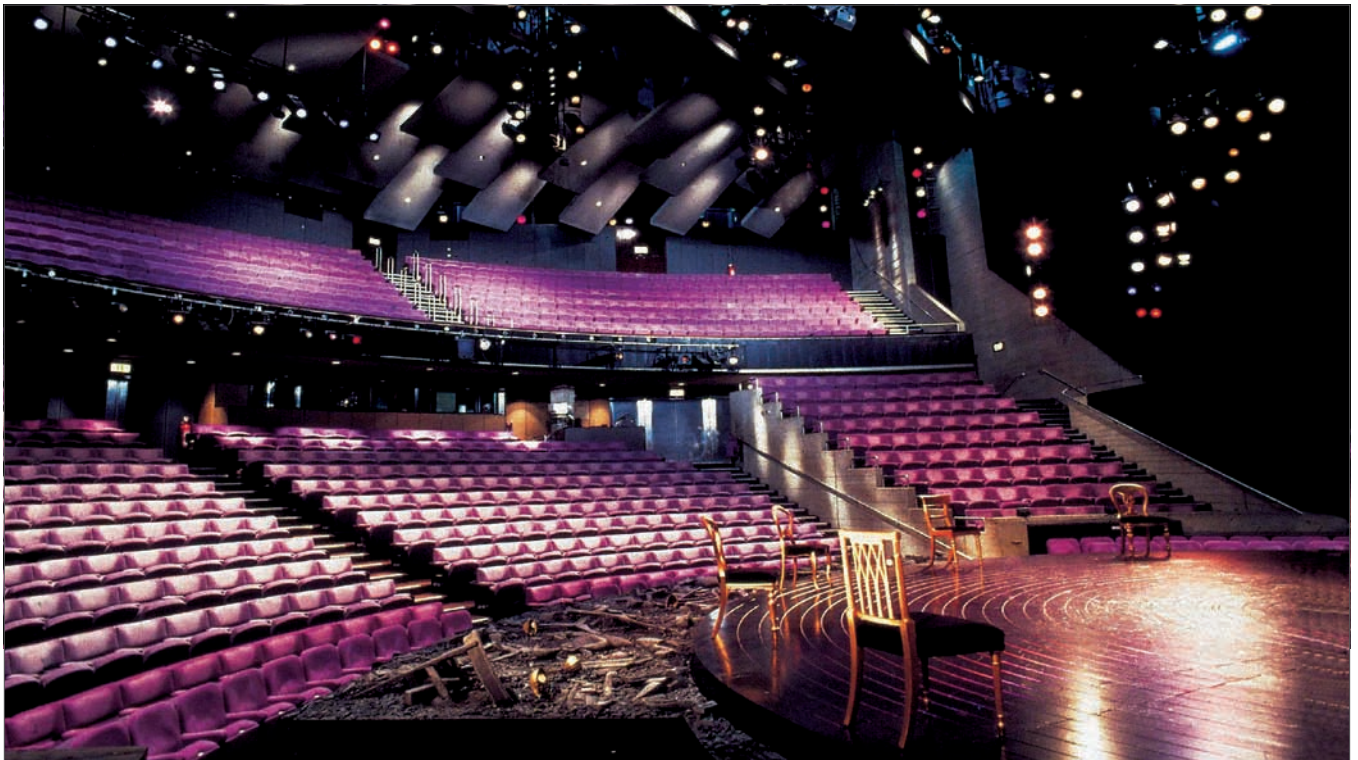
At the Olivier Theatre, the KARA L/R clusters are flown on either side of the proscenium arch at 7.4m above the stage. Each cluster comprises nine enclosures and its LF resources are reinforced by three ground stacked SB18 subwoofers extending the coverage down to 32 Hz. The KARA's 110° horizontal directivity maximizes the central overlap zone between L/R clusters coverage. This allows the sound designers to create a stereo image from incoming sources, offering the audience a stereo experience of both music and effects.

Demonstrating system capabilities

The L-ACOUSTICS team scheduled a day with the Olivier sound crew to familiarise them with the L-ACOUSTICS design, recommended kit, calibration, system configurability and capabilities. Giving the crew hands-on experience with the system meant the team had an idea of how the system would work in practice. Chris Vass took the sound crew through the SOUNDVISION plot and the LA NETWORK MANAGER design. The same method was used to tune the systems. "It is really important to let people hear what the system sounds like 'out of the box' with no EQ to demonstrate the quality of the L-ACOUSTICS presets." All that was needed was a little time alignment between the sources, and a couple of gentle filters in the NWM which could be popped in if the need arose. Chris did eight to ten measurements just to confirm what was being heard. The crew at the National Theatre were part of this process as well, looking in on the measurements as they were taken. Within about 20 to 30 minutes of the system being up it was handed over to the team at the National to play with independently.



Othello by William Shakespeare, directed by Nicholas Hytner,
sound design by Gareth Fry



The Oliver Theatre - Photo credit : National Theatre

Stuart Down, Sales Manager for the UK, says, "Various tests were conducted on the system. Using a live mic on-stage and using just the centre, ARCS® II sounded very natural and not like the speaker system was actually on at all. A notorious area for achieving gain before feedback was in one of the locations that live bands can be placed on a raised area opposite the stage right array. When percussion or condenser mics are required it can be problematic due to the proximity of the PA, as was the case at the time of the demo. With the arrays in place the mics were made live and levels pushed until the full travel of the fader had been made, showing a vast improvement in available headroom! At this point the crew wanted to check the EQ and the desk was set up correctly to be sure that the house system was in fact working as it should be, as the proposed replacement system illustrated some of the challenges of the existing system."

"In the final test we pushed some level with Underworld tracks. This showed the system could cope with just about anything thrown at it from delicate speech reinforcement to full-on impact sound effects, to putting on a rave if they wanted to. The system demonstrated that they would now have the tools to offer a virtual point source centre vocal system with a very natural feel and sound. A line array system offers sound designers the benefits of a line source array in

the left right KARA system. After this demo we were also asked to provide design for the delay speakers, which they hadn't planned to update. These were included in the final design."

The official National Theatre response to the demonstration from L-ACOUSTICS was glowing, "Our findings from the demonstration were very interesting. The KARA line array sounded great and its 110° dispersion gave fantastic coverage in the auditorium. During the demo we listened to radio mics through the centre cluster position. Spoken word relayed through the ARCS® II sounded transparent and natural. The ARCS® II really impressed in the centre cluster position, for their unobtrusive shape, great dispersion and fidelity. The L-ACOUSTICS' systems are based on a separate enclosure/amplifier controller platform allowing use of the current infrastructure with minimal changes."

The report concluded that that L-ACOUSTICS' system would be the ideal choice to replace the vocal and music system in the Olivier. With the diverse range of theatre that the Olivier produces and the need to cater for the requests of the world-class sound designers who work there, L-ACOUSTICS designed a flexible system that can cater for every eventuality and allow the venue to host multiple productions on a weekly basis.

SYSTEM SETUP AND CALIBRATION

System setup

Chris Vass: "For rigging and cabling, the theatre already has a cable infrastructure in place so it was easy for us to tie into this with minimum fuss or change. The amplified controllers were situated in the roof space. It was the same with the rigging. The only thing that needed looking at was the centre cluster and the 8XTi delays. Ed [Ferguson] had all this pretty much arranged before the kit arrived."

"The networking infrastructure was all in place as well, the LA NETWORK MANAGER sits on a Sound VLAN. In the end we did all the tuning and balancing of the systems in the LA NETWORK MANAGER with the thought that as this was then hidden away from designers they could do everything they needed directly with some external DSP. This approach of platform separation allows both designers to apply their creative design and the venue to preserve the system core settings and quickly go back to square one."



London Road by Alecky Blythe and Adam Cork, directed by Rufus Norris,
sound design by Paul Arditti. Photo credit : Mark Douet

Measurements

"We spent a lot of time on the calibration phase, taking measurements. Because of the changes to the listening areas (lower stalls, raised stalls, circle etc etc) I did lots of measurements for each section and then averaged that area to see what was happening locally. I then created an average for the whole space and compared that to the local "zones". Very little needed doing. When Paul Arditti came in, we let him play with the external DSP. With the KARA the only thing he did was make one of my "notches" a little deeper. Knowing how good Paul's ears are, I was very happy about that."

Final tweaks

"From a tonal balance point of view, both Ed and I were keen for the frequency response of the KARA to be as smooth and even as possible front to back. We talked about maintaining SPL throughout the auditorium, but decided frequency response was more important as the SPL change was minimal. We ended up taking a little LF contour out of the KARA with the zoom control in LA NETWORK MANAGER as this was deemed to give a flatter response and more likely what the visiting sound designers would want."

The ARCS® II was treated as a flat system with the entire contour available. As this is predominantly a vocal system, designers tend to remove the majority of the low end. When Paul Arditti came to listen to the system for the first time, one of the things he was really impressed with was the overall low frequency control from the system, as this was another area that had needed improving in the venue."

FIRST SHOW WITH L-ACOUSTICS

Paul Arditti, *London Road*

Paul Arditti was the first to use the L-ACOUSTICS system for the production of *London Road* which received five-star reviews, as well as winning the Critics' Circle Award for Best Musical and Show of the Year from Time Out. Arditti's recent work includes *Edward II* directed by Joe Hill-Gibbins at the National Theatre, London; *Charlie and The Chocolate Factory* directed by Sam Mendes at the Theatre Royal, Drury Lane and *The Audience*, directed by Stephen Daldry and starring Helen Mirren, at the Gielgud Theatre, London.

PAUL ARDITTI

Sound Designer



The Olivier Theatre is a very tricky theatre for sound – I have been designing shows in this auditorium for 25 years, and have generally been disappointed with the quality, power handling and dispersion characteristics of previously installed loudspeaker systems. I was knocked out when I first heard the KARAs in this space.

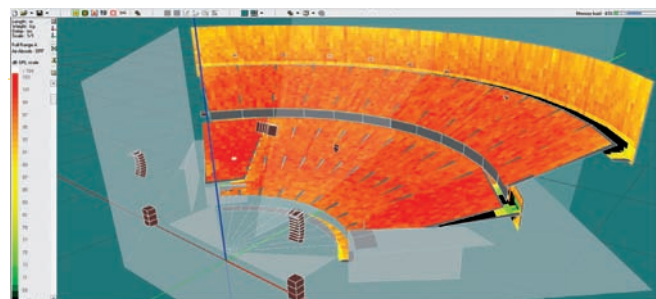
The sound is superbly detailed, the system is extremely powerful, and the horizontal and vertical dispersion of the arrays are very consistent. The stage and auditorium in the Olivier have always had very compromised acoustics, plus an audience layout requiring wide horizontal dispersion and tightly controlled vertical dispersion, all from a very limited number of not-ideal loudspeaker positions. The KARAs have an 110° horizontal dispersion, and we are able to cover the vast majority of seats in the theatre with just two arrays.

One of the first shows to use the KARAs and centre array of ARCS® II was *London Road*. Having previously designed this new 'verbatim' musical in the much smaller Cottesloe Theatre, I was anxious to maintain its domestic and natural feel, both for the vocals and for the band. As soon as we fired up the KARAs and started our band sound check, people started smiling. Every instrument sounded crystal clear and amazingly real. Similarly, the ARCS® II were able to project clean, subtle vocals evenly around the auditorium without hotspots, deadspots or the need for much EQ on the performers' mics. I am delighted that the Olivier Theatre has these speakers for keeps! The L-ACOUSTICS speakers have transformed the sound in the Olivier Theatre. Radio mics are being used more and more in this theatre, even in plays, and it has always been a struggle get a clean, natural sound to every seat, whilst maintaining good imaging to the stage. Now I am confident that whenever I need to put radio mics on actors in the Olivier, directors and audiences will be delighted with the results, wherever they sit.

EQUIPMENT LIST (capacity : 1160)

The Olivier Theatre

TOTAL QUANTITIES	PRODUCTS
6	ARCS® II
18	KARA
6	SB18
8	8XTi
2	12XTi
8	LA8



Olivier Theater SOUNDVISION

SHOWS AT THE NATIONAL THEATRE

since L-ACOUSTICS' installation

Timon of Athens by William Shakespeare,
directed by Nicholas Hytner, sound design by Chris Shutt.

The Magistrate by Arthur Wing Pinero,
directed by Timothy Shearer, sound design by Paul Arditto.

The Captain of Köpenick by Carl Zuckmayer,
directed by Adrian Noble, sound design by Mic Pool.

London Road by Alecky Blythe and Adam Cork,
directed by Rufus Norris, sound design by Paul Arditto.

Damned by Despair by Frank McGuinness,
directed by Bijan Sheibani, sound design by Dan Jones.

This House by James Graham,
directed by Jeremy Herrin, sound design by Ian Dickinson.

Othello by William Shakespeare,
directed by Nicholas Hytner, sound design by Gareth Fry.

The Amen Corner by James Baldwin,
directed by Rufus Norris, sound design by Simon Baker



The Magistrate



This House



Timon of Athens



Edward II