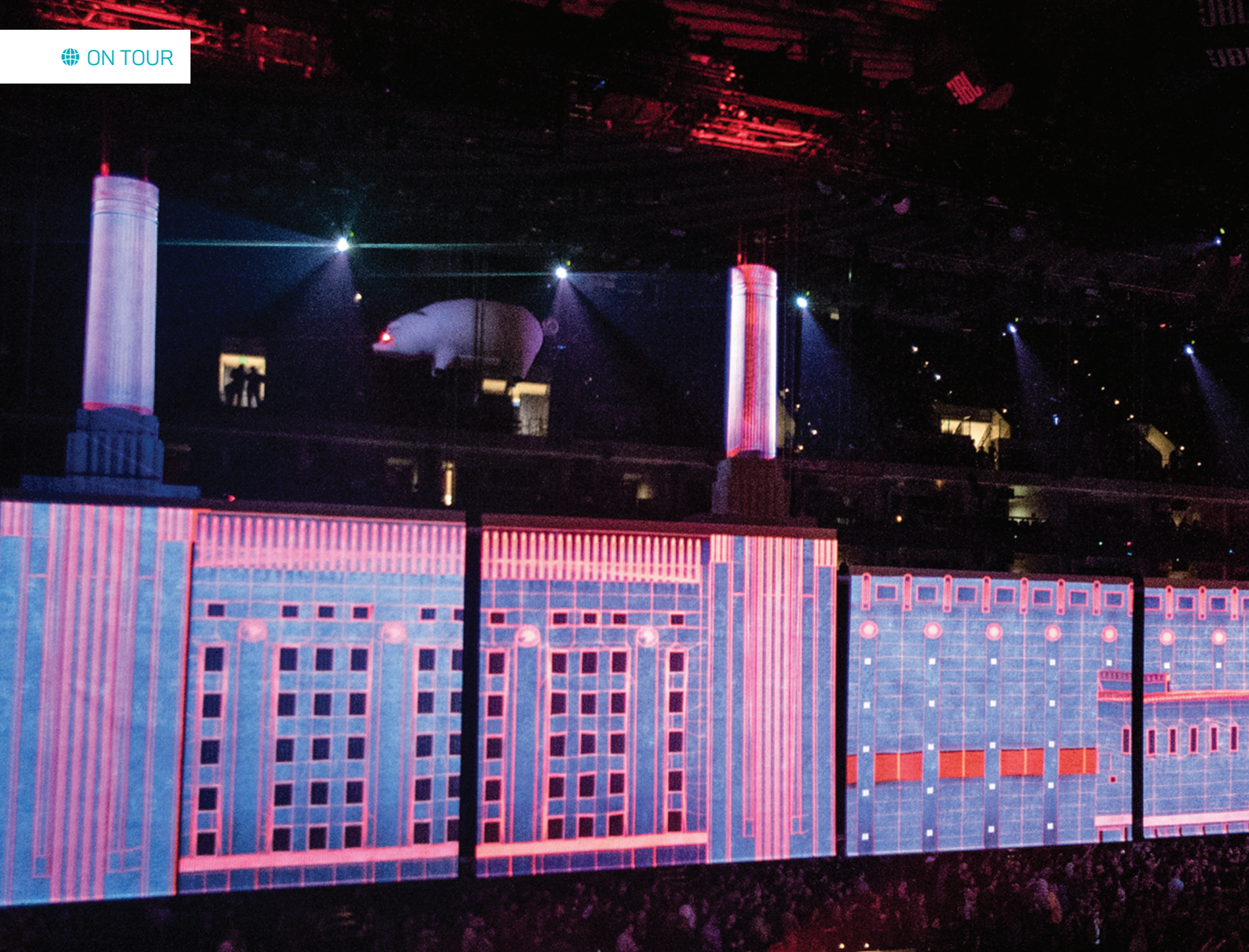




Steve Moles reports from Liverpool Echo Arena on Roger Waters' *Us+Them* tour, a video-heavy spectacle complete with flying pigs . . .

When Pink Floyd staged two shows at Earls Court in May 1973, they wrought a profound change on the world of rock concerts. It wasn't just the aeroplane traversing the arena or the quad sound system - the whole relationship between audience and performance had been re-imagined.

Roger Waters, former member of Pink Floyd, has undoubtedly established himself as one of the great rock and roll showmen by taking his conceptual shows across the globe. In his *Us+Them* tour, the musicians are often secondary to the drama served up on stage - Waters is well-known for raising difficult questions about the current state of the world through his productions, and whatever your political persuasion, it's impossible to gainsay him.

That considered, this was still an amazing spectacle to behold. Spectacle has become a cliché for live concerts - just how many major productions with huge sets, hundreds of moving lights, acres of LED screens, and a bucket-load of PA facilitate a connection between what we see and hear? Spectacles for spectacle's sake . . .

While Waters' show is no less a spectacle, there's not an ounce of fat - each element is meaningful, even profound, as songs

from the Pink Floyd heyday, such as *Welcome to the Machine* (from the album *Wish You Were Here*) or *Pigs* (from *Animals*) remain prescient today. For those unfamiliar with Floyd's repertoire, buy the albums, or better still, see the show. You won't regret it - Waters has discovered a secret reservoir of energy as he navigates his seventh decade. The tour is set to run until at least the end of the year, though by the time you read this, you'll need a ticket to the Americas.

PRODUCTION ELEMENTS

Led into the Liverpool Echo Arena auditorium by production manager Chris Kansy, I was greeted by the sight of multiple roller screens running the length of the arena floor - two parallel runs 20ft apart provide a sizable physical presence for an evocation of the Battersea Power Station that will be projected on their surface for the second half of the show.

First off, it was a pleasure to finally meet Kansy - such was the ease of my passage that day, I could have been visiting an as-yet-unbroken band playing Manchester Academy II. That is the measure of a good PM: a balanced perspective on what is important. There he was, discussing the Martin Audio system with FOH engineer Jon Lemon ahead of Waters' appearance at the British Summer Time (BST) festival in Hyde Park the

ROGER WATERS

US+THEM



following weekend (see side bar on page 108). Within minutes, he was showing me around FOH, taking particular pride in describing the wonders of the VYV Photon system, which, as part of its function, keeps an armada of video projectors out in the house perfectly framed to the dancing Tait Rollio screens.

The creative nexus of the show comprises creative director Sean Evans and Waters himself, plus Richard Turner for video, Pryderi Baskerville for lighting, and Jeremy Lloyd of Wonder Works, who elegantly solves the logistical / mechanical challenges. And my old friend Jon Lemon mixing FOH, a finer pair of ears you could not want.

"Every projector has an IR camera that tracks the screens. But this goes further," opens Kansy. Most readers will be familiar with the venue calibration routine - vertical strings of reference points festoon the arena so that IR cameras can map the spatial dimension of where they are relative to each other and their targets. Tracking screen positions is but a small part of what the Photon system does. "Photon data is used by Pryderi to run a set of lights to track the flying pig [inflatable set piece] as it navigates the auditorium. And Roger wears IEMs with IR transmitters so that lights can be assigned to him as followspots and never miss their mark." Similarly, the floating props - the pig and a silver orb - as well as the Rollios, have IR markers. The pig comes from Mobile Airships; the four Battersea Power Station chimneys that emerge above the Rollios, from Airworks, and the inflatable orb, from Airstage.

The production also utilises lasers from Strictly FX out on the floor; they run up a 3m tower with a scanning head, then project beams up to a flown central hub where more lasers reside. On stage, there are two more scanning heads at the same height as the tower out in the audience. The lasers

only perform at the show's finale to complement the soaring magnificence of *Comfortably Numb*, when a vast wireframe rendering of a pyramid is formed above the audience. And while we talk reference to Pink Floyd icons, despite heavy plundering of the *Dark Side* canon, never once did we see anything remotely like a circular screen ringed with moving lights behind the band. Marc Brickman, eat your heart out.

SOUND CHANGES

Waters shows have tended to sustain vendor relations over the years - audio supplier Clair Global being one of them - and through a quirk of evolution, Waters' connection to the original Floyd equipment company, Britannia Row, has been rekindled. I ask Kansy if there had been any appreciable difference for him as client now that Brit Row has come into the Clair Global fold? "It's better for me," he says emphatically. "If nothing else, I'm not paying for gear to be trucked all the way from Switzerland [Clair's European hub]." Fair enough - but that's just a point on the budget? "Well, the change is seamless and I wouldn't expect any different - I've known Bryan Grant at Brit Row for decades. They always deliver."

For the longest time, Waters had used Clair's most notorious FOH engineer, James 'Trip' Khalaf - yet here was Lemon in the coveted role. "I took over on the fourth show of the run," he explains. "Trip was already contemplating retirement and realised very quickly he just didn't have another tour left in him." Sad to see him go - besides being one of the most renowned engineers in the history of rock and roll, Khalaf also has a whip-sharp sense of humour. "Trip knew I'd mixed the Floyd reunion at *Live 8* and he called me. I also know many of Waters' band members and I'd done quite a few tours with Chris (Kansy) in the mid-late '90s, so there's plenty of history."



Photo: Kate Izor



- ↑ From top: LD Pryderi Baskerville
- Jon Lemon (FOH) and Dean Mizzi (systems tech)
- Matt Napier (monitors)
- Dave Rogers (video)

Had Lemon made any changes since the tour kicked off in May 2017? "When I took over, we had a Clair i-5D system with i3 surrounds. Two months later, I brought Dean Mizzi on-board as my system tech. There was nothing wrong with the system tech I already had, in fact I'd not worked with Dean before but I'd heard how good he was. We then switched from I-Series to the new CO-12, which he knows well. I wanted to bring the tour more into the modern world."

Lemon notes that in every other department - lighting, video and effects - the latest tech had been spec'd, while he had inherited two Clair XL4s out front and 74U spaces of outboard kit. "So, during a break in the tour, Dean and I went into a rehearsal room at Clair's base in Lititz and switched to CO-12 and a DiGiCo SD5-based mixing platform," he says. "But I also kept the analogue thing going, there's still quite a bit of outboard. The show is run much like a theatre show - timing is precise, and for what Roger requires in terms of delivery, it made more sense to allow digital control to take priority. We've gone from six off-board racks to two, and I still use the onboard plug-ins as well. Switching the PA, changing the desk - it's all about bringing the audio to the same cutting-edge as lights and video."

MONITORS IN DETAIL

Mizzi outlines the system: "We have flown L/R mains of CO-12 with 12 CP-218 [a twin 18" sub] in a central sub arc on the floor, plus six in the air behind the mains. I tend to push most energy into the air; they work hard. For off-side L/R we have CO-8 and the new CO-10 for the surround system hangs out in the hall." He adds: "The Cohesion system is a big jump from the

I-5. As we took it on, Clair had just completed the V3 software and that's made a big difference." Lemon agrees: "This is as good as it gets - CO-12 compares easily with d&b J-Series or L-Acoustics K1, and with Adamson."

"We've had great support from Clair throughout," adds Mizzi. "JPJ Audio in Australia, Brit Row here in Europe - three duplicate systems and support is seamless. I like that I can pick up the phone and Brit Row will deliver the next day."

So what of the show? "There are 10 people on stage and I have 110 inputs," says Lemon. "Everyone plays multiple instruments so the channels get eaten up soon - the drum kit takes 24, there are two keyboard players, synths, Wurliizers, Hammonds, all sorts. Roger plays bass, acoustic and electric guitars. Besides the BVs, seven band members sing, and there are quite a few playback effects." A noticeable characteristic of the surround system was the vocal clarity of the playbacks - the spoken parts on *The Great Gig in the Sky* - were crystal clear, the dual elements of the sound design giving Lemon ample space to bring such sounds into the foreground. "The vocal mics are all Shure SM58s, though you'll find most of everything else up there - Neumann, Pyle, Telefunken. Most of the mic choices are mine and I changed a lot, but Roger likes the 58 and I saw no good reason to change it."

Any reason to favour the DiGiCo SD5 over the popular SD7? "Most of the important issues are addressed here and it's a terrific board," continues Lemon. "The show is complex, so I use many snapshots, around 15 per song. This way

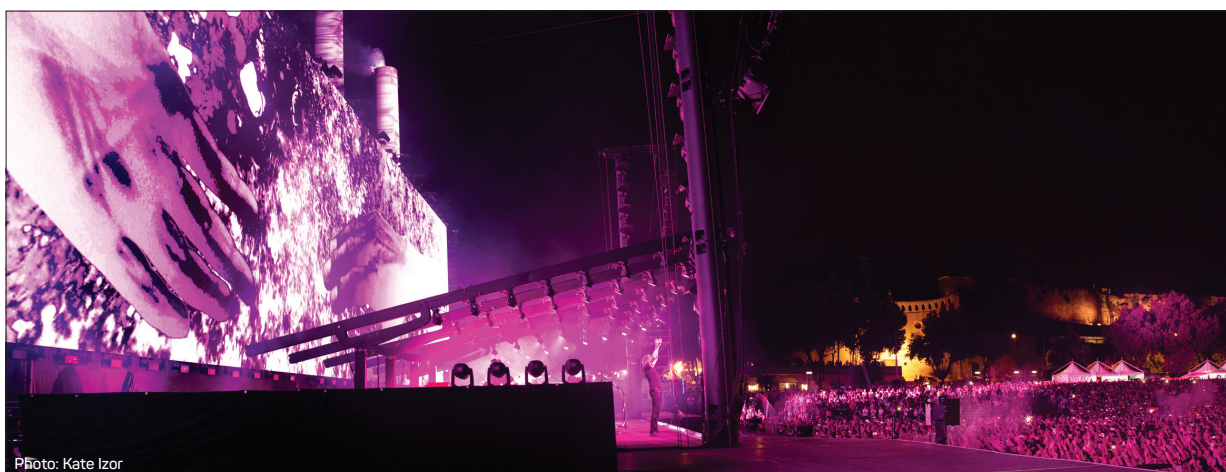


Photo: Kate Izor

I can concentrate on the mix, not the settings; and I run to timecode like every other department. The SD5 is a bit faster with the Waves SoundGrid, whereas the SD7 has more outputs - Matt Napier uses it for monitors. But the SD5 processes faster off that single engine, and we have the all-new 32-bit input cards. It's all a lot more stable."

He elaborates: "The show isn't a case of jumping from one cue to the next - it changes day-by-day. Arrangements get changed, we are rehearsing a new song. That keeps it interesting for all of us. Roger is the king of 'less is more', so if I have an issue that can't be solved in the board, he will address it on stage. That's one of the really great things about this tour - everyone works towards the common goal. It's the best tour I've ever been on, such a great group of people. It's a real pleasure."

Lemon's off-board racks might not be 74U, but are packed with exotica. "Three Neve Shelfords for Roger's vocal mics,

kick and snare run into a Midas XL42, and I have a Smart compressor inserted," he notes. "There's plenty of Tube-Tech for other vocals, bass guitar, Fatso Jr for the guitars, and I have a Maag EQ to tone the L/R outs. I run a couple of SoundGrids in Waves to de-ess the vocals, and model with an SSL to add warmth. Plus the Waves H-Reverb and H-Delay. It's a real mix, but it helps me keep a clear, separate stereo image. I have also added more to the surround and more orchestral strings to the ethereal vocals on *Eclipse*. It's about making use of the technology, that's why a good system tech is such an important job - I'd never have the time to set the delays in the surround for each arena. That role becomes even more important as we move into stadiums in Europe and later in South America. For those shows, we'll rent in local systems, L-Acoustics K2 or JBL VTX, with 10-12 hangs for surround. The difference between systems is noticeable, particularly because of the way you limit things."

"Photon data is used by Pryderi to run a set of lights to track the flying pig as it navigates the auditorium. And Roger wears IEMs with IR transmitters so that lights can be assigned to him as followspots and never miss their mark..."

- Chris Kansy

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For any Floyd anorak, this was a perfect rendering - the show exhibited a live feel, but stylistically was everything anyone could want. This was also just the second time I had heard the CO-12 in action, the first being at the Paul Simon / Sting double header (*LSi May-June 2015*), when the sound had the expected broadband coverage but lacked musicality. Not now - I recall a song in the first half of the set featuring three acoustic guitars, and I could distinguish between them all.

Matt Napier, the show's monitor engineer, shares Lemon's sentiment on the production's complexity. "All 10 musicians and singers are quite particular in their needs," Napier says. "They're not a fussy bunch, it's simply that many are studio musicians who understand the need for precision, so what I do needs to be right. Thankfully, I get fantastic help from Nicole Wakefield and Richard Burke from Clair on stage. The time clock is always running and I use it to trigger more than 100 snapshots on the SD7 - that mass of automated actions leaves me with a lot of freedom to concentrate on Roger. The SD7 is pretty much max'd out. When it first came out, I thought I'd never need all outputs - yet here we are, 21 mono, 16 stereo, 10 groups, four processing channels - by the time you've added in all the backline comms and stuff, it's 130. There are a lot of talk mics for the techs. We are using 20 channels of Sennheiser 2000 Series IEMs, eight channels of 2050 receivers for the guitars, and six channels of

the latest Shure Axient Digital system for the wireless vocal mics and the saxophone. The vocal channels run into an XL42 with an Empirical Labs EL8 Distressor pre-console - such a versatile compressor, I can emulate the UA 1176 and LA-2A fairly well. For some compression on Roger's mix, I have a couple of Smart Research C2s for bus compression, and a Lexicon 480L for a touch of hall reverb. There are also three Clair 12AM wedges that add a little weight to the stage environment and are useful for the kids when they come on stage for *Another Brick In The Wall*."

Roger's IEMs have IR sensors for the VYV tracking system, does that present any interference problems? "We are using JH Audio Roxannes, which have two twisted core cables - one of those cores powers the IRs and yes, there's a bit of interference in the HFs. But we found if we untwisted the two cores, the interference was greatly reduced. Noise on stage is OK, there's a fair bit from the guitars, but the CO-12 system is good on back rejection, so I'm happy enough."

LIGHTING: COMPLEMENTING THE CONTENT

I recall the lighting designer Simon Sidi telling me years ago how Waters had once lambasted him for not being note-perfect on his followspot calling. Sidi had been the first to admit he'd messed up, but importantly, this exposed Waters' completest vision. He isn't, to paraphrase Patrick Woodroffe's first assessment of the Stones, "blue in the slow numbers, brighter for the fast ones" - Waters has a coherent idea of how to present his music, and it doesn't end where his jack-plug meets the amp. That meticulousness is evident in the way the musician and his creative director would watch, listen and re-evaluate every aspect of the presentation.

Is that attention onerous for the tour's LD Pryderi Baskerville? "No, in a word. The main steerage comes from Roger and Sean [Evans], so their vision defines my response. The screen is huge - 96ft wide x 12m high for arenas and nearly 300ft wide for stadiums. With such a vast visual surface, you have to find a place for lights. There are two primary roles - to pick up individual musicians, and to accent what's happening on the screen."

"When I took over, we had a Clair i-5D system with i3 surrounds. During a break in the tour, we . . . switched to CO-12 and a DiGiCo SD5-based mixing platform. It's all about bringing the audio to the same cutting edge as lights and video . . ."

- Jon Lemon

What Baskerville has done is quite spartan at first look - two cross stage trusses and a third downstage parted in the middle are all populated with Robe BMFL fixtures. "The rig is shipped worldwide from Upstaging in Chicago, except specials here and there such as extra lamps needed from Neg Earth for Hyde Park. Besides what you can see, there are forms hidden behind the L/R PA, also all BMFLs, and more of them on the floor each side of stage."

Of course, there are different lights elsewhere on the set, as Baskerville will go on to describe, but on his very singular decision to go with just one type of light on the central trusses, he explains: "The video content is so gorgeous and it's often the driver, so I'm looking to complement, not distract. I chose the single light to reduce the visual clutter - the songs have a narrative, so the lighting accentuates the drama in the music. Jeremy, Sean and I have talked a lot about it - the lights, and the presentation as a whole, cannot be intrusive."

Moving on to the other fixtures, he says: "In the house, we have TMB Solaris Flares on the projector trusses running the length of the arena each side of the floor

area. They do some effects work and are our own house lights. It depends on the house rules at each venue if they let us run the whole house light thing. Having them is especially good for the intermission - having total control is important."

"There's also a row of Solaris Flares upstage of the band at the foot of the screen, and six Vari-Lite VL3500 Wash lights in the same position for that big beam finger look behind the band. The downstage edge has 13 bars of GLP impression X4s, usually on a low glow to give some uplight to the band. We inserted Lee Filters 251 diffusion into them, which softens the light and prevents reflection from other light sources. There is also one Vari-Lite VL6000 Beam upstage-left on the rear truss, which takes the role of a helicopter-mounted searchlight programmed to be jerky and look hand-operated."

Tell us about the pig. "It's a large dirigible drone flown independently around and above the audience. The IR sensors in the pig's nose and bum keep the lights on target. The four BMFLs in the house sit around the cardinal points of the FOH position. The spatial, positional data from the VYV Photon system tells my

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Photo: Kate Izor

grandMA2 console where the pig is when it flies out in the second half. With the Rollios down, there are always at least two lamps that can hit it. Figuratively speaking, we create 'boundary boxes' that define where one light takes over from another. With IR sensors in Roger's IEMs, I can use any lamp on the rig as followspot on him, sometimes I use them [BMFLs] all. Generally, I light him high

from one side - throw distance averages 48ft - and one from behind."

The lamps are strategically placed at an equal height to the stage as the tormentors, producing striking beam angles not often seen in a rock show. "It's a very dramatic position," agrees Baskerville. "This is not a question of a light show and some followspots - it's

all integrated, and I can refine what the BMFLs do as they track Roger."

Baskerville's been using a grandMA2 for years. "I also like to use the High End Systems Hog 4, but I've had an MA2 since I filled in for Mark 'Sparky' Risk at the end of *The Wall* tour," he says. "Running off a time clock is great; a fairly simple set-up. When programming the



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Photo: Steve Moles



Making the wonders work

For *Us+Them*, Wonder Works handled production design, technical design and technical coordination for all aspects of the arena and stadium shows. The company's creative director Jeremy Lloyd drills into the details...

On the PA towers: "The PA towers are tube constructions, which - at 500mm diameter - greatly reduced the visual impact to the screen. The chain hoists are also concealed below deck and drive a wire rope over a top mount diverter pulley. But the tube walls are quite thick - the tower needs to be rated up to 2.5t for the variety of PA types picked up in various markets; with the 16 cabs of CO-12 we've been hanging in Europe, we are looking at barely a tonne. The tower tubes and base section break down and fit into 10ft air freight palettes, around 3.5t per tower packed. To address wind bracing, the PA needs to be curved to the correct angle for coverage - we have a track on the downstage edge of the tube and the curve point is a trolley, so as the PA is raised, the curve point travels up the tower. On the on-stage side of the tube is another track for lights (Robe BMFLs are each fitted with a small trolley) to be pulled up via a motor pulling a wire winch over a top mount diverter pulley. The top of the tower is 13m above stage deck (15.5m from ground level)."

On Rollio: "The rolls drops are funny. We had been thinking for some time about a roll drop that came down and had the roller at the bottom for weight/stability, and the top edge soft good dressing raises and lowers too, so the screen can be varied in the vertical dimension and position. We took this idea to Tait and, blow me, they had been working on the same idea - Rollio, a far more refined and elegant solution than ours."

Iconic chimneys: "The chimneys for the stadiums are much bigger than those seen indoors; the setting demands scale. The stadium show chimneys have a self-erecting 12m spine inside them to keep the inflated outer skin stable. Many of the technical details for the chimneys were developed for the London 2012 Olympic opening ceremony. The big difficulty is rigging to a variety of modular scaff systems in South America, so our rigging and track system is modular to fit any system. The chimney positions are critical, they have to line up with the video content of Battersea Power Station's brick walls or it all looks a nonsense."

Going outdoors: "We have a new roofette for the outdoor shows. I proposed the one used for Genesis' 2007 tour [think overarching

metal beams rigged with lights], but Sean [Evans, production manager] wanted something less intrusive. We designed a new tube-based roofette with luff grooves for the transparent skin. The seven beams take seven Martin MAC Aura XBs each, mounted directly with custom fittings. Power and data is built into the structural tubes of the roof, so lampies use short jumpers to connect the fixtures. It means all lamps are rigged at stage level - fast and safe."

Team work: "We work on all aspects of the show with the tour's creative director, Sean Evans. Also heavily involved are: lighting director Pryderi Baskerville; video director Richard Turner; Tait Towers who handle set construction for arena show (including the stage, Rollios, mother grid and automation); Eventions (chimney mechanics and automation for arena and stadium shows); Air Works Inflatables who handle the inflatable scenery for arena and stadium shows (chimneys and pigs); and WiCreations for set construction for stadium show (roofette, PA masts, LED rigging and laser catenary)."

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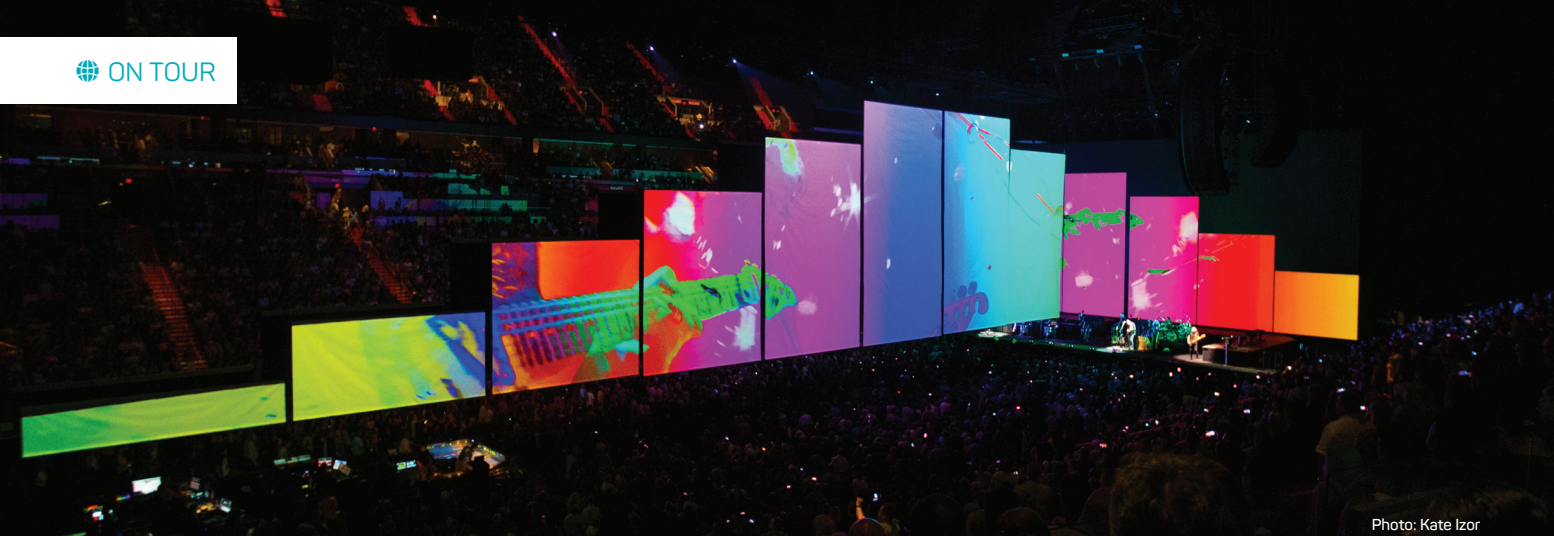


Photo: Kate Izor

show, we already had the timecode, so could programme accordingly. I also take a mono audio feed and click track into my comms. That's a pleasant way to hear the mix instead of bleeding it through the headphones from the main PA. It's also easy to add stations and switch between comms rings."

Baskerville's approach is quite rightly theatrical. To really see what he's doing, you have to mentally disengage with the show and fix upon the rig, and frankly, who wants to do that? So in that sense, he's doing a great job.

VIDEO: BUILDING A 'CONSTELLATION'

While video director Richard Turner was down in Hyde Park preparing for the show's arrival at BST, I was lucky enough to get some gear detail from Dave Rogers, a freelance tech overseeing video in Turner's absence. "I've worked with Richard on-and-off for the best part of 30 years. Sean and Roger steer the creative input to the visuals, and Richard translates those concepts to the screen.

"The equipment all comes from Universal Pixels (UP), the screen is InfiLED 5mm [equipped with Brompton Tech receiver cards]." UP first purchased Brompton Tech's Tessera S4 HD LED processors and then upgraded to the SX40 4K LED versions for the European leg of the tour. "The projectors are all Panasonic lasers," continues Rogers, "30K down the sides of the arena for the main projection onto the Rollios, and 20K for the end section and the chimneys. All content runs off VVV Photon servers - five 4K ones with four outputs for the projectors, and there are a further two 4K servers for the LED screen. Richard has specified Hitachi cameras - we have a long lens out front, a camera in the pit, one handheld on stage, and a pole camera in the pit stage-right." The latter produced great shots from very low angles, reaching upstage to catch Waters in profile with little intrusion to the audience. "We also have a pair of Agile remote cameras stage-left and -right used mostly for show operators out front and for me. We put live camera feeds into the Photon server, mix the content and project it onto the screens. Different



Festival focus: Changing things up



Roger Waters' *Us+Them* tour debuted in the UK at AEG Live's Barclaycard Presents British Summer Time (BST) festival in Hyde Park, where the festival's organisers and suppliers went out of their way to accommodate the show's unique requirements...

Audio: Martin Audio's MLA PA system supplied by Capital Sound provided the sound reinforcement for the Hyde Park concert, with Capital rigging an additional 12 hangs of MLA/MLA Compact on towers positioned through the concourse for one night only. Complementing the festival's standard audio package, the extra hangs offered 12-point surround sound effects - a first for the festival - at positions set by Loud Sound's Dan Craig and fine-tuned by Waters' sound team.

The immersive audio set-up required Capital's Robin Conway to design a new Optocore multi-node digital signal transmission system based around 21 x X6R-FX-8AE/8MI interfaces and an Optocore DD32R-FX at FOH to accommodate an AES signal distribution. Capital deployed its own stock of Optocore interfaces, with Gilles Bouvard's GB4D in France supplying additional surround sound units - linked by 24 lengths of multimode fibre across 1km of the site to create the loop - and the DD32R-FX AES interface.

Video: Water's show is, like BST itself, centred upon a huge widescreen presentation, but there the similarities end. "BST sees the entire stage enclosure, backwall, sides and wings totally covered with LED video; right up to roof height 94 linear metres of it," explains Alex Leinster of Video Design who provide all the video hardware and infrastructure to BST. "But Waters' show needs a much flatter screen, so we were asked to move the entire backwall section downstage as far as possible." No simple task, Water's show was the first night in a run of three, with The Cure headlining the very next night. Video Design worked with Star Events, PRG and Jeremy Lloyd of Wonder Works on a solution for the concert. Lloyd comments: "We took the normal LED which wraps the wings and stage inside and rear and brought the stage section downstage. We took it as far as possible while still leaving enough room downstage for the backline and a performance area. Upstage of the backline - but just downstage of the relocated screen - we had the decking sunk to accommodate a backline tech runway. Likewise for the monitor and guitar bunkers S/L and S/R, so nothing other than band members and their own amps intruded on the screen. We then added the chimneys on top and had one of the festival's oak trees removed to further clean the stage up."

Staging: Staging structures supplier Star Events redesigned the festival's Great Oak Stage sub-structure and super-structure to accommodate the production, including a 1,100sq.m video wall, as mentioned above. Involved with the AEG Presents/Waters negotiation since last summer, the company had to demonstrate its capacity to stage the show, without compromise, before switching back to a more traditional format for The Cure the following night. The changeover involved three cranes, six trucks for the kit coming out, including 10 Star FOH structures for Waters' surround sound and projectors. On stage, Star Events rebuilt the main floor deck and provided rigging support for the big screen move and lighting install. ☒

"VYV has developed a very clever way of measuring and managing every parameter that can significantly affect the image coming from the projector. I was sceptical - until their team arrived on site, set it up overnight, and it all worked the next day ..."

- Richard Turner

effects work different ways and, coupled with the prevailing lighting at the time, the POV cameras offer a better sense of the resultant image." It would be a fruitless task to try and describe what Turner does with the cuts he takes of the band. However, it is noteworthy how those live images, effected or otherwise, mix to the content in such a way that often they are perceived as a contiguous part of the content itself: seamless. As Rogers said, "I've worked with Richard on-and-off for the best part of 30 years, he comes up with some great ideas. Sean (Evans) and Roger (Waters) steer the creative input to the visuals and Richard translates those concepts to the screen."

I later contacted Turner to find out more about the VYV system. "VYV was funded by some clever Canadians from Montreal (VYV, CA)," he opens, "and I've been impressed since I first encountered them on a project managed by Nick Levitt in Dubai in 2013. I was Nick's video consultant, and what was being asked of the video system seemed practically impossible: to project onto roller blinds, but as well as moving up and down and rolling out at different trims, the screens could also be rotated, so we had six axis of movement. We could manage some of that through pre-set focus, but interpolating between different positions was a non-starter. VYV has developed a very clever way of measuring and managing every parameter that can significantly affect the image coming from the projector. I was sceptical - until their team arrived on site, set it up overnight, and it all worked the next day. We were so impressed that I set up VYV UK with Anthony Bezencon and we use the system with CT Group as a preferred partner."

"For Roger's show, there are 50 IR cameras in the rig - six on stage, one on every projector, and in several other key locations around the venue. Not only does the camera detect all IR emitters on the Rollios, Waters' IEMs plus on the pig and the orb, but they also support SLAC (Structured Light Auto Calibration), which helps maintain uniformity of projection quality / intensity across varied and varying lighting conditions."

The IR cameras cross-shoot the room, creating an invisible matrix used by the software to underpin movement and for control calculations. As each IR transmitter has a unique ID, the cameras can 'see' all targets within an abstract constellation. The six cameras on stage see the same targets from different POVs and between them can plot the constellation from any position. Such is the complexity of the set-up that it's

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Photo: Kate Izor



Photo: Steve Moles



Photo: Courtesy of Wonder Works

unsurprising the VYV tech who worked it out is a research fellow in multi-dimensional maths.

"With this technology - and the accuracy of the camera calibration technique - we can build a scene, whether to track the pig with lights, project onto the chimneys, or position the lasers, or the Rollios," says Turner. "And on the subject of the Rollios, they also have emitters on the bottom edge of the screen rollers, so when we're playing outdoors the projectors are constantly updated with positional (and parallax) information as the screens inevitably flap about in the breeze."

"As Sean and Roger are continually re-examining the show and how it works, the boys at VYV are constantly writing new code for us. It's very exciting. The tracking info was originally supplied to the grandMA2 over Art-Net as PSN files, but the desk works in WYSIWYG. The guys in Montreal calibrated the lights in 3D with the same detail as the projectors, which are controlled by an overview of the cone projection from the optical train. Moving lights don't have the same quality of optic - however, we can still use that cone shape technique to feed the pan/tilt vectors to the grandMA2 and then to the lights. It's so much more accurate."

Turner, who has worked for Waters on-and-off since 1999, praised the crew for their "tremendous effort", particularly after successfully completing outdoor shows at Rome's Circus Maximus and Lucca's Summer Festival with precious little rehearsal time and where 'wind flapping compensation' tech came into its own. "I can't begin to describe how exciting my life is these days," he says. "It's all I've ever wanted to do. But this is another dimension; when we did *The Wall* in 2013, the hardest thing was persuading production to let us go through the process. That has put us in good stead for what we are doing today. Thanks to all at VYV, not least Ellie Clement, our resident maths genius at VYV UK."

Waters' prescient lyrics from 40 years ago continue to offer vivid allusions to the modern socio-political landscape - and while the musician doesn't propound an alternative political system, he actively voices his protest, urging us - with some vigour - not to tolerate the current state of things. As Turner remarks: "All thanks to Roger - who we could say invented the idea of rock concert theatre - he wants to push things as far as we can." Good on you, Roger. ✕