Vancouver 2010

Presenting a spectacle for the Opening Ceremony of the XXI Winter Olympic Games . . .

words by Alan Hardiman

The aurora borealis dancing in the northern night sky served as a guiding metaphor in the design of the elaborate opening Ceremony of the XXI Winter Olympic Games in Vancouver, as light and projection were employed in place of scenery to dress the gargantuan stage in the 65,000-seat bowl of BC Place. Here, on 12 February, the ceremony was held indoors for the first time in the history of the Olympics.

Featuring the largest air-supported stadium roof in North America, BC Place offered executive producer David Atkins and his design team an unprecedented opportunity to stretch the boundaries of spectacle using state-of-the-art lighting, projection, sound and special effects. The fabric roof presented almost insurmountable challenges in rigging, projection, and sound reinforcement, however, and was sensitive to changes in barometric pressure, temperature, and wind conditions that caused it to rise and fall continuously by 1.3m (4ft) during the course of the ceremonies. Furthermore, it limited the total hang in the stadium to some 150 tons.

"We were in a somewhat inhospitable environment that generated a lot of technical issues, just in terms of gravity alone," says design director Douglas Paraschuk. "Because it was an air-filled venue, we were limited in the amount of equipment we could physically hang from the ceiling. The engineering of the rigging, which was handled by Riggit Services in Vancouver, was a technical nightmare. We had to be very careful about where the rigging points were located, and how we articulated the entire rig in order to get to where we needed to be. We also had to deal with the issue that the ceiling breathed. This caused nightmares in focusing, because it was moving all the time, and so all of our flown elements, and their relationships to the projection and the lighting were encoded."

"The victory ceremonies every day between the Opening and Closing Ceremonies required an entire additional set of truss masking to be hung in order to create a kind of concert bowl in the venue," continues Paraschuk. "The intent was to have it look like a different space on television, and this impacted greatly on our ability to maintain focus and continuity for the Closing Ceremonies, let alone physically rehearse the Closing Ceremonies. Our target for the bowl was 25,000 seats for the victory ceremonies. The full seating in the venue is 55,000, and we expanded the lower bowl for Opening and Closing, so the total capacity was about 65,000."

To accommodate the crowds, Stageco designed and built a further three video screen structures to relay the Opening and Closing Ceremonies for the Games and nightly Victory Ceremony presentations to 55,000 spectators. The three screens, measuring 47sq.m and two 96sq.m displays were built into the stadium's infrastructure.

The fabric roof let in so much daylight that programming and rehearsals for the Closing Ceremonies could be conducted only from midnight until dawn, following the conclusion of the daily Victory Ceremonies and pre-programming for the following night's headline talent. "The lighting department worked 24 hours a day, with some individuals putting in 16-hour shifts, and that turned out to be more ambitious than we had initially anticipated," says Bob Dickinson, the production's lighting designer.

Projection & Lighting

With spectators and athletes forming the backdrop, the entire bowl was transformed by projection into an extension of the stage for the duration of the two-hour spectacle. The 56m x 104m (184ft x 341ft) stage itself was bathed in projection by a battery of

30 Christie K20 video projectors, painting it successively as a native welcoming ground; a mountain range; a sacred grove complete with a stand of giant redwoods, inspired by the work of the Canadian artist Emily Carr; prairie fields; and ocean playgrounds.

Aerialists were flown intermittently over this lilting landscape of light. In one particularly memorable segment depicting autumn in Canada, a solitary fiddler stood in a silvery blue canoe suspended high above a forest floor littered with giant red and gold maple leaves, the scene bathed in the amber light of an enormous full moon beneath an indigo sky comprised of three gigantic ring screens.

To light scenes of such proportions was a huge undertaking, fraught with tremendous difficulties. Consider the task: giant images were projected 360° around the bowl by 36 double-scrolling projectors (7K Xenon Pigi units) onto 65,000 spectators clad in white ponchos (distributed in their audience kits), while another set of images was projected by 24 18K Christie projectors for the flown elements onto three oversized, stacked concentric ring screens suspended over the stage. Simultaneously, a third series of continuously shifting moving images was projected onto the stage deck and the screen-covered mountains, redwoods, and other scenic components of each segment, while aerialists, onstage performers, and special effects, such as a gigantic mesh Spirit Bear encrusted with thousands of bright white LEDs, had to be lit against this background of light. (Lighting for the bear was controlled with using an RC5 high-security wireless DMX system from RC4 Wireless.)

"We threw lighting director Bob Dickinson a hell of a curve with the physical reality of what we wanted to do," says Paraschuk.

"The fact that we were a projection-based world and not a scenic-based world meant that he had to light the bodies and waste the light in an efficient way without wiping out the content. This was not an easy task, considering that he still needed to maintain the lux levels required for television."

"This was a case of a lighting design that had to do with *not* lighting, as opposed to lighting," Dickinson adds. "When you illuminate anything, you've got to deal with the waste light that occurs. In the case of this environment, we were inside a sphere where every surface was a projection surface, except for the ceiling. We had to light people and objects within that space and not ruin the projection. Usually lighting design is not only about illuminating people and objects, it also has to do with using our available tools to interpret the meaning of the story, of the narrative, the moment, the music. By using colour, angle, texture and intensity we were able to amplify the narrative that is being presented. In this case, we were asked to amplify the narrative, but we were also asked to stay off the main surfaces, so it created a huge challenge from a lighting perspective."

In the segment 'Peaks of Endeavor,' for example, a screen-covered mountain, suspended on the stage, served as a projection surface, while a group of aerialists performing around the mountain had to be lit on angle so that the light would spill into the audience without hitting the mountain, says Cyril Meusy, head of audio-visual.

What helped save the day for Dickinson was the fact that the stage deck stood a little over 2m (6.5ft) above the structural concrete floor, enabling him to design tech pits surrounding the stage. In these pit areas, Dickinson relied heavily on Philips Vari*Lite VL1000 and VL3500 Spots to focus in tightly on the talent. Lighting designer Ted Wells also had a number of followspots in the pits.

Below: An example of design becoming reality - from CAD to Arena.

"That gave me the opportunity to put in a series of instruments that were right at performance elevation, so that, when we tipped the lights down, there was almost no light that would contaminate the horizontal projection surface - but we could light people who were standing on it," says Dickinson. "At times, it was almost magical, because there would be someone standing on a projection surface who was lit from head to toe without any perceivable cast shadow from lighting. It really was a remarkable visual. Knowing that we had that position, I was at least able to move forward with some level of assurance that we were going to be able to light it and not destroy the projection surfaces."

One of the more memorable effects was a pod of projected whales "swimming" across the floor. To create the whales' spouting, small traps in the floor were equipped with water cannons, supplied by Hollywood North in Vancouver. These were triggered by SMPTE time code as the video whales swam across them. Dickinson had to light the spouts so they could be seen. In order to prevent the water spray from blending invisibly into the projection, he used four lights tightly focused on each water spout to back light it from different angles. This allowed them to be seen not only by the people in the stadium, but all of the television cameras as well.

Lighting programmers Rob Hume, who handled the automated spot fixtures, and Laura Frank, who took control of the wash lighting and scenic lighting for the ceremonies, both worked on PRG's new V676 lighting control consoles. Hume's console handled the 400 automated lights with framing capabilities, while Frank's board controlled all wash lighting and scenery lights. When projections were being used, Hume controlled the framing units, including the Philips Vari*Lite VL3500 Spots, VL1000s, VLK2416 units, Martin MAC Performances, and PRG Bad Boys. These handled the key lighting in conjunction with the 28 followspots under Wells' direction. 12 Bad Boys were hung from the mother truss, over 200ft in the air, and were used as downlights, especially for the aerial performers in the tree ballet sequence.

Frank's portion of the ring consisted of approximately 1200 fixtures, including VL3500 Wash units, VL3000 Spots, A&O Technology's Falcon 6kW searchlights, and Philips Color Kinetics ColorBlasts. These were used to tone the field when the projections were less dominant or turned off, as well as providing fill lighting and toning the field for the athletes' entrances.

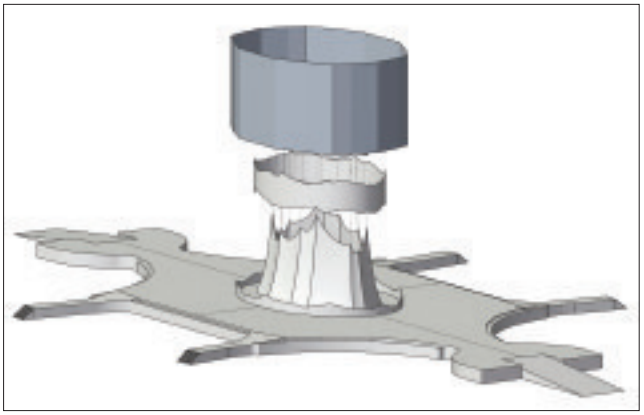
Because many of the scenic elements - including the welcome totem poles and the Olympic cauldron - were treated with plastic to resemble ice, they required a great deal of light. Each of the cauldon's four legs had a VL5 Arc light as well as an Arri 200W HMI Pocket PAR. Four Bad Boys were placed under the centre of the floor to uplight the cauldron. The main stage had more than 200 ColorBlasts built into it.

Arrays of 28 followspots, under Wells' direction, were used as keylight by Dickinson. 16 followspots, including Strong Gladiator IIs and IIIs (10 of which were retrofitted by PRG to handle 4kW lamps), were placed on the upper levels of the arena. In the tech pits, Wells had 12 Lycian M2 2.5kW followspots. These were used in combination with Hume's automatic framing fixtures to provide keylight for the performers and speakers as needed.

Dickinson knew that television would be well served even though the job had to be done at a much lower light level than is typical with a broadcast of this nature. "Within the confines of what modern camera technology offers, it was possible. So we went ahead and endeavoured *not* to light most of the Olympic ceremonies," he says, with just a trace of irony.

To complicate matters even further, the audience bowl was filled with projections from 36 7K Xenon Pigi DDRA double scrolling projectors arranged in 18 areas covering the entire bowl. "Because there were always objects on or over the stage in the centre, we could not project in a straight line from one side to the other. So the Pigi projectors were deployed around the perimeter of the bowl with their beams forming a giant iris, as it were, each covering an almost adjacent segment of the audience without cutting through the centre," says Patrice Bouqueniaux of E/T/C, who supplied the projection hardware and software.

With so many variables attendant on giant image projection in such a venue and with such stringent requirements, the show



couldn't have gone on without the aid of robust image deformation software. Floor images from projectors mounted on the ring beam were projected onto the stage at an angle of 21°. "When we project an image that is many times the size of HD, there's a lot of processing involved to begin with," says Bouqueniaux. "But when the original flat image is projected at such an extreme angle, it has to be severely deformed in software to look like a normal image on the floor. That is where our Onlyview V3 software comes in."

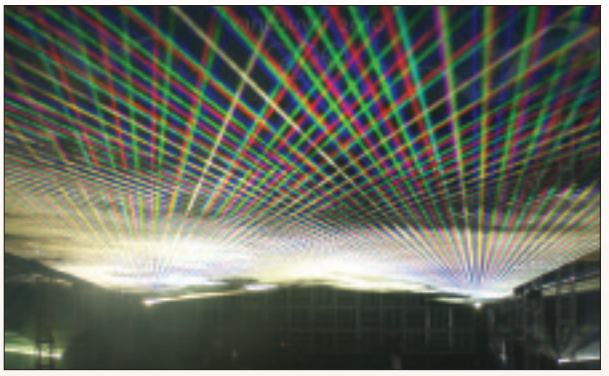
Screens

E/T/C's Onlyview V3 also helped the projectors track the constant vertical motion of the three ring screens above the stage as they rose and fell with the roof and, within that overall oscillation, also fluttered up and down independently of each other at different rates. The elliptical ring screens were 6.5m (21ft) high, and varied in size from about 37m x 26m (122ft x 85ft) down to 24m x 13m (80ft x 42ft).

"Optical encoders tracked the movement of the rings. We worked very closely with Jim Tinsley of Stage One, who manufactured the concentric fabric rings and truss," explains Bouqueniaux. "Their Qmotion software is designed for the controlled manipulation of objects in space. They monitored the level of the roof every second during the ceremonies, and, from that data, we were able to move all the images together."

"The beauty of Onlyview is that you can have optical encoders linked to the software so that when the ring screens move, the content moves with it," adds Paraschuk. "On each screen there were a number of motor drives, and there was a tell-tale line that gave exact and precise measurement of how far the screen had moved, so the content could be updated

tarm grabs the attention



A laser show from German specialist tarm Showlaser added to the spectacle during the opening and closing ceremonies. With the organisers tasking Australian producer and director David Atkins, who put on the opening ceremony at the 2000 Summer Olympics in Sydney, to outdo himself at Vancouver, Atkins drew on the expertise of the same team of laser specialists who had contributed to the 2004 Summer Olympics in Athens and the 2006 Paralympics in Turin to provide the attention-grabbing laser sequences.

During the 15 months of secret preparations, which included a site visit and rehearsals at the company's own facilities, tarm Showlaser's three-man team created, installed and programmed the system, ready to conduct rehearsals before the deadline. A total of four tons of laser equipment was air freighted to Vancouver for the ceremonies.

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in real time in the projectors to follow the screens. Using Onlyview, we could also deform all of the content intended for projection on the 3D surfaces. It was especially evident in 'Peaks of Endeavor' with the mountain, because that was a rather complicated surface."

The mountain was the quintessential '3D object of varying size'. "In total, there were more than 300 texture mapping points to match the convergence on the three rings, the mountain, the leaves, and all the objects that were moving on and over the stage," says Bouqeniaux. "We created a virtual cylinder of images with a total surface measuring 30m high by 120m in diameter (98ft x 394ft), and we were able to map any object moving inside that virtual cylinder."

"We had to manage a huge amount of data - in total, 54 times that of HD. Every video projector had its own video feed and its own mapping texture, because the optical centre was not the same for all projectors, since they sat side-by-side. And as the objects onto which the images were projected were all in different positions in space, we needed to have a different convergence for each object. The numbers are so high that it's difficult to imagine the work that went into that project: there were 1,736 points of deformation programmed for the 24 projectors that were mapped onto the mountain," he said.

Onlyview V3 also functioned as the media server driving the projections to the 56 Christie video projectors used in the Opening and Closing Ceremonies.

The screens were fabricated from rip-stop nylon. "We experimented with just about every projection material we could get our hands on," says Paraschuk. "The challenge was trying to find something that could transmit light, because we were worried about the 360° view of things - we wanted them to be able to read on both sides - but also reflect enough light that television would be happy. Some years ago I had done a production of *Evita*, where I used rip-stop nylon - sail cloth - which is cheap as chips, light, and which in the end had the greatest luminosity, generating the greatest lux levels that we could find. It also helped solve a substantial weight problem that we had with loading in the ceiling. Another thing about rip-stop nylon is that, when the screens moved, they changed shape, and actually it was quite magical. At first we were terrified that it would be a problem, but once we got to see how the projections, the tracking of the projections, and the ethereal nature of the fabric worked together, it became pretty exciting."

The ring screens were borne out of an original idea to create an ethereal theatrical world without scenery that would shape-shift continually - just like the aurora borealis. Emulating the aurora was, in fact, one of the first ways in which the ring screens were used.

"The way the northern lights continually dance in the sky, changing and shifting, is really a great metaphor for the journey we wanted people to take during the ceremonies, and it's a fantastic metaphor for Canada as a nation as well," says Paraschuk.

"You can be in any environment, anywhere in this country and in a day you can experience all four seasons, and the landscape changes drastically. When the snow starts to fall, it becomes this very beautiful, soft box of glowing white light where edges are lost and you can't tell up from down. Anyone who has ever skied in a bowl on a mountain where there's snow falling can relate to that. And then there are vast, open landscapes that are very hard-edged, like the prairies. We were trying to tell a story and describe a sense of the spirit of the country, and the northern lights became a core metaphor. The ring screens helped us to transform them into other physical elements, which gave us other ways of telling the story."

Sound

Two million watts of amplification powered 200 loudspeaker cabinets in audio director Bruce Jackson's sound system design. To help tame the horrendous nine-second reverberation time in BC Place and keep the loudspeaker arrays out of the line of video projectors and lighting, Jackson flew the 28 tons of sound equipment, distributed 100ft up in two rings: the inner ring, of eight arrays, each consisting of 12 Clair Global i3 full-range line array modules, and the outer ring of 12 arrays, each consisting of seven Clair Global i5 boxes. These were augmented by 16 low-frequency cabinets.

Jackson explains: "I decided early on I wasn't going to do it the way we traditionally do, which is shoot up from the ground, because that would have had the sound bouncing off the ceiling, and gives you much less control, especially in BC Place with its legendarily bad reverberation time."

Power was supplied by 160 Lab.gruppen amplifiers in a combination of four-channel 10,000W PLM 10000Q amps and two-channel 14,000W PLM 14000Q amplifiers: these were flown on each side of the lighting trusses nearest to the hanging loudspeaker arrays.

The entire amplifier system was networked on Audinate's Dante digital audio network, configured in a triple redundant configuration. "The Dante system in the roof was comprised of two completely separate standard gigabit networks which were backed up with analog feeds to provide an additional level of failsafe. The amplifiers monitor their inputs and if the primary network were to fail, it would be backed up by the second network and then finally the analog. That's all built into the firmware in the Lab.gruppens that we developed at Dolby," said Jackson, who is a director at Dolby Laboratories, which acquired Lake Technology in 2003. (Lab.gruppen acquired the Lake trademarks and exclusive rights for use of Dolby Lake Processor technology for the sound reinforcement market from Dolby in 2009.)

The two DiGiCo D5 house consoles (main and back-up) were complemented by two Yamaha PM1Ds for monitor mixing (main and back-up). An Optocore dual redundant fibre optic ring network was used to transport audio throughout the venue (microphones, sends, returns, playback from the Fairlight digital audio workstations) and out to the broadcast audio truck. "We created the 5.1 and stereo mixes going out to the world from the truck. We had a separate Optocore run that delivered our digital signals out to all the rights holders via two Dolby Lake Processors for sample rate conversion, and then across to Olympic broadcasting, where they added in the audience mics, and that's what went out to the world," Jackson explained.

"Our audio department generated all the time code," says Jackson. "It came from the Fairlights operated by Aussie Steve Logan and Canadian Rob Stefansson. Many different effects - including the whales, video, and pyrotechnics - were sync'ed to time code. We used a new hour for each segment, and employed an A roll/B roll system to burn up time in loops whenever that was necessary. We also had a completely redundant second set of two Fairlights (A roll/B roll) in reserve. In one of the closing segments, Steve and Rob had to fly in something like 40 audio cues, timed to the action on the field of play. Dave Pierce, our music director, created the audio effects, and also conducted most of the music, which he wrote especially for the occasion. Dave also played drums on much of the music, which gave it a unique push."

Quite a few performers brought their own microphones, including K.D. Lang and Neil Young, who sang into two Audix harmonica mics

Top: Sound engineer Ian Shapcott of Norwest Productions.

Above: Two DiGiCo D5s at the FOH position: Steve Caldwell and Ian Cooper of Norwest Productions are in the seats.

Main picture: Various members of the Norwest crew, with local volunteers and the show's audio director. Back row, from L-R: Ian Cooper, Derrick (volunteer), Josh Wildenberg, Steve Caldwell, David (volunteer), audio director Bruce Jackson, Ian Shapcott and Andrew Rodd. Front row, L-R: Stephanie (volunteer) Rachel Caldwell, Amy McDonald, Aja Sandoval, Andy Marsh and James Nam.

that he had mounted on his harp brace, so he could turn and face the athletes as he sang his 1976 classic "Long May You Run" during the Closing Ceremonies.

Stage & Special Effects

When it came to constructing the stage, which was built by Show Canada, there was a lot of debate about what its surface texture was going to be.

"We used a product called Geo Tech that we had previously used at the Sydney Olympics," says Paraschuk. "It works great outdoors because it tends to absorb any bit of moisture in the air and thereby becomes denser and shrinks, because it is an organic fibre product. Indoors at BC Place, however, it was extremely dry. As a result, the fabric tended to pill a bit, which meant it created its own nap all the time. Bob Dickinson was very concerned about how much light would be absorbed by the additional pilling.

"This was both a blessing and a bit of a hindrance because as it pilled, it looked more and more like snow, which is exactly what we were after. In fact, on the periphery, we distributed a whole bunch of plastic snow. The downside of it was that, because it had a nap, it absorbed light in a way that wasn't very friendly from the point of view of television lux levels. So there was a continuous battle between what was working well for the projection and what was working well for the overall feel and the illusion of a snow surface, and what was helping us from the point of view of television lighting. We had to weigh the difference between a television audience of potentially three billion versus the 65,000 people in the venue."

Four hydraulic arms were designed to rise from the floor to support the crystal cauldron that held the Olympic flame. The arms performed double duty, serving early on in the ceremonies as the four host nations' welcome poles, clad in Lexan and topped with a layer of acrylic gel to simulate ice. Once the poles were lowered back into the floor, the cladding had to be removed before the arms could be deployed again to hold the cauldron.

Unfortunately, one of the elements of the Opening Ceremony that proved most newsworthy was a malfunction of one of the arms. There was quite a long pause in the proceedings while billions of people around the world waited for something that never happened, including former Olympian Catriona Le May Doan, who was left out of the proceedings as her three torch-bearing companions - Steve Nash, Wayne Gretzky and Nancy Greene - lowered their torches to light the flame.

"That was one of those moments of live television that kind of destroys you on the inside," Paraschuk recalled. "We all sat there in shock and terror. We had run that segment hundreds and hundreds of times. In the end it was something like a $25 encoder that messed up. It wasn't the hydraulics or the arms; it was the door in the floor that didn't know where it was. We couldn't open it, and we couldn't disengage it. We looped, and sat there for a hell of a lot longer than we would have wanted to. We tried to figure out how to solve the problem, but in the end we couldn't, so we delivered the three arms. We had cued and engineered each one of these elements to work independently of each other, and we got three arms up with the central crystal. That was part of our contingency planning," he said.

This malfunction was revisited humorously in the Closing Ceremonies, when the disobedient door slid effortlessly open and welding sparks were thrown up out of the pit, followed by a mime, equipped with tool belt and oversized hammer. The mime went through a series of exaggerated pulling and pushing routines as the arm was raised, and Le May Doan finally got her chance to light the flame in preparation for its final extinguishing at the conclusion of the ceremonies, marking the end of the Games.

"It was a nice way of addressing what had been a problem for us, and I think it's typically Canadian that we could be self-deprecating and create a moment that was a bit of a laugh," Paraschuk recalled. "In the Closing Ceremonies, we wanted to set a much lighter tone that was more of a party, so it really helped set the tone for the evening. Once we started going on it, it grew a little bit - let's have some sparks, let's have some welding, and some sound effects. It became a fun moment."

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