CURING THE STADIUM SOUND BLUES

DYLAN, PETTY & THE DEAD

AT RFK STADIUM, WASHINGTON, D.C.

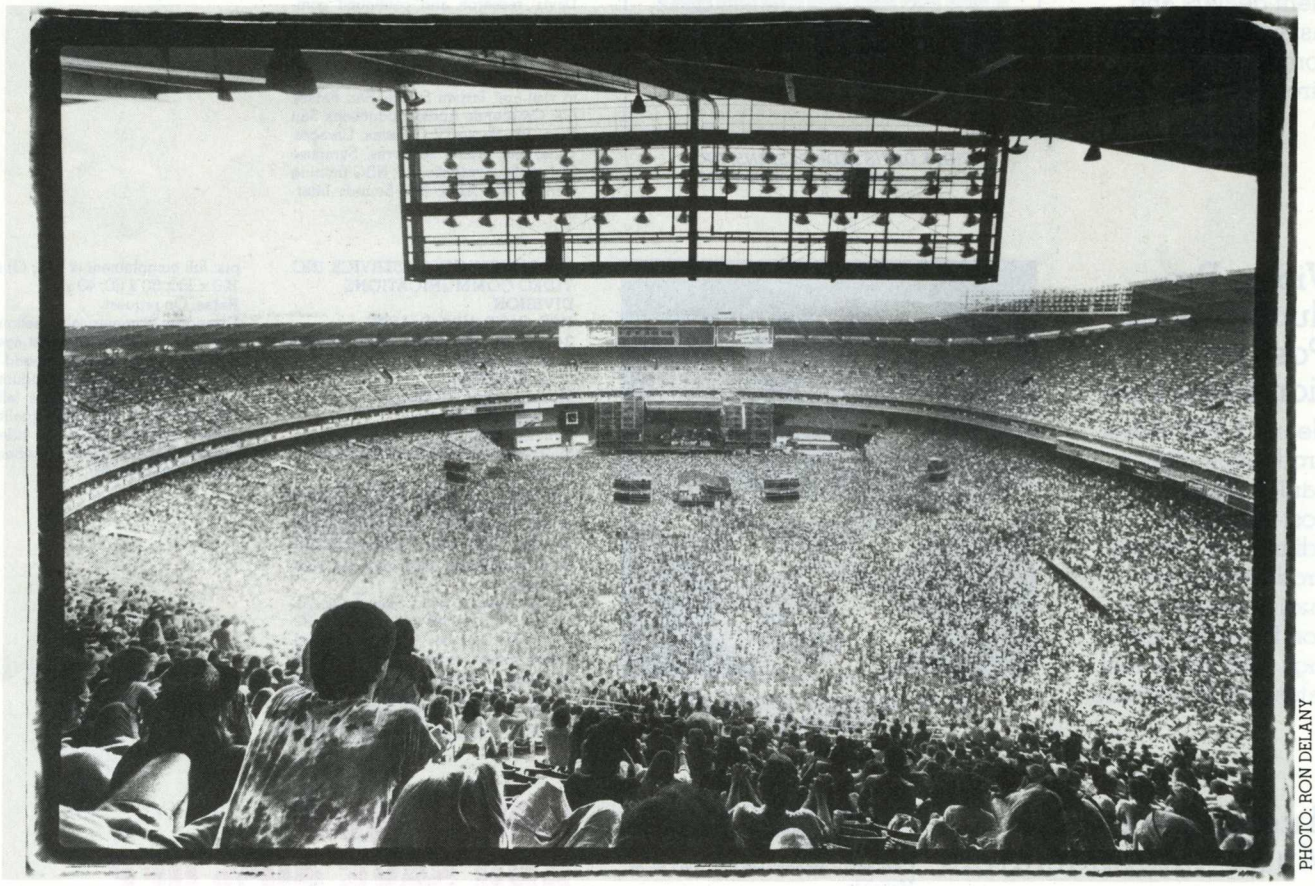


PHOTO: RON DELANY

Overview of RFK from the top deck during Dylan's performance.

by Larry Oppenheimer

The sun beat down mercilessly, pushing the mercury over the 100 degree mark inside the stadium. Mounted police cruised the perimeter of the grounds, enforcing the "No Cans, No Glass, No Coolers" provision, as thousands of scantily- but brightly-clad fans milled about consuming a host of liquids and intoxicants of all types. Slowly, the crowd worked its way inside to fill the cavernous area of RFK Memorial Stadium and spend a long, steamy, Washington, D.C. afternoon continuing the activities begun outside (leading hundreds of the more intoxicated and/or less prudent to collapse from heat prostration), roasting its collective flesh to a fiery lobster red, and, of course, dancing to the sounds of the two supergroups that drew the people out of their air-conditioned comfort in the first place.

The scene described actually took place 13 years ago, when the Allman Brothers Band and the Grateful Dead warmed up for the massive event at Watkins Glen, New York which they staged (along with The Band) later that same summer. (That event drew 600,000, still a record.) However, the description also fits the two shows staged here this past July by Cellar Door Productions which featured Bob Dylan, Tom Petty & the Heartbreakers, and the Grateful Dead. Despite these similarities, things were not really the same as they were when I so gleefully fried my teenage brain and body all those years ago; and the difference was more than the wear and tear that showed on the now middle-aged rock-and-rollers onstage. In the intervening time, the art and science of concert production has advanced by quantum leaps.

Background

Robert F. Kennedy Memorial Stadium was opened in 1961 as D.C. Stadium, and renamed in 1969, a year after Kennedy's assassination. It serves as the home for the Washington Redskins football team, and was used by the Washington Senators baseball franchise until it moved to Texas in 1971. The stadium seats

65,000 for Redskins games, but these concerts drew crowds of 67,000, which included "festival" seating on the playing field. Many music concerts have been held there over the years, including The Beatles, the Rolling Stones' July 4th concert on their 1972 tour, the aforementioned Grateful Dead/Allman Brothers concerts, Michael Jackson, and Bruce Springsteen. Weather has always been a significant consideration for events at the stadium. You see, when the city of Washington, D.C. was no more than a glorious plan on paper, the only land contribution the then-small Federal government was able to wrangle for the construction of a capital came from Maryland, which proudly and patriotically offered a large parcel of stinking swampland on the banks of the muddy Potomac River. Consequently, summertime in D.C. tends to be blazingly hot and maddeningly humid and sticky, with mosquitoes the size of toy poodles thrown in for general annoyance. Although this extracted its toll from all involved at these concerts, the crews still had fewer complaints than about the immediately preceding dates in Buffalo, where severe rainstorms complicated both the load-in and load-out (although it did not rain during the performances).

The concerts at RFK July 6 and 7 were the last of five that the Dead played with the Dylan/Petty alliance; the others were in Akron, Minneapolis (Dylan's hometown), and Buffalo. Looking at the three artists, it is obvious that Petty, a product of the late '70s, has been around and touring for considerably less time than the headliners. The Grateful Dead, of course, have toured incessantly for the last 20 years, while Dylan's appearances have in that same time been far fewer and much further between. Petty and the Heartbreakers' role as Dylan's backup group began when they appeared together at the now-legendary Farm Aid concert, but was also facilitated by other factors, such as their shared management, Elliot Roberts' Lookout Management. A tour of Australia, New Zealand, and Japan solidified the symbiosis. The RFK concerts came in the middle of an extensive (40 to 45 dates) U.S. Dylan/Petty tour, and held added significance for the Dead because of Dylan's longtime influence on them (and, in retrospect, because they turned out to be the Dead's last performances before the tragic collapse of guitarist Jerry Garcia's health less than a week later).

Unlike Dylan or Petty, live performances and touring have been the Dead's *raison d'etre* all along. Years of experience and many thousands of dollars have been poured by the band into their sound and lighting systems, never sparing expense in the continual effort to improve their technical production in the service of bigger and better fun. Consequently, it was decided that the main house sound system would be supplied by Ultra Sound, the San Rafael, California company which has serviced the Dead since the early '80s. Delay towers were supplied to Grateful Dead sound engineer Dan Healy's specifications by Electrotec (Canoga Park, California), which provided the sound system for the entire Dylan/Petty tour.

Concerts of this size and stature present tremendous logistical problems, perhaps the most significant being the coordination of two separate and quite different touring productions. Nowhere was this more evident than in the technical aspects, particularly sound, where the stage and mixing needs of these large concert acts must be met in a smooth and predictable fashion. Rearranging and repatching stage equipment between bands was an unthinkably dangerous proposition: what if something was mispatched and Dylan's microphone didn't work when he stepped up to sing? Furthermore, after working with

PHOTO: LARRY OPPENHEIMER

Dan Healy (at the console) mixing position during the Dead's set. At right is Ultra Sound's Don Pearson.

a particular console and set of outboard equipment for some period of time, it is untenable to consider switching everything around on the spot. Some of the possible problems can be easily seen with a quick look at Fig. 1, which shows the mixing console layout for each act. Note that Dylan engineer Gennaro Rippo set up his console (from lowest channel to highest) with drums first, then instruments, then vocals down by the masters; while Healy had the opposite order for the Dead: vocals, instruments, drums. No matter how such a conflict was resolved, significant amounts of repatching would have to be involved.

The solution was the most straightforward idea conceivable: if sharing was impossible, then simply use two completely separate setups. And so they did—after Dylan's and Petty's set, the stage was completely struck by their crew and reset for the Dead by the Dead's crew. Each group used its own microphones, cables, stands, and so on. Similarly, the large mixing station held both Ultra Sound's and Electrotec's house consoles and outboard racks. Separate monitor systems and consoles were used, even separate snakes were run. Although this redundancy may seem wasteful, it turned out to be the most efficient system, as it minimized the amount and complexity of coordination and/or compromise between the two sound companies, and required the least deviation from their respective familiar and road-tested procedures.

Main Sound System

Ultra Sound bases its main system around Crest amplifiers and Meyer Sound speakers, and is perhaps the only large-scale sound reinforcement company that consistently runs its systems in stereo. For the large venues used for the Dylan/Dead concerts, Ultra put up everything they had. This amounted to over 50 Meyer Sound MSL-3 full range systems and 16 Meyer 650-R2 subwoofer systems (two 18-inch drivers per system) on each side of the stage. The two 12-inch drivers in each MSL-3 were powered by one side of a Crest 3500 amplifier (430 W/ch/4 ohms), the MSL-3 horns (one per cabinet) by Crest 4000s (800 W/ch/2 ohms, 4 horns per channel), and the subwoofers with a Crest 5000 (900 W/ch/2 ohms, two cabinets per channel). (These are FTC power ratings, and stated loads are those actually seen by the amplifiers in this system.) The crossovers are contained in the Meyer Sound processor electronics that accompany each system. Meyer Sound speakers are designed to be stacked in arrays, which result in excellent acoustic coupling and coherence. An accompanying photo shows how the speakers were stacked at RFK. Note the vertical arraying of the subwoofers, designed to provide maximum coupling. The low frequency performance of this system is particularly astonishing, with the ability to develop more SPL than this writer has ever heard from any other sound system. Ultra Sound also has a carefully designed AC distribution system, which scrupulously balanced the load on the legs of the three-phase house AC drop. This results in more efficient performance, especially from the power amplifiers, and avoids a lot of interference and voltage variation problems.

Delay Stacks

Watkins Glen, which followed the Dead's 1973 RFK Stadium shows by only a few months, was perhaps the first large-scale application of delay stacks. This technique employs speaker systems located on remote towers in the audience area to supplement the main stage system, with digital delays on the remote speaker feeds to match the acoustic propogation delay on the main speakers, thus making the sound from the two sources coincident. This technique is now standard for large concerts. The use of delay towers at RFK served several purposes: it assured beyond a doubt adequate coverage and SPL for the distant upper bleachers, effectively increased the ratio of direct to reverberant sound (thus helping to ameliorate the intelligibility problems that typically plague large venues designed more for sporting events than music), and allowed both sound companies to participate fully, avoiding any potential confrontation that could have resulted from the use of one company to the exclusion of the other.

For the RFK concerts, four delay stacks were used. On each stack were two levels of nine Electrotec speaker systems each, a total of 18 per tower and 72 in all. The Electrotec speaker system, known as the "Lab-Q" system, is a two-box design using JBL drivers, with the low end provided by a single 2240-G (18-inch) speaker in one cabinet, and the mid and high frequencies coming from two E120 (12-inch) speakers, one custom biradial-type horn (designed by Electrotec engineer Mick Whelan) with a 2445 driver, and two 2402 "bullet" tweeters (located in front of the E120s) in the other cabinet. Each low frequency cabinet was powered by one channel of an Electrotec Lab-Q amplifier, which is a customized JBL 6233 (300W/ch/8 ohms). The other channel powered the E120s in one mid/high cabinet. The horn and tweeters in each mid/high cabinet were powered by one channel of a UREI 6400 (four channels at 100 W/ch/8 ohms). Each amplifier rack contained four Lab-Q amplifiers and one UREI, enabling it to power four complete Lab-Q systems. A Brooke-Siren modular crossover with MCS 203a, 204, 205, and 208 modules completes the setup.

Bob Dylan/Tom Petty and the Heartbreakers Console Layout

CHANNEL	INPUT	SOURCE
1	Kick	AKG D12E
2	Snare (top)	Shure SM57
3	Snare (bottom)	Shure SM57
4	Hi-hat	Beyer 201
5	Rack toms	Sennheiser 421
6	Floor tom	Sennheiser 421
7	Conga	Sennheiser 421
8	Overhead (stage right)	AKG 460/CK8
9	Overhead (stage left)	AKG 460/CK8
10	Bass	Countryman DI
11	Mandolin	Countryman DI
12	Dobro	Countryman DI
13	Electric guitar, Campbell	Shure SM57
14	Acoustic guitar, Campbell	Countryman DI
15	Electric guitar, Petty	Shure SM57
16	Acoustic guitar, Petty	Countryman DI
17	Electric guitar, Dylan	Shure SM57
18	Acoustic guitar, Dylan	Countryman DI
19	Keyboards (Dylan, not used)	
20	Electric grand piano	Kbd sub mixer
21	Organ Leslie (low)	AKG D12E
22	Organ Leslie (high)	Sennheiser 421
23	Roland SDE3000	Direct
24	DX7 synthesizer	Kbd sub mixer
	Queen Esther Marrow and the Queens of Rhythm:	Beyer M88
25	Backing vocal 1	Beyer M88
26	Backing vocal 2	Beyer M88
27	Backing vocal 3	Beyer M88
28	Backing vocal 4	Beyer M88
29	Piano vocal	Beyer M88
30	Organ vocal	Beyer M88
31	Drum vocal	Beyer M88
32	Dylan/Petty vocal	Helpinstill pickup
33	Piano bass	Helpinstill pickup
34	Piano mid	Helpinstill pickup
35	Piano high	Direct
36	224X dig reverb left	Direct
37	224X dig reverb right	Direct
38	REV7 dig reverb left	Direct
39	REV7 dig reverb right	
Stereo submasters		
1	Drums	
2	Backing vocals (Queens of Rhythm)	
3	Backing vocals (TP and the Heartbreakers)	
4	Bob Dylan	

Grateful Dead Console Layout

CHANNEL	INPUT	SOURCE
1	Bass vocal	Neumann KM84E
2	Rhythm guitar vocal	Neumann KM84E
3	Lead guitar vocal	Neumann KM84E
4	Keyboard vocal	Neumann KM84E
5	Bass	Custom DI
6	Rhythm guitar	Sennheiser 421/ custom coil mic
7	Lead guitar	Sennheiser 421
8	Keyboards 1	Countryman DI
9	Keyboards 2	Countryman DI
10	Organ Leslie (high)	Shure SM57
11	Organ Leslie (low)	Shure SM57
	Drums: Billy Kreutzmann	
12	Kick	*Assorted:*
13	Snare (top)	AKG 451s,
14	Snare (bottom)	AKG 460s,
15	Hi-hat	AKG 414s,
16	Rack tom 1	Sennheiser 421s,
17	Rack tom 2	used on drums.
18	Floor tom	
19	Overhead	
20	Overhead	
	Drums: Mickey Hart	
21	Kick	
22	Snare (top)	
23	Snare (bottom)	
24	Hi-hat	
25	Rack tom 1	
26	Rack tom 2	
27	Floor tom	
28	Percussion O.H./SP2016 left	
29	Tar/SP2016 right	
30	Son of Beast 1	
31	Son of Beast 2	
32	Beast left/Dylan vocal	
33	Beast right/Dylan guitar	
34	Lexicon 200 left	Direct
35	Lexicon 200 right	Direct
36	Super Prime Time	Direct
37	Roland SDE3000	Direct
38	Echotron	Direct
39	Multi-effects	Direct
40	PCM42	Direct
Effects returns		
1	Timbale (top)	
2	Timbale (bottom)	
3	Rototoms	
4	Octobans	
5	Other percussion	
6	dbx 500 boom	
7	Walk-in music left	
8	Walk-in music right	
Stereo submasters		
1	Vocals	
2	Bass	
3	Keys and guitars	
4	Drums – Billy Kreutzmann	
5	Drums – Mickey Hart	
6	Rhythm Devils/Electrotec console feed	
7	Autopanners	
8	Effects return	

The stacks were located in a gentle arc such that they were equidistant from the center of the stage, meaning that one delay time could be used for all the stacks. The stacks were run in mono, and the delay was provided by an Ampex ADD-1 Mastering digital delay from the GD. The only difficulty encountered with the stacks came when the sound companies, after completing load-out in Buffalo at 3:30 a.m. and driving straight through to D.C., arrived about noon on July 5 to discover that the scaffolding for the towers had only been set up to accommodate one level of speakers. The RFK house crew was quickly set to work constructing platforms for the second level of speakers, which were in place and fully operational by about 6 p.m.

Bob Dylan/Tom Petty and the Heartbreakers

The Dylan/Petty portion of the concert featured a set that alternated between several different configurations: Dylan with Petty, Petty without Dylan, Dylan without Petty, more Dylan with Petty, more Petty without Dylan, and more Dylan with Petty to close. From a production standpoint, however, it was a relatively straightforward rock and roll setup. Dylan sang and played electric guitar with Petty, and acoustic guitar and harmonica in his solo spot. Petty's group featured Petty on vocals and rhythm guitar, plus the Heartbreakers: lead guitar, keyboards, bass, drums, and backup vocals. Backup vocals for Dylan were also performed by Queen Esther Marrow and the Queens of Rhythm. Petty and Heartbreaker Mike Campbell also played acoustic guitars in spots, and, on one song, Campbell played dobro and mandolin. In all, there were five snakes, each with 32 lines, coming from the stage. These were passively split in a stage box contained in the monitor console and then fed to the house snakes.

Out at the mixing station, these inputs were fed into a Soundcraft Series 4 console which was constructed by Soundcraft to Electrotec's specifications. (The monitor console was also a

custom Series 4, with the splitters and 16 monitor mix buses.) Among the features of note on this console are the four-band parametric EQ on each channel, and the programmable mute feature. This last allows any number of inputs to be arbitrarily grouped under the control of a single mute switch. There are eight such mutes on the Electrotec console. The stereo master outputs of the console were patched into a stereo submaster insert point of Ultra Sound's console. In the signal processing racks were dbx 903 compressor/limiters for the drums and Dylan's vocal, White 4000 1/3 octave equalizers for left and right house mixes and Dylan's vocal, a Lexicon 224XL for Dylan's vocal, a Yamaha REV7 for the snare drum, and a Roland SDE3000 delay for Campbell's guitar. The White equalizers on the house mixes enabled Dylan's set to be EQ'ed without altering any of Ultra Sound's equipment. The monitors were Electrotec cabinets with a JBL E130 or E140 (15-inch) speaker, and a JBL 2390 horn/lens assembly with a JBL 2441 driver. Two Lab-Q systems were used on each side of the stage for side fill. Engineer Gennaro Rippo declared that he did "nothing special" in mixing Dylan and Petty, mixing them simply as "a guitar band."

The Grateful Dead

In contrast to Dylan, the Dead's production is extremely sophisticated, although the instrumentation is almost identical. Each musician has a complex setup involving an exten-

Recording at RFK: Ultra Sound's M-S System

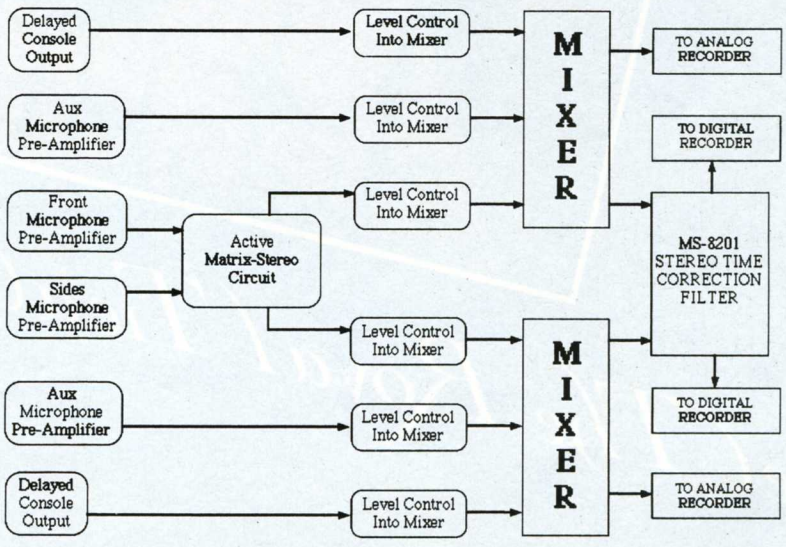
The Grateful Dead have not recorded an album of studio material since 1980's *Go To Heaven*, yet they are probably the most recorded band ever. This is largely due to the sect of their legions of fans known as "the tapers." These fans have come to realize the significance of live recording to a band that does not do well in the studio, and have acquired increasingly sophisticated techniques and equipment for this task, especially since the band began to officially condone such recording with a reserved "tapers' section" at concerts. As one might guess, this lesson is far from lost on the band themselves. In fact, their last two albums, both recorded live, were recorded using techniques developed by Healy as a result of his contact with tapers' recordings. The Dead record every concert, with both digital and analog 2-track recording systems. This has precipitated the need for equipment which allows this recording to be done with maximum flexibility and uncompromised quality. To answer this need, Ultra Sound has again risen to the occasion with a new "black box" for the Dead, designed by Healy, Geoff Peters and Don Pearson, which at this time is simply referred to as "the M-S box."

The M-S box does not in and of itself perform any amazing new function, but it collects a number of needed features in a coordinated system housed in a 3u rack space package. The basic goal is to allow the combination of a signal from a microphone, the direct signal from the console, and, if needed, voice-over microphone signals, with numerous ancillary functions. A block diagram of the M-S box is shown here.

The Dead use an AKG C34 microphone in an M-S (Mid Side or Matrix Stereo) configuration, mounted in front of the console. The C34 contains four of the AKG 414-type gold foil capsules in one housing. This is powered by a phantom power supply, with true active ± 48V circuits. A low-noise microphone preamplifier for each section of the mic follows, and the outputs are fed into an M-S matrixing circuit. Note that there are level controls, mutes and cue bus monitoring placed in strategic points before and after circuits.

The mixing console signal is also fed to the M-S box, but in order for it to be coincident in time with the mic signal, it must be delayed equivalently to the propagation delay on the mic signal. At this time, this is achieved with an insert loop which sends the console signal out to an Ampex ADD-1 Mastering Digital Delay. After returning from the delay, the console signal is mixed with the mic signal in the desired proportions. Also at this stage are two more microphone inputs which can be used for cueing or voice-overs during live broadcasts. Following this, the mixed stereo signal is sent into a Meyer Sound MS-8201 Stereo Time Correction filter, which compensates for the objectionable phase shift (particularly at high frequencies) which often occurs in anti-aliasing filters in digital recording equipment. In this case, the signal is fed from the M-S box into a Sony PCM701 or 501 and a battery of analog cassette recorders (which derives its feed from before the MS8201 module). Finally, a five watt headphone amplifier is included onboard to allow the monitoring bus to be heard above the sound reinforcement system when monitoring. The unit is constructed in a "roadworthy" fashion to provide reliable service on the Dead's journeys. *—L.O.*

RECORDING SYSTEM BLOCK DIAGRAM



sive inventory of electronics and/or multiple instruments. As a result, the 42-pair house snake is completely filled up. Technical needs in the Dead's set-up are often met with custom electronics, usually designed by John Cutler, Dan Healy and/or Don Pearson, and built by Ultra Sound. The style of music purveyed by the Dead often features extended instrumental passages. To avoid the problems caused by open vocal microphones, Healy has devised a system wherein each vocalist (excepting keyboardist Brent Mydland, who plays seated) has a small pad placed in front of his mic stand. When he steps up to sing, a pressure switch in the pad is activated, sending a DC voltage which then opens a dbx 904 noise gate at the mixing station. To facilitate this application, the noise gates have been modified to DC couple the keying input. When the vocalist finishes singing, he steps back to play and the gate closes. This system works quite well to a point: it is often the case that the vocalist (particularly Jerry Garcia) will wish to stand on or near the pad when he is not singing, perhaps to hear the monitors or to be able to resume singing easily after a short solo. Worse still, Garcia likes to rock back and forth on his heels when he plays, which can cause the gate to flop open and closed. Healy deals with this with an override footswitch placed just beneath the mixing console, which keeps the gate pulled low. Mydland's gate is also dealt with by a footswitch operated by Healy, who, amazingly, never seems to miss any of Mydland's vocals. A similar gating scheme is used on Mydland's organ Leslie mics: the voltage output of the Hammond organ is transformer split, with one feed going to the Leslies, and the other being sent to a custom box at the mixing station, containing gates and threshold comparators. The microphone signals go into the gates while the Hammond feed goes to the threshold comparator which keys the gates. Thus, the Leslie mics are only open when the organ is actually being played.

All stage inputs feed directly into the monitor console onstage where they are passively split and then sent out the house snake. The house console is a 48-input Gamble console which includes a number of the same deluxe features found on the Electrotec console: four-band parametric EQ on each channel, programmable mutes, and eight effects sends (configured as four dual concentric pots). Those sends get used, too; Healy's goodies racks contain: a Lexicon PCM42, Super Prime Time, and Model 200, ADA Digital Multi-effects, Roland SDE3000, DeltaLab Echotron ADM4096, Eventide SP2016, two custom autopanners, and a dbx 500 subharmonic synthesizer. These get used to create a variety of subtle or bizarre effects, depending on Healy's mood of the evening. In addition to the gate control footpedals already mentioned, Healy also has footpedal control of delay time and the repeat/hold function on the Echotron, and the speed of the autopanners. To keep all the effects sends straight, strips of colored tape corresponding to the color coding of the effects send pots are placed beneath the faders of the appropriate effects return channels and marked "upper" or "lower" to indicate which part of the concentric pot is the send to that effect. The subharmonic synthesizer sees consistent use on the large drum assembly played primarily by Mickey Hart and known as "The Beast." This is where the large numbers of Meyer subwoofers really get their workout, as the dbx unit allows reproduction of low frequencies from the drums in a way that no microphone could do, in fact, it most likely creates more low frequencies than the drums actually have! The section of the show which features The Beast —an exotic percussion duet between Hart and Kreutzmann, calling themselves the "Rhythm Devils"—delivers sufficient low frequencies at its climax to literally vibrate your pants against your leg. Mind you, these are just the toys.

In the way of more utilitarian processing there are two dbx 900 racks, containing a total of 12,903 compressor/limiters and four 904 noise gates (used for the vocals as described above). The 903s are used for vocals and instruments, including Son of Beast, the melange of electronic percussion and processing which is Mickey Hart's latest addition to the Rhythm Devils. Equalization is performed with five Meyer Sound CP10 Complementary Phase parametrics. The CP10s have been altered to allow several sections to be cascaded in series, thus achieving deep notching while retaining very narrow bandwidth. Other racks at Healy's station contain test and recording gear and assorted ancillary devices. All snake and rack connections are terminated with AMP Quick-Latch multi-pin connectors, which mate to a panel wired to a large patch bay on the back of one of the racks. Thus, just as in a recording studio, any desired configuration can be patched quickly without running any additional cables.

At the second show, Dylan came out during the Dead's set and performed two of his songs with them. To accommodate this situation, Dylan's guitar and vocal inputs were patched when he came onstage into two channels which would not be in use simultaneously with his appearance: those used for the Beast. Each musician monitored through a Meyer UM1 speaker system, fed from the 40 x 16 Gamble monitor console.

System Setup and Test

With this great mess of speakers and electronics, it would seem likely that a sophisticated system of aligning and equalization would be used, and this is indeed the case. The Grateful Dead and Ultra Sound have worked very closely with Meyer Sound in the development of many of their products, and have also been instrumental in helping Meyer devise his Source Independent Measurement test procedure. The system currently used by Healy and Ultra Sound differs somewhat from that used by Meyer, but is basically the same. In essence, the technique works like this: first, a sound system is constructed with a consistent (from cabinet to cabinet) and flat frequency and phase response, thus eliminating the speakers as variables in the equalization problem. Next, a reference point in the signal chain, typically the console output, is chosen and fed into the reference input of a dual-input FFT analyzer. A calibrated test microphone is set up in front of the mixing station and its output fed into the analysis input of the analyzer. To match the propogation delay between the speakers and the microphone, a delay is inserted in series with the reference. The two analyzer inputs are then compared, and the CP10 equalizers used to flatten the response. The great advantage of this system is that any signal, even music, may be used as a test source, as the technique depends only on a before-and-after comparison. The classic sound reinforcement problem of drastic changes in acoustics between a full and empty hall is eliminated.

In the case of the Grateful Dead and Ultra Sound, the Meyer speakers are the flat system, having matched processor electronics to compensate for any anomalies. The analyzer is a Bruel and Kjaer 2032, which contains an onboard trigger delay for making the reference signal coincident in place of the digital audio delay. The microphone is also Bruel and Kjaer, consisting of a preamp and 4133 capsules. It is mounted on a rail and motorized to allow it to be moved laterally at a calibrated rate over an eight-foot range in front of the console, with the resultant signal being averaged, thus eliminating from the

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measured data any acoustical artifacts that may be present only at a single spot. The analyzer shows two traces: the room response, determined by deconvoluting the reference signal with the mic signal, on top; and the correlation between the two signals, which gives an ongoing indicator of the validity of the test date, on the bottom. The equalizers are set manually to make the top trace maximally flat or to the desired curve. The initial setup was done using pink noise, but final adjustments were made using taped music after the audience had entered, but before the show. Minor tweaks were also done during the performance, especially in the first few songs.

The analyzer was also used (before equalizing the system) to determine the proper delay time for the delayed stacks. The line output of a General Radio 1565B SPL meter was fed to the line input of an HME wireless PAL (Precision Audio Link), and the two were placed in the bleachers beyond the stacks. With the delay stacks shut off, pink noise was played through the main house speakers. The meter signal was received at the mixing station, fed into the analyzer (which was in impulse response mode), and stored, thus capturing the acoustic delay, displayed as the arrival time of the test signal wavefront. Then the house speakers were shut off and the stacks turned on. Using the B&K's cursor alignment function, the other trace of the analyzer now showed the delay from the stacks to the microphone. Finding the correct value for delaying the stacks was now simply a matter of subtracting the latter from the former. As the delay was actually set up, the results could be viewed on the analyzer and fine-tuned until the two wavefronts appeared to be vertically (in time) coincident. The only difficulty experienced with this procedure was in elevating the meter enough to avoid the effects of primary reflections off the seats.

A standard Altec/Hewlett-Packard 8050A third-octave real time spectrum analyzer sat on top of the console on the right side, and a small video monitor with the B&K's display on the left side to allow Healy a quick monitoring capability that didn't require turning around. The Gamble console also includes an onboard spectrum analyzer, but this was not needed under the circumstances.

System Performance

RFK Stadium has no one's idea of desirable acoustics. The last concert I heard there before these was the Dead/Allman Brothers in 1973, which had used the Dead's "Wall of Sound," a very good, if impractical, sound system. Without doubt, the Ultra Sound/Electrotec system compared favorably with that system. Although there were some difficulties with Dylan/Petty's sound the first day, the Dead, who were, of course, used to the system, sounded full and clear, filling the cavernous stadium with ample amounts of music. The normal stadium slap echo was still there, but the dull roar of undesirable low frequency reverberation was noticeably absent, which reduced the annoyance of the slap. This was most likely due to the tuning of the system, and resulted in much greater intelligibility than would usually be experienced in such a venue. The smooth interaction and level of coordination between the two sound companies and touring organizations was quite in evidence and certainly contributed heavily to the success of the shows. The audience, quite obviously being more of a Deadhead crowd than anything else, was generally thrilled with the proceedings . . . with the exception of the blazing weather. ■

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