Audio Facilities— Planning, Construction and Servicing

Following are the highlights of a meeting held by the New York Section of the AES this past September.

The panelists were Richard W. Burden, president of Burden Associates, consulting engineers; Henry Krochmal, facilities engineer with NBC; Joseph Giovanelli, president of Audio Tech Laboratories, specialist in disc mastering and long a columnist for Audio Magazine; and Abe Kobrin, with Harvey Radio for twenty years and the foremost technician in the New York area on Ampex professional products. Irving Joel of Capitol Records was the chairman and moderator. The transcript has been edited somewhat to improve clarity.

Before the question and answer session that comprised the bulk of the session, each panelist made an opening statement.

KROCHMAL: My role is in the facilities engineering department as a designer and engineer. Whenever there is a need for a new piece of equipment or a system — audio or video system for studios or camera chains, or any system that requires components, we are given the job of putting something down on paper that someone can build. When the job is first assigned to us we get an idea from the operating people as to what the system should contain. This is logical; after all, they have to operate it as comfortably as possible, and want it trouble free. It's best to go to these people, of course, but it must be remembered that you just cannot add everyone's desire for everything or you'll end up with a console that won't even fit in the studio. So you weave through all the information, colate it, and make up what you think will fit the bill for most of these people.

The final design must be not only comfortable—that is, easy to operate — but also it must present few problems as to maintenance (since down-time could run into thousands of dollars).

The discussion panel. Left to right seated—Abe Kobrin, Joe Giovanelli, chairman Irv Joel, Henry Krochmal, and Dick Burden. Art Gruber, standing, is introducing the panel.

Once a rough design is down on paper we build a mock-up, usually of cardboard. This gives the people who will ultimately use it an idea of what it looks like; how it will fit. If there are no further changes to be made we go right ahead and engineer the system. Most of the time the job will be turned over to a construction firm. On occasion when the job is to be built right here (at NBC), we hire people to do the constructing.

Burden: When a construction company such as we are comes in we take Henry's basic idea, sit down with him and his paperwork, look at his mock-up, and go back and read over his ideas again. Then we come up with a list of questions:

Why do you do this? Why do you want that? In this way a design engineer from the construction company's side of the fence can get a pretty good idea of what someone like Henry wants this console to do. Then we can start without preconceived notions as to how this unit is to operate. And when we get to the final design we may find that something must be rearranged because this is the only way we can fit the necessary components together.

Today's industry is going more and more toward modular type construction. There often isn't time during the day-to-day operation to look through a console, trace a wire, or run into an amplifier to replace a capacitor. We have to be able to check quickly, pull the faulty amplifier out of the circuit, and replace it with something—fast. So the item must be accessible as well as replaceable. If we are going to make a modular arrangement, it will not do if maintenance must go down beneath the operator, through a trapdoor and down a set of stairs to get to something.

So the system must be set up with quick accessibility in mind. This will sometimes require moving a few things around on the panel. All this must be done with some thought to the operator himself so that he doesn't have to be a foot-and-a-half tall with an arm reach of seven feet to be able to operate this gadget. We want to make those sections that we have set up for preventive maintenance particularly accessible. The logic behind this dictates that hard to reach areas will be skipped during routine maintenance – and the next thing you know you have a failure.

All of these factors must be considered before actually building a piece of equipment.

Kobrin: After Henry and Dick have completed their jobs we have the ever present problem of maintenance. It hardly seems necessary to stress the importance of proper maintenance. So allow me to give you the difference between proper and improper maintenance.

We had a man bring in a recorder with the complaint that it didn't work. So we opened it. We found that he had read his instruction book carefully. It said that he should put three drops of oil on the capstan bearing – so he did. He liked this so much that he put three more drops in. This looked very good so he put three drops on the idler bearing. And this looked very good so he put three drops more there.

"Well," he said, "this looks terrific." So he put three drops on the heads because the tape runs over them and he put about four or five drops on the screws and five or six drops on the meter because it wasn't glossy enough. Well, by the time it came to us it was one massive glob of oil. Now the clincher is that this wasn't bad enough, but the darn thing smelled of Mazola!

This is what I consider improper maintenance. If he had really followed his instructions properly and used the correct equipment, this machine would have run properly.

Giovanelli: If we have done our routine maintenance correctly, the odds are that any emergency is a rather minor failure. With proper maintenance being done, you are not going to have a general catastrophic failure somewhere in a feedback loop. It is a diode that has popped in the power supply, an electrolytic which has shorted; now these things do not call for esoteric tracing methods. We can look and see where the smoke is coming from. Most of the time we can fix something quickly using nothing more than a pair of headphones and a couple of alligator clips. Even without any equipent we can usually do it. You don't need an oscilloscope to find that there is no B+; you don't even need a volt meter much of the time.

All I'm trying to say is look for the problem easily. Don't get so involved in theory and analytic work that you lose sight of the fact that you didn't turn the switch on or put in the plug. It happens.

This concluded the formal opening statements. What follows are selected audience questions posed to the panel.

Question: In the wiring of facilities there are two methods in common use. One is known as the brute-force ground method, where you use non-insulated shield wire bundling them together. The other is the method using insulated wire bundled together with a grounding at one common point.

I'd like to know from the panel which they prefer – and why.

Krochmal: It has been my practice and my feeling to use shielded wires but no jacket at all. (I assume the type of wire referred to in the question is shielded wire with no jacket on it.) It makes wiring much easier. I would say that virtually all of the time it is entirely satisfactory. The one thing we find that we must watch carefully in our installations is where we terminate those wires.

We bundle wires depending on what level audio we expect in those wires. For example, keep all microphone-level conductors in a single bundle, but keep that bundle at least one-half to one-inch away from a bundle that might be carrying line level. At NBC we use the three shielded bundle forms: mic level (around –60), fader level (around –22), and line level (around +8). We simply run them parallel to each other but not bundled together. When they terminate at a block we make sure that our lugs in the block are assigned in such a fashion that there is never mic level on a lug adjacent to one carrying line level. We will, in fact, often use separate blocks for the purpose. With this system we don't run into trouble at NBC. However, I do see where r.f. pick-up could be a problem when you are in high fields. I think that Dick Burden probably has a different point of view on this.

Burden: It's r.f. that is the problem, particularly at the a.m. stations where you get a length of wire that all of a sudden is the right length to become a half-wave antenna and pick up r.f. Bundling wires together, though it certainly produces a good ground, can put you in this position. Grounds are an odd thing; it depends so much on how and where your cables are connected.

What we do is usually leave the shields to a certain point along the line. Then we decide where they are going to tie, making sure that they are only tied on one end. Once you start to bundle, if you have tied a cable by mistake in the wrong place, you've got a real problem on your hand. My preference is definitely to insulate, particularly if there is an r.f. field.

Joel: I think it has to be remembered that in grounding practices you must realize that we are dealing with two different types of technology. There is *broadcast procedure*

where everything is balance that comes and goes. And there is also *unbalanced circuitry* that is inherent in transistor equipment. Grounding procedures have changed considerably since the advent of the transistor and its type of circuitry. In any case, you cannot intermix the two systems. You must decide which way you are going to go – and stay that way.

Question: It should be added that most of what has been said refers primarily to balanced circuitry where two wires are shielded to a conductor. But what are the general ideas today when using single-ended circuits where some of the time the shield is carrying part of the actual signal or the ground side of the signal circuits.

Giovanelli: You wouldn't want your shield to carry the ground signal. You'd rather have it come back almost as if it was balanced, where you have a second conductor to bring the signal back and then tie the shield at one end somewhere – assuming you could, of course.

Burden: We treat it just as though it was a balanced line.

Joel: I was going to say earlier, travel your audio as *high* and *low* audio. Don't confuse it with B+ or B–.

Burden: A good example of this is that you might run into a bunch of ground loops at the actual installation site even though none were present when the system was setup in the shop. If you have used this type of grounding procedure with two wires hanging, you can use an isolation transformer to get rid of the ground loops. Once you have used the shields for grounds you are finished as far as putting a transformer in.

Question: It has been mentioned that there is signal-conductor shielded and two-conductor shielded. Now in referring to microphone lines of 50-, 150-, and 250-ohms input through a transformer, there is another method using three wires. This uses all three run through with the shield connected at one end only. Now do any of you have an opinion of this as compared to two lines?

Krochmal: Our practice, with mic circuits particularly, is to ground in only one spot. That would be the point close to the terminal or amplifier equipment.

As an example, we have just completed a job where we had long mic lines on the order of six-hundred yards. (It was a golf match.) We used no grounds at all except right at the receptacle panel where the mic cables were plugged into the truck. This raised no problems. If we had connected at the far side as well we would have had ground loops.

Question: With a run like that wouldn't you want to have a preamplifier right at the microphone, thus overcoming the problems by boosting the level right there?

Krochmal: Yes, that would be very fine, except that we had thirty-nine mics.

Joel: There is an NAB standard that spells this out very clearly.

Question: Quite a bit has been said now about shielding. But one worry that remains is: where do we get our ground terminal system; do we go out to a water pipe or some such in a tall city building?

Burden: The water pipe is not necessarily a good answer. It might be better than nothing but sometimes it makes a fine antenna picking up your competitor down the street. In some cases, a heavy cable is simply brought up to the level you need it. It can be even a 00 Greenleaf, jacketed. Then bring that up inside a conduit. Ground the conduit and the wire at the bottom end. The conduit becomes a shield eliminating r.f. pickup by the ground wire (to some degree).

It must be added that we are dealing with a considerable problem. There are no simple answers that can be given.

Question: Where do you finally ground to when you've taken that conduit down? There are different levels even of earth grounds?

Burden: In New York this is a very real problem since we are on rock. You simply have to find the best ground you can get. In a broadcast station you may want to ground right to earth through the ground plane for your antennas. Drop a good piece of copper and braize right to it.

Question: What do you do on remote locations where you simply must plug in wherever you are?

Joel: Bell System practices specify on remote location that multiple grounds be driven and the audio ground then be attached to this system. I've been out on remotes where we had to drive as many as twenty stakes before we got where we were going.

Remember that there are two basic theories to keep in mind:

Ground only to one place and ground everything to it. Or, ground everything to everything.

On remote locations the usual practice is to pick your location and ground everything to it. Only if you are in a small complex might you consider the ground-everything-to-everything practice.

Question: I'd like to expand on the question of wiring a bit more. In the past it has been the practice to use an audio system starting with a microphone, bringing it up to a patch panel, bringing it back down again to the mixer, bringing the mixer to the patch panel, back down to the amplifier – this could go on forever. Do you feel that this is still the way to go?

Krochmal: At NBC we still do this, mainly for flexibility purposes. We do not do what many recording studios do; there isn't a filter for each mic channel. We have four patchable filters in one of our consoles and we make it patchable to any one of forty-two mics. Four is the maximum we will ever need, but we don't know where we will need them.

Giovanelli: I would like to add that I prefer the system of coming out to a patch panel so that I can plug something in if I want to listen to it; or feed a signal into it just from a maintenance standpoint.

Joel: Let me just air both sides by saying that if you could conceive of a module that would do everything you could ever ask of it by switching, or by duplicating whatever equipment was necessary, then it would be feasible to remove some of the patching facility. Some of this is being done successfully because of such things as operational amplifiers. Where it was formerly quite expensive to build something such as an equalizer, now professional amplifiers costing extremely little – under $10 – are capable of doing some of the equalization. It then becomes feasible to put these in multiple into the console's modules. When you do this, you can eliminate some of the jacking.

Everytime you remove a jack you remove a point source of noise because in most systems these jacks are normals; thus they are a potential source of noise. And with unbalanced circuitry in the module, you are able to live with fewer transformers in the chain (looking at it from front-to-back). This is certainly a design consideration.

Burden: This is going back to the idea of planning before anything is done. Ask yourself or someone else if you really need all the things you are asking for. Talk to someone on the outside and you may get a fresh view. I've found that in many cases people ask for a lot more than they need. They *over specify*. After discussion we may find that 10-15 per cent less than was thought is actually needed.