POWERING THE OFF-PREMISES SIGNAL CONTROL SYSTEM

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ABSTRACT

The advantages and disadvantages of drop cable and feeder cable powering of off-premises signal control systems are discussed.

INTRODUCTION

The last three years have seen growing cable industry interest in various types of off-premises signal control systems - as evidenced by the papers being presented at this panel today.

I have grouped the various methods of off-premises control into two general categories: 1) Converter systems, where a signal conversion from the cable channel to the TV set channel is made off-premises and 2) Interdiction systems, where the channel conversion is made in or at the TV receiver and remotely addressed traps or jamming carriers are located off-premises.

One powering concern with these systems is the cost burden to the operator if the off-premises system is powered from the feeder cable or the cost burden to the subscriber if it is powered from the home. A second concern is the retrofitability of an off-premises system into an existing plant, if it will be powered from that plant. A third concern is safety if power is being supplied from the subscriber's home and if for any reason the integrity of the drop cable is lost, creating a shock hazard.

POWER CONSUMPTION

Six representative off-premises signal control systems have power consumptions per subscriber between 1.75 and 4 watts for interdiction systems and between 8.5 and 33 watts for conversion systems, with several of the latter in the 10-15 watt range. In this paper, I have assumed 3 watts for interdiction systems and 15 watts for conversion systems.

For a system designed for 80 subscribers per mile, the signal control power consumption would be 240 watts per mile with an interdiction system and 1200 watts per mile with a conversion system.

SYSTEM POWERING

A recent 106 passings per mile cable plant was designed by ATC for the 60 volt power supplies to supply 554 watts per mile, assuming a power factor of 95%. Of this power, 462 watts was amplifier usage and 92 watts was lost as heat in the trunk and feeder cables.

Approximately 15-20% of the power supplied by a 60 volt power supply is actually lost as heat in the trunk and feeder cables. For example, in carrying 10 amps through one mile of 3/4 inch copper clad aluminum center conductor GID cable, 380 watts are lost. With comparable 1/2 inch cable, 866 watts are lost.

The 60 volt power supply can have an efficiency of approximately 80% for non-standby power and as low as 40% for a standby powered supply. For the purposes of this paper, I've assumed an efficiency of 80%. The cost of power from representative power companies throughout the United States ranges from 5¢ to 15¢ per kilowatt hour, with a large number of the rates clustered around 8¢, the number I've used for this paper.

With all of these assumptions, and without any off-premises signal control consumption, this particular cable plant design should have a power cost of $486/per mile/per year.

When the off-premises signal control powering needs are added, and taking into account approximate factors for cable loss and power supply efficiency, interdiction would increase this system's power consumption costs by $252, a 52% increase, while a conversion system would increase the power consumption costs by $1,262, a 260% increase. This could represent a power cost, for signal security alone, of over $126,000 in a 100 mile system - and could be double this number if standby power supplies with 40% efficiency are used. In addition, this does not take into account the capital and makeready costs of additional power supplies nor the labor costs for their installation. Because a conversion system can cause the current in some feeder cables to increase as much as from .6 amperes to 9 amperes, there is also a possible power passing problem.

HOME POWERING

In this section, we will look at some examples of the drop cable voltage drop and power cost to the subscriber for home powering off-premises control systems, with a subscriber supplied voltage of 24 volts and a drop length of 100 feet.

If the drop is an RG-59 size foam dielectric cable with an aluminum foil sheath and a copper clad steel center conductor of 73 ohms per 1,000 feet loop resistance, a 3 watt interdiction system would cause a 0.95 volt drop in the drop cable with 3.12 watts being supplied by the subscriber. If we assume 80% efficiency on the voltage conversion in the subscriber's home, this would lead to a draw from the 117 volt line of 3.9 watts, at a cost of $2.74/per year. A 15 watt conversion system would have a 6.1 volt drop in the drop cable and a total power consumption of 25.2 watts, at a cost of $17.67 per year.

At this cost, some subscriber opposition may be encountered. However, the power consumption may be explained as not significantly greater than the approximately 20 watts that might be drawn by an in-home addressable converter. It could also be explained that the subscriber's fees would have to be increased by this amount, if the subscriber were not supplying this power.

If lower loop resistance is needed in the drop cable, we could use a similar construction RG-6 size cable of 48 ohms/per 1000 feet, which would cause a 3.5 volt voltage drop for a 15 watt conversion system, a subscriber power consumption of 21.9 watts, and a subscriber cost of $15.36 per year. Going all the way to an RG-6 with copper braid and a solid copper center conductor with a DC loop resistance of 14 ohms per/1000 feet could reduce the voltage drop on a 15 watt system to 0.9 volts and require a power consumption for the subscriber of 19.5 watts, at a cost of $13.68 per year.

Another subscriber powering concern is safety. The 24 volts we've used in these calculations is generally considered safe in an indoor environment. But because of the possibility of a small child picking up a broken drop cable while standing in a puddle of water, additional safety is recommended. Suggestions have included locking shields on drop cable connectors and warning labels on the cable, but the security shields do not prevent the broken drop cable problem nor do the warning labels answer the question of a pre-schooler picking up the broken cable. There are also some systems with higher power consumption or the need for longer drops that would like to run drop voltages as high as 50 to 60 volts.

One method of increasing the safety is by increasing or decreasing the power frequency. The most hazardous frequency for cardiac fibrilation, the primary cause of death from low voltage electric shock, is close to 60 Hz. If we reduce the frequency to DC, or more probably a few tenths of a hertz to avoid galvanic corrosion problems, or increase the frequency to approximately 10 kHz, the safety factor goes up by approximately five times, i.e., five times the voltage can be carried for the same level of safety.

An approach taken by one manufacturer is a circuit that will instantly interrupt the voltage leaving the in-home power device if the drop current is interrupted for any reason. In this particular system, when drop integrity is restored, the system will automatically restart if some other subscriber or subscribers are still supplying power to the off-premises device. If that subscriber was the only one supplying power, he may attempt to restart by pressing the "on" button. Power will come on for a maximum of 390 milliseconds, and if no data communications are established from the off-premises device within that time, the system assumes drop integrity has not been restored and the voltage is again interrupted. This timing is significantly shorter than the time required for a shock hazard at the voltages involved.

HYBRID POWERING

Another system suggested by some manufacturers is to divide the powering. The microprocessor and the communications circuits in the off-premises device are powered from the feeder cable but the actual conversion or interdiction equipment is powered by the subscriber. Although this does reduce both the cable powering problem and the home powering problem, it does still leave both and causes the operator the necessity of dealing with both.

RECOMMENDATION

I believe that the subscriber cost, safety, and drop cable voltage drop concerns with subscriber powering are much easier to solve than the capital and operating costs for system powering. System powering can be a particular problem in a retrofit installation, because of the need to install additional power supplies and completely recalculate system powering.

REFERENCES

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