

ASSOCIATION FOR MAXIMUM SERVICE TELEVISION, INC.



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July 17, 1992

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BY MESSENGER

Ms. Donna R. Searcy
Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, DC 20554

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JUL 17 1992
Federal Communications Commission
Office of the Secretary

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Re: MM Docket No. 87-268

Dear Ms. Searcy:

Transmitted herewith is an original and five copies of the report prepared by consulting economist Larry F. Darby entitled "Implementation of Broadcast High Definition Television: Costs, Burdens, and Risks."

This report is pertinent to issues in the Commission's Second Report & Order/Further Notice of Proposed Rule Making in MM Docket No. 87-268, and was referred to in the MSTV Petition for Partial Reconsideration filed June 22, 1992, in that Docket.

Please direct any questions regarding this matter to the undersigned.

Sincerely,

Julian Shepard
Julian L. Shepard

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Federal Communications Commission
Office of the Secretary

**IMPLEMENTATION OF BROADCAST
HIGH DEFINITION TELEVISION:
COSTS, BURDENS, AND RISKS**

Larry F. Darby

July 17, 1992

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OVERVIEW

The Association for Maximum Service Television, Inc. (MSTV) retained Darby Associates to prepare this report with the primary objectives of assessing from the perspective of television broadcast station owners: (1) the costs of implementing broadcast HDTV; (2) the relationship of these costs to current revenues in markets of varying sizes; and (3) the stakes of other industry sectors in the development of broadcast HDTV. Despite the apparent imminence of HDTV, this report was prepared in a technological, economic and regulatory environment pervaded by enormous uncertainty and rapid change. Key variables that will influence the development of HDTV are impossible to predict and are also contingent on determinations in the regulatory arena of technical standards, spectrum assignments, and related operational and structural rules. Indeed, the technology itself is still developing as tests of proponent HDTV broadcast transmission systems are currently underway at the Advanced Television Test Center. Key points from each of the three areas explored are highlighted below.

I. BROADCAST HDTV CAPITAL COSTS

- o Broadcast HDTV equipment is under development, but is now largely nonexistent. It is nevertheless clear that substantial, and expensive, infrastructure must be developed if broadcast HDTV is to become a significant feature of the local television marketplace.
- o Several estimates of the investment required for broadcast stations to implement HDTV technology have been prepared. We have reviewed the major industry projections (mainly those performed by PBS and CBS) of the capital costs of implementing HDTV at the broadcast station level. These projections have been put in the context of broadcast industry financial data. The analysis is limited to capital costs and touches only tangentially on operating costs--programming in particular.
- o The task of estimating the costs to stations of acquiring HDTV production and transmission capability is more vexing than the usual business forecasting problem for several reasons. The main difficulty arises from the fact that we are considering the investment costs of serving a market which does not now exist, for which enormous complementary investments are required, and for which only a few of the key technical and related regulatory parameters have been sketched out. Thus, the expected cost of constructing an HDTV capability by a broadcast station is subject to considerable uncertainty at this time.
- o It is possible, however, to bound the uncertainty and come up with a range of expected costs within which actual cost experience is likely to fall. The major influences on HDTV-related station

construction costs include: the degree of HDTV functionality desired; the timing of the investment; the size of the market to be served; the extent of volume-related (studio/transmission) equipment manufacturing economies; the adequacy of the station's existing tower and site; and, the extent to which ongoing NTSC plant can be "economized". Numerous other factors will effect the expected investment by individual stations, but these represent the predominant industry-wide cost forces.

- o The largest influence on expected HDTV investment cost is the extent of HDTV functionality. The options range at the top from replicating fully the current NTSC capability in a new HDTV plant, to the bottom, which entails merely constructing the ability to pass through an HDTV signal originated by a network or another source off the station's premises.
- o An extensive HDTV station capability (with no off-premises electronic HDTV news-gathering equipment) can, according to available studies, be constructed for \$10-12 million over a five-year period for a large station in one of the top 10 markets. There will be some variation in that range according to the particular circumstances of an individual station.
- o A more basic HDTV capability involving the ability merely to pass through an HDTV signal originated by a network and to insert commercials locally, for example, could be constructed in one of the larger markets for about \$1.5 million. Again, some variation for local circumstances should be expected.
- o The spread between \$1.5 million and \$10-12 million reflects the additional cost of adding more HDTV functionality to the station -- including more extensive local playback capabilities, the ability to transmit non-syndicated programming, a local production capability and assorted other characteristics associated with final station conversion to an HDTV capability that is essentially a replica of the current NTSC plant.
- o The timing of the HDTV investment, both in terms of the state of development and production of HDTV transmission and studio equipment and in terms of the amount of time over which the investment is made, will be also be a potentially significant factor. The available cost studies assume significant declines in equipment costs over time as a result of production scale and learning curve economies. There may also be economies resulting from disinvestment in NTSC plant, but the scope of such economies will depend heavily on the development of "fungible" HDTV-NTSC equipment and the length of time dual-channel operation is anticipated. The available cost studies appear to assume that the HDTV investment will be phased in over five to fourteen years depending on market size.

II. MARKET SIZE AND TIMING

- o For a given level of HDTV investment the financial burden will vary from station to station according to differences in several market related and financial characteristics. Given the expected pattern of the dispersion of HDTV receivers, the economics will facilitate construction of HDTV facilities in the larger markets earlier than in the smaller ones. Lagging behind larger stations will permit stations in smaller markets to enjoy lower equipment prices (driven by volume-related cost reductions for particular equipment lines). Other costs will be less for stations in smaller markets as well, and those stations will likely find it advantageous to take longer to implement HDTV technology than stations in larger markets.
- o Even though investment costs for all levels of HDTV functionality will be lower in the smaller markets, costs do not fall proportionately with reductions in market size and revenue of stations serving those markets. This phenomenon means that the relative burden of HDTV investment grows larger as we consider smaller markets and smaller stations.
- o Even under the assumptions of the current cost studies with respect to the timing of HDTV investment, it is apparent that many of the smaller market stations and relatively weak stations in large markets will find it challenging to find the necessary resources. For many stations, then, the HDTV application/construction timetable may be critical to their ability to make the requisite investments.
- o An analysis of HDTV programming costs indicates considerable uncertainty about the terms and conditions under which HDTV programming will be available to stations. Inasmuch as programming in an NTSC environment is a substantial portion of station expenses, the availability of HDTV programming will have a significant impact on station costs. Moreover, the quality, quantity, and timeliness of HDTV programming will have a significant impact on expected HDTV revenues. Thus, the development of HDTV programming and the conditions of its availability to stations will have an important effect on the incentive of stations to assume the risk of constructing an HDTV capability.

III. BROADCAST STATION HDTV IMPLEMENTATION -- RISKS AND MARKET INCENTIVES

- o Broadcast station incentives to invest in HDTV will be a function not just of capital costs, but operating costs and revenues as well. While there is a fairly detailed, though conjectural, record on the expected capital costs of HDTV stations, there has been very little discussion or analysis of the likely incremental operating costs and revenues.

- o Operating costs of a fully constructed HDTV station may not be substantially different from the costs of operating the current NTSC station. During the "transition" period, there are likely to be substantial "economies of scope" in the joint operation of a new HDTV station and an NTSC station. There are good reasons to believe that stations will incur some incremental costs associated with engineering, marketing, sales, advertising and promotion, and general administration. The size of the increment will depend in large part on how the two channels are programmed and marketed, e.g., 100% simulcast or two separate programming services. There is also considerable uncertainty about programming costs, a major expense item for current stations. Depending upon the market strategy adopted by the broadcaster, programming may be a major expense in the HDTV environment.
- o There is also considerable uncertainty about revenues and, in particular, about whether HDTV operations will generate positive net advertising revenues for broadcasters or will merely divert current NTSC revenues. To generate positive net revenues for the industry as a whole, broadcast HDTV will have to draw market share from other non-video and video competitors -- a very uncertain outcome. Less speculative is the fact that HDTV-related revenues accruing to broadcasters will vary directly with the number of HDTV viewers and households. Under one set of reasonable assumptions, household penetration will reach one percent by the year 2003, 25% by the year 2008 (15 years after a broadcast HDTV standard is to be selected) and 50% in 2011. These estimates clearly indicate that, regardless of programming strategy, stations cannot expect substantial advertising revenues for several years after HDTV receivers are first introduced in the marketplace.
- o Under these circumstances, and responding to market forces alone, when would a broadcaster invest in the technology? Different stations would follow different strategies, ranging from "risk takers" who seek to drive HDTV set penetration to "risk averse" stations who would opt to wait and see how the market develops. Stronger stations and stations in large markets are, of course, more likely to be aggressive than weaker and smaller market stations.

IV. BROADCAST HDTV AND OTHER STAKEHOLDERS

- o The introduction and growth of HDTV in the United States requires complementary investments in three main sectors, (1) receiving equipment, (2) programming, and (3) signal distribution facilities and equipment. Investment in all three is necessary, inasmuch as they comprise the interrelated elements of an HDTV system. This strict complementarity among the three sectors gives rise to significant positive market "externalities". That is, investments and other improvements in one sector will create value not only in that sector, but in the other two sectors as well.

- o Broadcaster investment in HDTV transmission facilities will increase the value of and the demand for both HDTV programming and HDTV receivers. These external benefits of broadcast investment will accrue to other stakeholders.
- o In the case of color television, these externalities were internalized by RCA, by virtue of its integration of all three sectors under a single ownership. Thus, RCA was in a position to capture all the values generated by investment in each of the individual sectors and thereby was spared the externality problem faced by local stations that implement HDTV. Today, RCA is no longer in the broadcast equipment manufacturing business and its programming arm (NBC) has a much smaller share of the total programming market. Indeed, while there has been considerable vertical integration among equipment manufacturers, programmers and non-broadcast distributors (cable, VCRs), there has been very little vertical integration involving the broadcast industry. Furthermore, because of legal and regulatory restrictions -- the FCC's financial interest and syndication rules -- and multiple and cross-ownership rules, no appreciable increase in vertical integration can be anticipated in the relevant time frame.
- o In addition to creating value in complementary programming and equipment manufacturing sectors, broadcast investment will also create value in competitive sectors, i.e., for other distribution media--cable television, DBS, VCR/preprogrammed cassettes. These "second order" externalities occur as broadcaster investment creates demand for and provision of HDTV programming and equipment which, in turn, increase the expected value of investment in other distribution facilities.
- o Greater broadcast investment will stimulate investment by households and programmers in goods/services that will increase expected HDTV-related earnings for cable systems, as well as for DBS and VCR related distribution systems.
- o Given the uncertainty about consumer demand for HDTV products, receiver prices, service/picture quality, etc., there is substantial risk (of no earnings and capital loss) associated with HDTV-related investment.
- o Notwithstanding the numerous attempts to anticipate the rate of household adoption of HDTV products, the fact remains that all such efforts are conjectural. Despite the proliferation of increasingly optimistic views of the HDTV household diffusion rate, one sobering fact remains unchallenged. There is a significant possibility that this technology simply will not be successful and may indeed fail.
- o Recent "studies" of HDTV receiver penetration are increasingly bold in their assumptions and aggressive in their forecasts. Unlike our study for NTIA (See Appendix C), these do not consider the

possibility that the technology will not be successful. Thus, recent estimates of HDTV penetration coming out of the subcommittees of the Commission's Advisory Committee are substantially more optimistic than earlier studies in large part because they ignore the caveats urged by more sober analysis and commentary.

- o Even if the authors of optimistic penetration studies do not call attention to, and are otherwise insensitive to, the uncertainties associated with their forecasts, potential investors in the technology, including broadcasters, must and do recognize the uncertainties as they decide the level and timing of their capital commitments to building the necessary parts of the infrastructure.
- o Market uncertainty implies investment risk. Reasonable minds might differ on the expected result of undertaking a particular investment, but there can be no disagreement that there is always the chance that an unexpected, undesirable result will occur. In the HDTV context, investors faced with market uncertainty must determine if the potential payoff justifies the associated risk.
- o It is important that the Commission be aware of this risk and take it into account in its rules. If the Commission underestimates this risk, it may distort market-based investment incentives and thereby undercut its own policy objectives and goals.
- o Specifically, by placing rigorous requirements on the timing and level of broadcast investment, the Commission may force some stations to forego investment they might otherwise have made, while forcing others to make unduly risky investments that might well undercut their ability to sustain fully their NTSC service. In view of the substantial investment risk faced by broadcasters, the Commission should consider carefully the implications of prescribing a rigid program of capital formation for broadcasters.
- o Combining the foregoing considerations of HDTV-related market externalities and uncertainty suggests that the Commission's proposed rules may lead to substantial "risk-shifting" -- i.e., shifting risk to broadcasters from other stakeholders (who remain in a position nevertheless to capture a substantial part of the benefit from broadcaster risk taking).
- o The Commission's apparent intention is to require broadcasters to construct an HDTV transmission capability well before other parts of the necessary infrastructure (programming and household receivers) have developed. In effect, the proposed rules will require the broadcast industry to resolve the "chicken and egg" dilemma by setting up powerful non-market pressures for broadcasters to invest in the face of enormous uncertainty about the likely payoff of such investment.

o The "risk-shifting" aspects of the Commission's proposals will benefit program suppliers and manufacturers of both HDTV receivers and studio equipment, as well as other potential distribution media -- cable, DBS, etc. The proposed rules will create value for other stakeholders, while forcing broadcasters to sustain much of the cost burden related to investment risk.

I. INTRODUCTION & BACKGROUND

This report presents the results of a project undertaken by Darby Associates on behalf of the Association for Maximum Service Television, Inc. (MSTV). The project was initiated to explore some of the economic implications of implementing broadcast High Definition Television (HDTV). In the very near future, station owners will face several HDTV-related decisions that could prove critical to the industry's future. The technological, economic and regulatory environment within which these decisions must be made is characterized by a very high degree of uncertainty.

Technical standards governing the manufacture of studio, transmission and receiving equipment have not been determined; testing of proponent HDTV systems has yet to be completed; key regulatory issues are still being framed and debated; the business strategies of other key HDTV interest groups and entities (both competitors and suppliers of broadcast stations) are in the formative stages; and, the future directions of the broadcast industry itself, without regard to HDTV, are less clear today than in times past.

These uncertainties combine to complicate substantially a series of decisions that must be timely and carefully made if the industry is to balance successfully the risks and opportunities presented by the development of HDTV technologies. In the context of this uncertainty, this study has been organized and conducted in an effort to identify: (1) the costs of implementing broadcast HDTV; (2) the relationship of these costs to market size; and (3) the stakes of other industry sectors in the development of broadcast HDTV.

By way of overview, the remainder of this section puts the HDTV investment issue in context by reviewing briefly the regulatory environment that is driving the process. The next section reviews available analyses of the potential costs of implementing broadcast HDTV. The report then examines available financial data which may provide some insight into the relative ability of stations in different markets to finance the necessary capital expenditures. Finally, the stakes of firms in other industry sectors including program supply, program distribution, equipment manufacturing, and competitive media are explored.

In recent years several technological developments have combined to make possible substantial improvements in the techniques of producing, transmitting, and receiving over-the-air signals with significantly improved video and audio quality. Some of these techniques and technological improvements (collectively referred to as HDTV, or advanced television) are being used in other countries to substitute for or complement traditional television signals. These technological and market

developments have provoked considerable discussion and debate in the U.S. respecting how, if at all, the technologies should be configured and introduced into the domestic video distribution marketplace.

To resolve some of the key public policy issues, the Federal Communications Commission has made a series of determinations that begin to establish a general framework for broadcasters' development of an HDTV capability. Thus, the Commission has declared that over-the-air HDTV transmissions be undertaken within the limits afforded by the spectrum currently allocated to television broadcasting. The Commission has also indicated that it prefers HDTV to EDTV, and that a standard for the latter is not likely to be adopted. This report concentrates on HDTV related matters, to the exclusion of EDTV options, while recognizing that EDTV development may very well be pursued by stations.

Since the initiation of the Inquiry on Advanced Television (ATV) Service, the FCC has expressed concern for not "stranding" consumer investment in NTSC receivers. As one means of protecting the installed base of NTSC receivers, the Commission adopted a "simulcast" approach, in which broadcast NTSC service would continue during and following the commencement of HDTV service, but would then be wholly supplanted by HDTV service. Presumably, this scheme would protect the installed base of NTSC receivers and VCRs. But, the details of its implementation in the marketplace could also be key determinants of stations' ability and incentive to undertake capital budgeting programs that will permit their entry into the HDTV transmission services market.

These Commission decisions, and decisions by many system proponents to pursue digital technology, have given important, but still incomplete, detail in defining the important parameters of a broadcast standard for the development of terrestrial HDTV systems.

Some four years ago, the broadcast industry created the Advanced Television Test Center for the purpose of conducting exhaustive objective tests of HDTV systems proposed by various interests. System testing commenced on July 12, 1991 and the Center is under pressure to complete the testing and report the results during the fourth quarter of 1992, in time for the FCC to make a decision on an HDTV transmission standard based on recommendations of its Advisory Committee on Advanced Television Service in 1993.

Ultimately, these standards will determine the changes that will be required in existing broadcast plant and equipment to permit transmission of an HDTV signal into the home. The cost of

these changes is of considerable concern to broadcasters and is the subject of the next section.

Before turning to a discussion of investment costs, we want to note some important related developments at the FCC. In June 1991, the Office of Plans and Policy released a comprehensive study of broadcast television in the context of changing technology and the evolving multichannel marketplace. The study concluded that the historical circumstances upon which the Commission's broadcasting policies and rules have been based have been drastically changed and urged that a comprehensive review of the current forces and broadcast policy implications be undertaken.

There are several closely-related proceedings now pending before the FCC. The Commission has undertaken a review of television multiple ownership rules and has recently revised the network-cable cross-ownership rules. In addition, Congress continues to consider issues related to the carriage of television broadcast signals on cable television systems. Resolution of each of these issues may have a significant impact on the economic climate in which broadcast station owners find themselves at the time when they must make HDTV investment decisions.

In May of this year, the FCC adopted a Second Report and Order/Further Notice of Proposed Rule Making in the Advanced Television proceeding which further refined the Commission's schedule for HDTV implementation, and reached decisions on five critical issues related to the subjects addressed herein. First, the Commission decided that broadcasters will be eligible to apply for HDTV channels during a two-year restricted eligibility period, although stations may have to apply much earlier if the Commission adopts a first-come-first-served channel assignment approach. Second, stations will have a three-year period of time in which to construct their facilities following the issuance of a construction permit. Third, the "construction" requirement would be satisfied by a facility that is capable of "emitting ATV signals, regardless of the source of these signals", i.e., a network signal pass-through would be sufficient. Fourth, the Commission tentatively decided to impose a requirement that broadcasters 100% simulcast their NTSC and HDTV channels no later than four years after the five-year ATV application/construction period has passed. Finally, the Commission tentatively decided that broadcasters will be required to surrender one of two broadcast channels used for the transition, and to cease broadcasting in NTSC, 15 years from the date of adoption of an ATV system or a final Table of Allotments is effective, whichever is later. The 15-year period is subject to review by the FCC in 1998.

II. ESTIMATES OF BROADCAST HDTV CAPITAL COSTS

The television broadcasting industry is heavily invested in plant, equipment and a variety of specialized facilities designed to produce programs and to transmit programmed signals in conformance with technical standards adopted by the National Television Standards Committee (NTSC) some 50 years ago. The NTSC standards have governed the technical characteristics of television broadcasting, programming and receivers and, under the FCC simulcast approach, will continue to do so into the foreseeable future. However, implementation of HDTV would permit broadcast television stations to produce and transmit HDTV programmed signals. The FCC envisions the continued provision of NTSC for at least a fifteen-year period of time following the authorization of HDTV broadcast service.

Implementing HDTV while maintaining NTSC service will require broadcast station owners to undertake ambitious construction programs to modify existing plant and obtain the new equipment required by the HDTV technology. Early estimates of the costs to station owners of HDTV-related "upgrades" were based on preliminary data. These assessments of likely transition scenarios yielded "back of the envelope" estimates ranging up to forty million dollars per station. More recently, however, in response to inquiries made by the Cost Task Force of the FCC Advisory Committee, somewhat more refined analyses and estimates of the cost to station owners have been made available. What follows is a review and discussion of the implications for broadcasters of two studies -- one performed by PBS dated October 1990, the other by CBS dated February 20, 1991.

Methodologies of Cost Estimation

Estimating the costs to stations of acquiring HDTV production and transmission capability requires practicing a mixture of art, science and divination. The task is more vexing than the usual business forecasting problem for several reasons. The main difficulty arises from the fact that we are estimating the investment costs of serving a market which does not now exist, for which enormous complementary investments are required (in programming and household receivers, for example), and for which technical and related regulatory parameters have only been sketched out.

Several important variables can only be approximated within broad ranges. Thus, for example, the rate of household absorption of HDTV receivers will be a key economic stimulus to both program producers and the owners of video distribution systems. Yet, with no product available for consumer trial and evaluation, it is difficult to predict consumer reaction and the rate of consumer adoption of the associated consumer electronics.

These uncertainties imply that estimates of capital requirements related to construction of an HDTV capability must ultimately be based on reasonable assumptions derived from very limited information about the nature of important determinants of HDTV-related investment costs. Irrespective of who makes them, the best current estimates of these future costs will be very sensitive to underlying assumptions regarding, for example, investment timing; the behavior of equipment costs over time; fungibility of existing plant, equipment and labor; the specifics of the rules and standards ultimately adopted by the FCC; and, a host of circumstances more or less unique to particular stations, such as market size and demographics, transmission power, network affiliation, and amount of program origination, to name just a few.

The validity of many of these assumptions can be tested only as new facts become available. In the following analysis, we will point out the areas in which the validity of the estimates of cost are particularly vulnerable to the accuracy of the underlying assumptions.

Overview of PBS Study

The PBS study released in October 1990 divides the costs of creating an HDTV capability into six general categories. A major contribution of the study derives from its insistence that each broadcast station is unique and that its construction of an HDTV capability will reflect the station's particular economic and technical character. Accordingly, within each of these six general cost categories, alternative assumptions about key parameters of expected cost (adequacy of current tower and tower site; adaptability of current transmitter building; power level; etc.) are specified and used to derive a range of cost estimates. The six categories and the range of costs estimated by PBS for each are summarized in TABLE 1.

TABLE 1

RANGE OF POTENTIAL INVESTMENT COSTS
FOR SELECTED CATEGORIES
(PBS ESTIMATES)

<u>COST CATEGORY</u>	<u>MINIMUM</u>	<u>MAXIMUM</u>
I. Tower Site/System	\$ 10K	\$2,410K
II. Transmitter Building	10K	113K
III. Legal Services	5K	500K
IV. Engineering Services	8K	36K
V. Transmission Plants	817K	997K
VI. Origination/Studio Plant	770K	9,776K
TOTAL--ALL CATEGORIES	\$1,620K	\$13,832K

The range brackets the cost for each individual station between "high cost" and "low cost" scenarios. Accordingly, adding up the high estimates for each cost category suggests the upper limit of a PBS estimate for the creation of a simulcast capability, while the sum of all the lower estimates indicates the lower bound of the required costs. This procedure yields a range of potential costs between the lower limit of \$1,620,000 and an upper bound of \$13,832,000.

The (approx.) \$12M spread between the high and low estimates derives mainly from the first and last categories -- tower-related expenditures and those related to broadcast origination and studio plant capabilities -- with roughly \$9M of the difference attributable to the high and low estimates for broadcast originations and studio plant modifications. This clearly implies that the bulk of HDTV investment will be assignable to maintaining the "local" character of individual broadcast stations by permitting them to retain their local origination capabilities in an HDTV environment. The cheapest option is for stations to prepare themselves as local conduits for non-locally produced HDTV programming.

The low and optimistic tower cost projections are based on the assumption that the standard adopted by the FCC will provide for all-digital terrestrial transmission, thereby permitting most stations to utilize lower power, smaller and cheaper transmitters with antennae mounted on existing, albeit, strengthened tower structures.

The validity of the PBS assumption that HDTV will be digital has been increasingly confirmed as (all except one) system proponents have followed the lead of General Instruments and submitted digital systems for testing to the Advanced Television Test Center. However, it does not necessarily follow, as contemplated in the PBS study, that incremental tower and transmitter costs will be minimal. In fact, more recent analyses suggest that they could in many cases be substantial. This issue will not be resolved with certainty until system testing has been completed.

If an HDTV dual-transmission can be created, using the current tower site and simply modifying the existing tower, the tower related costs of the transition will be substantially lessened: the upper bound of the estimate of such costs declines from \$2,410,000 to \$100,000.

The sum of the costs estimated by PBS for transmitter space, legal consultation, and engineering services yield upper and lower bounds of \$109,000 and \$707,000. Most of that range is accounted for by PBS recognition of the possibility that the industry may be required to sustain substantial litigation and associated legal fees related to the FCC assignment process.

There are good reasons to expect that substantial litigation may accompany future FCC decision(s), and that broadcasters will be obliged to litigate their interests in court. Nevertheless, if past is prologue, the critical "industry-wide" issues arising from FCC processes may be resolved in a few judicial proceedings whose resolution will have precedential value for all/most stations, thereby negating the need for each station individually to litigate such "national" disputes.

Costs will also be incurred by some individual stations to resolve essentially "local" issues involving, for example, land use and zoning regulations. Such issues may arise in selected jurisdictions and the associated litigation costs will have to be borne by the local station operator. Unlike most of the other investment costs identified by PBS, the burden of legal fees associated with local litigation will not fall equally on all stations. For some stations, the burden may be significant; for others, of no consequence.

The spread between the high and low cost estimate for constructing new transmission plant is almost entirely attributable to potential differences (10 KW ERP versus 150 KW ERP) in transmitter power, with the larger transmitter being twice as expensive as the estimate of \$150 thousand for a fully installed transmitter capable of 10 KW ERP. Which of these estimates is relevant for practical purposes depends, of course, both on the capabilities of HDTV transmission technology and on the size of the market to be reached by the HDTV signal.

Inspection of the PBS estimates indicates clearly that the bulk of the HDTV implementation costs are associated with construction of enhancements and additions to a station's broadcast origination and studio plant (Category VI). The PBS analysts anticipate that the conversion of broadcast studios to HDTV will not be accomplished on a flash-cut basis, but will very likely take place in discrete and well-defined stages. Stations will undoubtedly choose different paths to HDTV capability; and, many will choose (or be obliged) to proceed in stages. The specific rate at which conversion will in fact take place is a function of both market and regulatory forces.

TABLE 2

INCREMENTAL AND CUMULATIVE COSTS
OF DIFFERENT DEGREES OF
HDTV FUNCTIONALITY
(PBS ESTIMATES)

<u>FUNCTION</u>	<u>TOTAL COST</u>	<u>INCREMENTAL COST</u>
Network Pass-Through	\$ 770K	\$ 770K
Limited Local Playback	1,276	506
Extensive Local Playback	2,343	1,067
Local Production Capability	8,566	6,223
Full HDTV Conversion	9,776	1,361

The PBS scenario of the HDTV construction process visualizes most stations commencing with construction of the means necessary to permit stations to pass through HDTV programming originated by the network. From this initial base point of passing through network signals, PBS examines scenarios that sequentially incorporate a limited local playback capability; enhanced and otherwise more extensive local playback capabilities; a studio/field/post production capability; and, finally, full HDTV conversion.

PBS cost estimates (total and incremental) associated with each of these five stages of the broadcast origination/studio plant conversion are reproduced in TABLE 2 and discussed below.

Network Pass-Through Station provision for receiving and retransmitting network originated programming will require, according to PBS, additional expenditure by the station of about three-quarters of a million dollars, a large proportion of which represents expenditure for equipment that will be specifically designed for, and only for, HDTV broadcast operations.

Manufacturing processes for broadcast origination and studio equipment will be subject over time to a variety of production efficiencies related to learning economies, as well as economies of scale and scope. Most of the costs of passing through a network originated signal will be for totally new and unique HDTV specific equipment subject to these economies and likely therefore to exhibit a declining price curve over time.

Local Play Back Capability--Modest and Extensive. The addition of band compressed, HD videotape recorders, a variety of HD monitors, and, eventually, an HD compressed format cart machine (for playback of locally produced commercials) will give the station a range of local playback capabilities for an incremental investment between (roughly) a million and a million and a half dollars. As with the network signal pass-through equipment, much of the equipment required in this phase will be state-of-the-art and subject over time to price decay driven by production economies, as more stations come on line with an HD capability.

Production Capability. The addition of a full studio, remote and post production capability will require an array of VTR's, monitors, cameras, signal distributors and processors, editing and paint systems, and other related equipment. The PBS study

puts a price tag of about six and a quarter million (\$6,223K) on the entire package, including installation costs. Station owners will, however, have considerable discretion in the pace and extent of HD investment and may choose from this array to construct a variety of production capabilities over time. Many stations may, for example, choose to defer investment in equipment required to confer a remote production capability, and/or they may elect to invest in only limited capacity for post production operations. Again, these decisions will vary from station to station and will be driven in large part by local market economics.

Full Conversion. The acquisition of additional monitors and wideband VTR's will permit the station to be equipped with HDTV facilities fully comparable to a station's existing NTSC capacity, thereby resulting in a full simulcast NTSC/HDTV capability.

Summary--PBS Study

The PBS study of the costs of putting in place a simulcast HDTV capability provides the basis for a more informed discussion of the determinants of necessary station outlays for HDTV related investments. Overall, the study indicates that the cost of implementation may be less financially burdensome to station owners than previous estimates had suggested; that stations may have incentives to phase in the necessary investment in increments that reflect a sequential rolling out of different functional capabilities; and, that different stations may find it desirable to choose different conversion rates and degrees of HDTV functionality.

The study suggests that a station can tailor the construction of an HDTV capability to its particular needs by choosing from several different "packages", with price tags depending primarily on the functionality of the local broadcast plant. The study results yield a rich array of potential investment cost scenarios between the \$1.6M and \$13.8M boundaries of the expected range.

Assuming that only minimal modifications to an existing tower (and no zoning variances) are required -- the capability to pass-through a network signal with a medium powered transmitter can be constructed for a total investment cost on the order of one and three quarters million dollars.

More extensive local playback capabilities can be obtained for (approximately) an additional one and a half million dollars, so that a station may be able to create the ability to pass through in real time, or store and forward, network (or other

third-party) originated programming for a total investment of less than \$3.5M.

The PBS analysis confirms prior expectations by concluding that the most costly element of local station HDTV functionality will be the creation of a local production capability. The incremental cost of adding a local production capability to a station that is already equipped to pass-through and/or play-back a network feed is over six million dollars, or nearly twice the cost of merely providing a conduit for network programming.

The PBS study does not explicitly address or account for the probable decline in equipment costs over time as various economies are realized by manufacturers, nor does it address the extent to which HDTV capability can be phased-in gradually to replace fully depreciated NTSC equipment. To the extent that such economies will be passed forward by manufacturers in the form of lower prices to stations, some stations may be able to enjoy lower construction costs than those implied by the PBS scenarios, as will stations which can install HDTV equipment as part of their regular capital investment program. The implications of timing are discussed more fully in the CBS study, to which we now turn.

Overview of CBS Study

The Department of Engineering and Development of the CBS/Broadcast Group in October 1990 released preliminary results of a study of scenarios for TV broadcast station creation of an HDTV simulcast capability. At the time of this analysis, the CBS study remained a "work-in-progress" and labeled "preliminary", but had been revised as of February 1991. Like the PBS study, this one has been submitted for consideration to working parties two and three (on transition scenarios and economic assessment, respectively) of the Planning Subcommittee of the Advisory Committee on Advanced Television Service.

The CBS study also advances our understanding of the conversion process significantly. It divides the transition to an HD capability into different dimensions, while explicitly breaking down the conversion into distinct subparts.

A central premise of the CBS study is the expectation that stations are not likely to "flash cut" immediately to an HDTV capability, but will, instead, implement the necessary technology and make the necessary investment in phases. Each phase of the transition will increase the HDTV functionality of the station.

As indicated above in the discussion of the PBS contribution, there is a wide variety of feasible phased processes, or investment paths, that stations might adopt in implementing a full HDTV capability. The number of phases and

the content of each will vary from station to station, depending on their current capabilities, the evolution of their needs, the specifics of their competitive environment and their long-term business strategy. In recognition of these differences and contingencies, the CBS scenarios provide for a six-phase process:

Phase A--Network Pass-through. In this phase the station constructs the capability to receive an HDTV signal; to decode it and route it to a switcher; and, finally, to encode the signal, feed it through the studio-transmitter link to the transmitter and antenna. It is almost identical to the first step in the PBS scenario.

Phase B--Local Commercial Insertion. This capability requires addition of VTRs, to feed an automation switcher, for the playback of HDTV commercials.

Phase C--Local Videotape Programming. Given the ability to pass through a network signal and to insert an HDTV commercial, the local playback of non-network HDTV programs requires the further addition of program VTRs and a routing switcher.

Phase D--Local Studio Origination. Upgrading to this capability requires investment in new studio cameras, VTRs and a production switcher. Addition of this equipment will permit a station to complement its ability to pass through network signals with locally originated programming.

Phase E--Final Plant Conversion. This phase calls for installation of a down converter to feed HDTV programs to the NTSC transmitter for simulcasting. Also required are an HDTV cart machine, along with assorted test and monitoring facilities.

Phase F--Electronic News Gathering. Installing an ENG capability requires the purchase of camcorders, VCRs, and assorted editing facilities.

CBS segments its sample of network affiliate stations into six groups classified according to the size of the market in which they operate. GROUP 1 contains the thirty stations in the top ten markets; GROUP 2 the 40 stations in the next largest markets; GROUP 3 the next 80; and so on for GROUPS 4, 5, and 6 which include 160 stations, 320 stations and 640 stations, respectively.

In the CBS vision of the evolution of an industry HD capability, stations will commence the transition at different times and take varying amounts of time to complete the transition

to a full capability. CBS assumes that stations in the larger markets will begin the transition process before smaller stations; and, the larger stations are also likely to escalate the transition thereby completing the conversion more quickly, once it has commenced. These scenarios, of course, do not take account of the very recently announced FCC requirements for HDTV implementation which make no distinctions based on size of station, or relative financial strength.

The CBS study also assumes, without any explanation or analysis, that the industry's transformation to a simulcast capability sketched out by CBS will take 5-14 years, as measured from the time, a) when the largest GROUP 1 stations begin to make substantial alterations to existing NTSC plant and equipment, to the time, b) when most stations in the industry -- including the very smallest in GROUP 6 -- have "practically" completed the transition to a full HDTV capability. Initiation of the conversion process is assumed to be staggered over a six-year period. The study hypothesizes that the largest 30 stations will begin construction immediately after the necessary regulatory standards are defined and regulatory clearances are achieved, while the 640 or so smaller stations in GROUP 6 begin five years later. Again, the study simply assumes these dates and contains no analysis or other basis for their selection. The large GROUP 1 stations are projected to complete the five-phased transition one phase at a time in each of the subsequent five years. In contrast, the smaller GROUP 6 stations are expected by CBS to take nine years to complete the five-phase transition process. Intermediate-sized stations are assumed to complete the process within the five to nine year interval -- with the larger stations completing it more quickly.

The CBS estimates of HDTV implementation rates also assume further, without explanation that:

- Within 10 years from adoption of a standard, about 95 percent of all households may have access to signals from stations fully converted to HDTV;
- All households may have access to network programming from terrestrial over-the-air sources within 5 years of the beginning of the transition;
- Within 8 years of the start of the transition, over half of the U.S. households will have access to signals from a fully converted broadcast station, while 95 percent of those households will have access to signals that will be almost fully

programmed in an HDTV format. The exception will be programs that are produced locally -- news and assorted other programs of local origin.

The CBS analysts also recognize that additional costs for labor must be incurred to complement the investment in equipment. Those labor costs are assumed to recur annually in amounts equal to 20 percent of the cost of investment in capital equipment.

As discussed above in the context of the PBS cost estimates, one of the major HDTV investment uncertainties turns on the need for additional land and tower capacity for the simulcast signal. Acquisition of land for a new tower site, of course, would require major outlays in markets of all sizes, but in large markets in particular.

In contrast to earlier study estimates, the CBS analysis builds its investment forecasts on the assumption that the HDTV transmission system selected will be all-digital and will require much less power than current NTSC systems -- a proposition that is still very uncertain. This implies that only a small transmitting antenna will be necessary; that the existing tower will be adequate; and, that there will be no need for the station to undertake a costly land acquisition program. In this respect, the CBS study is consistent with the optimistic PBS scenario discussed earlier. It also implies that the additional power costs will not be substantial.

If HDTV-related components follow the economic path of other new technologies, the costs of manufacturing new HDTV studio and related equipment will very likely decline over time, as will product prices in the marketplace. (We noted above that the PBS analysts do not explicitly account for this in their study.) The initial production runs of new product lines almost invariably occasion cost levels that will diminish over time. Initial product prices are frequently quite heavily loaded with developmental costs. Production by manufacturers of HDTV-related equipment will be subject to economies of scale; learning curve effects; and, opportunities to spread non-volume sensitive (fixed or overhead) costs over a larger base.

In recognition of these forces, the CBS analysts assume that the elasticity of average cost with respect to changes in output is on the order of negative 10 percent. That is, as the output of HDTV equipment doubles, the unit cost declines by one-tenth. This assumption, while not on its face unreasonable, is clearly optimistic or even aggressive. This assumption could result in an understatement of the costs for some stations in the smaller markets. It may result from the fact that costs to smaller stations are sensitive to the construction programs of larger stations who are assumed by CBS to have already purchased

equipment in order to complete their transition to HDTV. To the extent that some larger stations do not meet the timetables envisioned by CBS, the smaller stations who cannot also delay the commencement of their conversion will be denied the full benefit of the lower equipment costs assumed in the study to derive from volume driven economies. Of course, if small stations lag behind the schedule assumed by CBS by the same amount as do the larger stations, they may still enjoy the lower prices. In short, bringing into play the possibility of slower-paced HDTV conversion rates for large stations requires adjustments of construction costs for smaller stations. Estimates for stations in GROUPS 1, 2, and 3 are not affected. However, costs for smaller stations, especially in GROUP 6, but also in GROUP 5, may be understated by as much as 25 percent.

The results of the CBS study are summarized in TABLE 3, which shows the estimated investment required by the implementation of an HDTV simulcast capability by the terrestrial broadcast industry. The table is fairly straightforward in its interpretation. The total cost of complete plant conversion to HDTV is greater for the larger stations and ranges from about \$11.6M for the largest 30 stations to \$6.8M per station for the smallest fifty percent (640) of the nation's terrestrial broadcast stations.

The potential relationship of the cost of conversion to the extent of HDTV functionality for stations of different sizes is also indicated in TABLE 3. These data indicate that any station, irrespective of size, can adapt current plant to permit passing through network programs, insertion of local commercials, and local play of syndicated programs not originated by the networks, for a little over a third of the total costs of conversion. Thus, the plant and equipment additions required to allow the largest stations to transmit programs originated off-premises, while also providing them with the capability to insert local commercials, will cost in the neighborhood of \$4.3M. That same capability will be available to the 640 stations in the smallest markets for about two and a half million dollars.

The costs of local origination and final conversion to HDTV are a substantial part of the total. The CBS analysis places the costs of originating local programs in an HDTV format at slightly less than 30 percent of total capital cost per station; and, that percentage is assumed to be independent of the size of the station and otherwise constant across the industry. The costs of final plant conversion are estimated at a little over one-third of the total cost per station.

Another factor considered in the CBS study is the extent to which HDTV investment can be offset by NTSC plant disinvestment. Because stations must assume that their dual-channel operations