

(vi) Existing plant, studio, and control room audio equipment will be reused, not replaced. It is further assumed that a station has previously converted to stereo.

### 3. PHASED IMPLEMENTATION

The introduction of a HDTV transmission service at a TV station will be a gradual process and will be implemented in phases. Each phase provides an incremental capability, and builds upon the preceding phases.

(Figure 2) The number of phases, and the nature of the capability added in each phase, may vary from market-to-market or from station-to-station.

Here is one, six-phase scenario:

#### Phase A: Network Pass-through

This is the minimum conversion necessary to deliver network supplied HDTV programming to a market. An additional transmitter and antenna will need to be purchased and installed, together with an additional studio-transmitter link, using microwave or fiber optics. Additional satellite earth station equipment for the reception of network programs, and some distribution, test, and monitoring equipment will be required. The only local origination is the insertion of station identification announcements.

#### Phase B: Local Commercials

In phase B, additional equipment will be added by the station to allow for local commercial inserts within the network programs.

# **SIMULCAST HDTV SCENARIO PHASES OF TRANSITION**

## **PHASE**

- A - PASS-THROUGH OF NETWORK HD PROGRAMS**
- B - INSERTION OF LOCAL COMMERCIAL MESSAGES**
- C - PLAYBACK OF NON-NETWORK SYNDICATED  
HD PROGRAMS**
- D - LOCAL ORIGINATION OF HD PROGRAMS**
- E - COMPLETE PLANT CONVERSION TO HD**
- F - LOCAL NEWSGATHERING (ENG) IN HD**



Phase C: Local Videotape Programming

Video tape equipment will next be added to allow for playback of non-network (syndicated) programming when the network is not supplying HDTV programs.

Phase D: Local Studio Origination

A local station in this phase becomes an HDTV production facility. Phase D will add equipment to allow local production to be staged, recorded, edited, and broadcast.

Phase E: Final Plant Conversion

The entire plant systems are next upgraded, giving the station full HDTV capability. All production and origination, except for news gathering, is in HDTV. At this stage when the network transmits a program only in HDTV, the local station will down-convert the signal for the NTSC simulcast.

Phase F: Electronic News Gathering

This phase requires the conversion of the Electronic News Gathering (ENG) equipment to HDTV. At this point all local production is effected in HDTV, and the HDTV signal will be down-converted for NTSC simulcast.

#### 4. TRANSITION SCENARIO

The six phases of conversion identified above are designed to provide an incremental capability with the completion of each phase. The block diagram in Figure 3 presents the completely converted station, with each phase outlined.

##### Phase A: - Network Pass-through

Shows the acquisition of an earth station receiving a satellite signal. The signal is decoded and routed to a switcher.

In this first phase, the switcher need only be of relatively simple design, to be expanded in later phases.

A station ID is inserted at this point. The signal is then encoded and fed through the STL to the transmitter and antenna.

##### Phase B: - Local Commercial Insertion

Two VTRs for the playback of HD commercials are added, feeding an automation switcher. When only NTSC commercials are available, an up-converter may be installed, increasing the 525 lines of NTSC.

##### Phase C: - Local Playback of Non-Network Programs

Requires the addition of program VTR's and a routing switcher.

# HD STATION CONVERSION BLOCK DIAGRAM

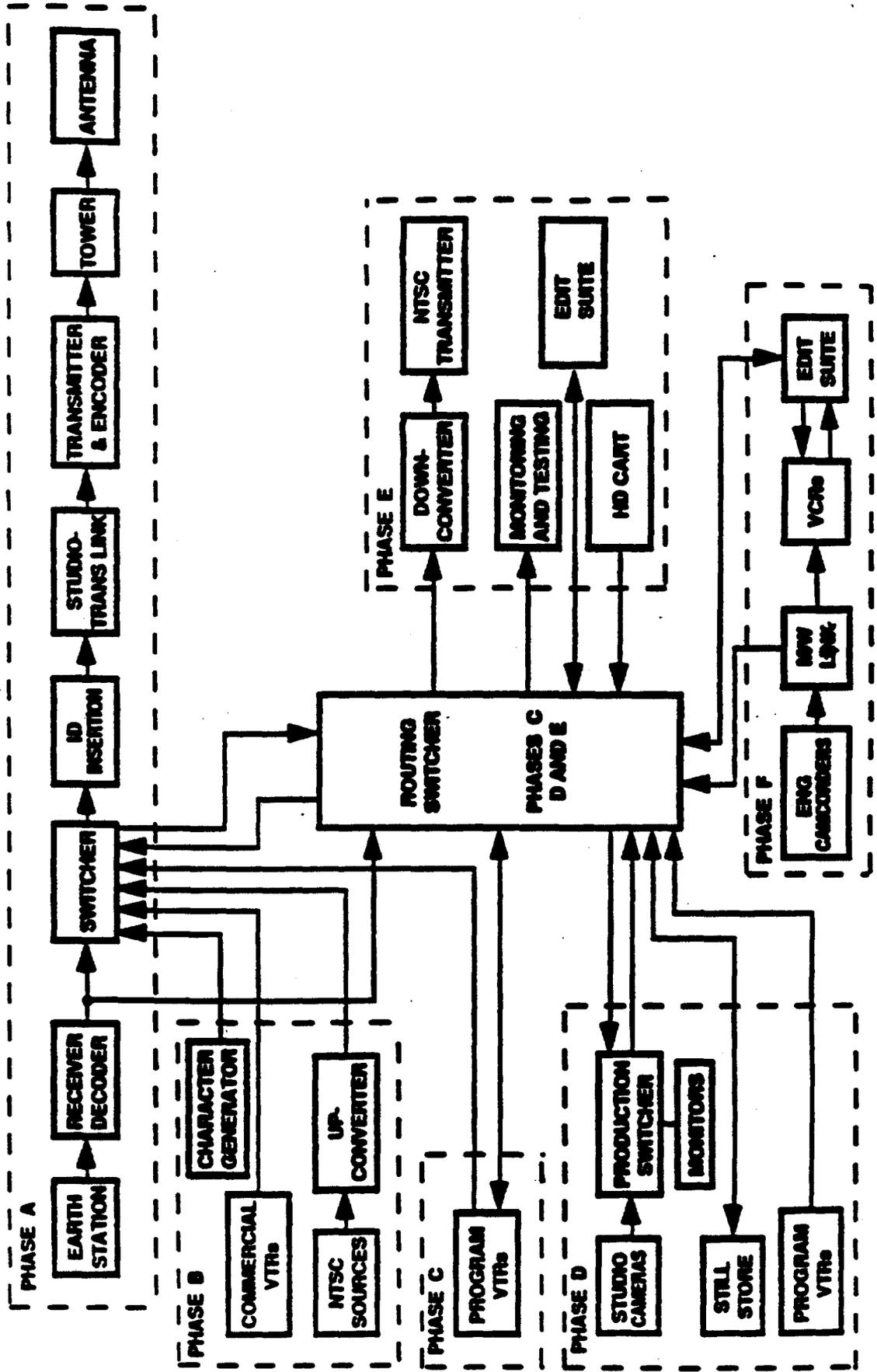


FIGURE 3

Phase D: - Local Origination

Requires the addition of studio cameras, VTRs, and a production switcher.

Phase E: - Final Plant Conversion

Calls for the addition of a down-converter in order to feed HD programs to the NTSC transmitter for simulcast operations. An HD cart machine for the playback of commercials is added in this phase, together with test and monitoring facilities.

Phase F: - ENG

Requires the addition of HD camcorders, VCRs, and editing facilities.

Existing microwave links will be used.

5. FINANCIAL ASSUMPTIONS

In assessing the costs of implementing each phase of the conversion to HDTV, the following financial assumptions have been made.

5.1. Labor

The cost estimates include the labor for installation. For broadcasters who capitalize labor for installation, the labor cost for the type of equipment and systems considered is assumed to be 20 percent of the capital equipment cost.

Some stations will use in-house technical labor for installation, while others will employ outside contractors. The amount of labor required for installation will vary widely with the physical conditions and equipment existing at individual stations. Accounting procedures for recording labor costs also vary from station to station. Overall, however, a 20 per cent factor for labor is believed reasonable.

### 5.2. Transmission Signal Format

A number of HDTV proponents have proposed systems using lower power transmitters and lower ERP than NTSC. The transmitter power could be 10-20 dB less than a current NTSC transmitter to provide similar coverage.

For example, a typical NTSC UHF transmitter has an ERP of 1 megawatt, while a HDTV transmitter would have an ERP ten to one hundred times less. Such reductions in power also lead directly to reduced costs for primary power.

This is important because the HDTV system adopted for terrestrial transmission must allow the simulcast transmitter to be located approximately 100 miles from a co-channel NTSC television station without causing interference, while providing HDTV service to a comparable area.

The resultant smaller antennas and transmission lines will reduce the weight required to be mounted on the tower. Even more important, the smaller antennas reduce the wind load that a tower must support.

By minimizing the incremental loading, the need for tower modifications, or for an additional tower, is eliminated, and substantial cost savings are achievable.

For purposes of the following analysis, it is assumed that stations will not require a new tower in order to add a simulcast HDTV antenna. This assumption is discussed in Appendix A.

### 5.3. Economies of Scale

It is assumed that with each doubling of the number of units of equipment ordered annually for HDTV broadcasting, the cost and price of equipment will be reduced by 10% of the initial cost, as equipment design is refined and manufacturing productivity is improved.

Much of the equipment required for conversion is new and initial prices are those currently quoted for prototype and pre-production samples. It is anticipated that prices for production runs of equipment even for the first stations to convert may well be lower than those assumed here.

Moreover, some equipment involved in the conversion process will be sold in many other markets, including program production and post production, medical, printing and publishing, corporate training and communication, and non-broadcast video communication. Such non-broadcast applications

will involve equipment quantities far exceeding broadcast needs, and in the future lead to significant economies of scale.

Finally, much of the equipment employed for HDTV broadcasting will be the same or similar to that employed in other countries introducing HDTV service.

Although manufacturers frequently gain market entry by pricing early production units at cost or less, no such assumptions have been made herein, and the prices of equipment used for the conversion of the first 30 stations are, as noted above, the currently quoted prices, often for prototype equipment.

As a result of these considerations, a 10 percent reduction in equipment cost for each doubling of the number of units used for HDTV broadcasting is considered a reasonable, although moderately aggressive, assumption.

#### 5.4. Reuse of Existing Equipment

Existing plant, studio and control room audio equipment will be reused, not replaced. Since all proponent systems include multi-channel digital audio, stereo conversion of local origination is assumed prior to HDTV conversion.

Studio lighting and sets are assumed to require little or no modification. Existing studio/control room/plant communication systems will be reused, not replaced.

6. CAPITAL COSTS

Figure 4 presents the anticipated costs for each phase of the conversion for each of the first 30 stations, (Group 1),  
the next 40 stations, (Group 2)  
the next 80 stations, (Group 3)  
the next 160 stations, (Group 4)  
the next 320 stations, (Group 5), and  
the next 640 stations, (Group 6), for a total of 1270 stations.

The capital investment in HD equipment for each of the first 30 stations in Group 1 is projected to be \$11.6 million. This cost becomes progressively smaller for stations in each subsequent group. Thus, for stations in Group 5, the cost is \$6.9 million.

The estimated cost of converting ENG operations to high definition is not shown. HD ENG equipment with the light weight and small size of current professional camcorders is not yet developed, and cost assumptions have not been made. It is anticipated that such equipment will be available in quantity, at a reasonable incremental cost over replacement NISC equipment, in the time frames envisioned, although it will also prove feasible to defer that investment for several years.

# SIMULCAST HIGH DEFINITION TERRESTRIAL BROADCAST COSTS BY PHASE AND QUANTITY \$ THOUSANDS\*

GROUP	GROUPS OF STATIONS ACQUIRING EQUIPMENT					
	1	2	3	4	5	6
NO. OF STATIONS	30	+40=70	+80=150	+160=310	+320=630	+640=1270
% TVHH SERVED	31	53	83	95	98	100
<b>A - NETWORK PASS-THROUGH</b>	1481	1333	1185	1037	889	741
<b>B - LOCAL COMM. INSERTION</b>	1652	1487	1322	1157	992	827
<b>C - LOCAL PLAY OF SYNDICATED NON-NET PROGRAMS</b>	1057	951	845	739	633	527
<b>D - LOCAL ORIGINATION</b>	3277	2949	2621	2293	1965	1637
<b>E - FINAL PLANT CONVERSION</b>	4113	3702	3291	2880	2469	2058
<b>TOTAL CAPITAL COST PER STATION</b>	<b>11,580</b>	<b>10,422</b>	<b>9,264</b>	<b>8,106</b>	<b>6,948</b>	<b>5,790</b>

\* IN 1990 DOLLARS

FIGURE 4



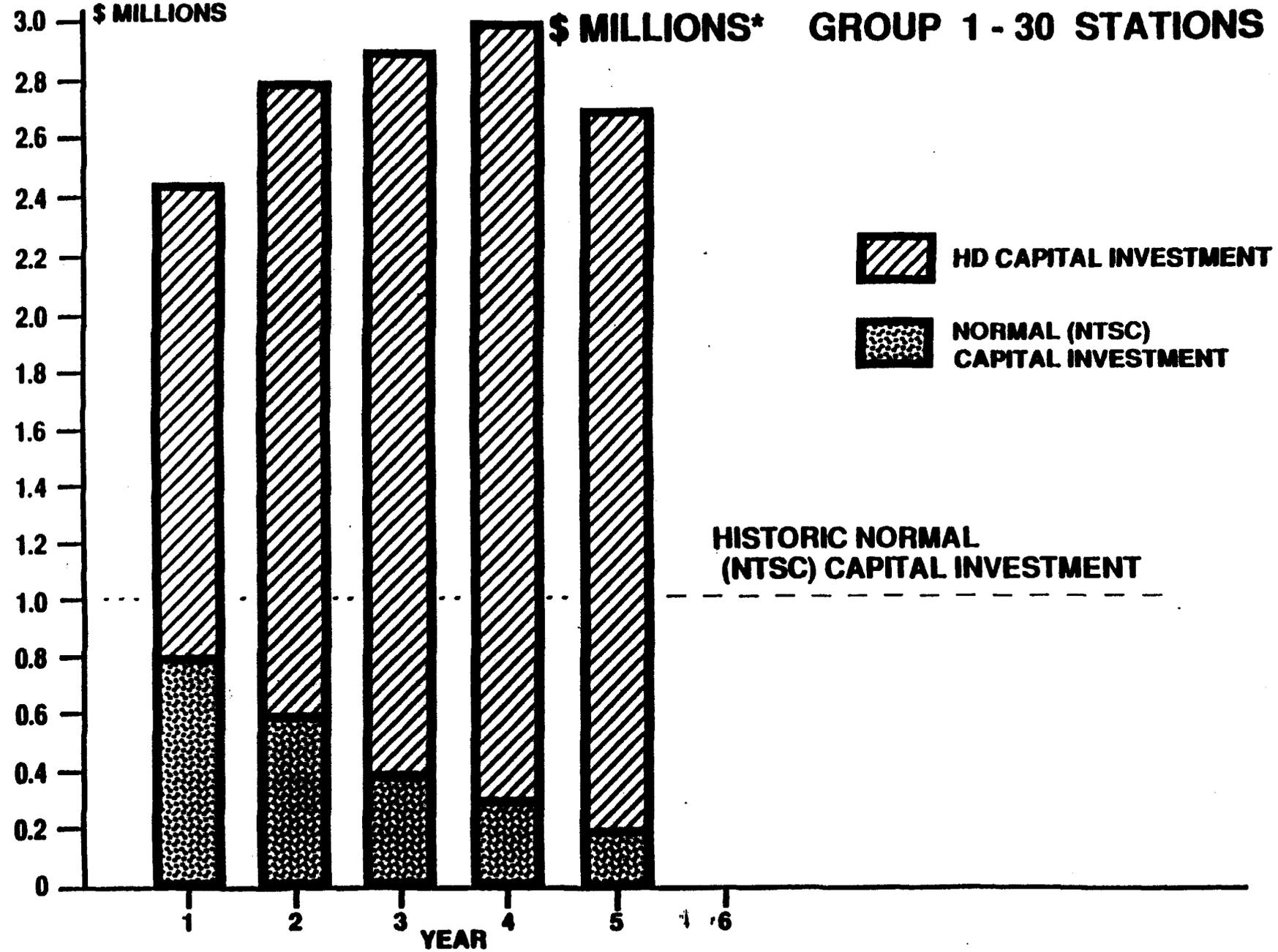
It may well be that, in the interim period prior to the local studio origination and ENG conversion, news and public affairs programs in NTSC will be subjectively improved by electronically artificially increasing the number of lines in the picture prior to transmission. Such "up-conversion" would be a relatively simple operation which would not improve picture definition or color rendition, but would have the subjective benefit of removing line structure in the picture.

In Figure 5, the capital equipment cost for Group 1 stations is presented as an annual cost for each year of the conversion process. Referring to Figure 5, the annual capital investment in HD equipment is shown in the upper part of each column, while the lower part represents the continuing, but declining, capital investment in normal (NTSC) equipment.

As the conversion to HD proceeds year-by-year, the investment in NTSC equipment is seen to decline from its historic level of an assumed \$1.0 million indicated by the dotted line on the chart.

For the 30 stations in Group 1, it is projected that the conversion program can be completed in five years. Similarly, figure 6 shows the annual capital investments for the 40 stations of Group 2. Here the conversion program starts in Year 2 and is completed in six years. Annual investments are lower because the total investment is spread over a longer period than Group 1, and because of lower equipment costs as manufacturing efficiency improves. The total investment in HD equipment is \$10.4 million.

# ANNUAL CAPITAL INVESTMENT IN HD EQUIPMENT



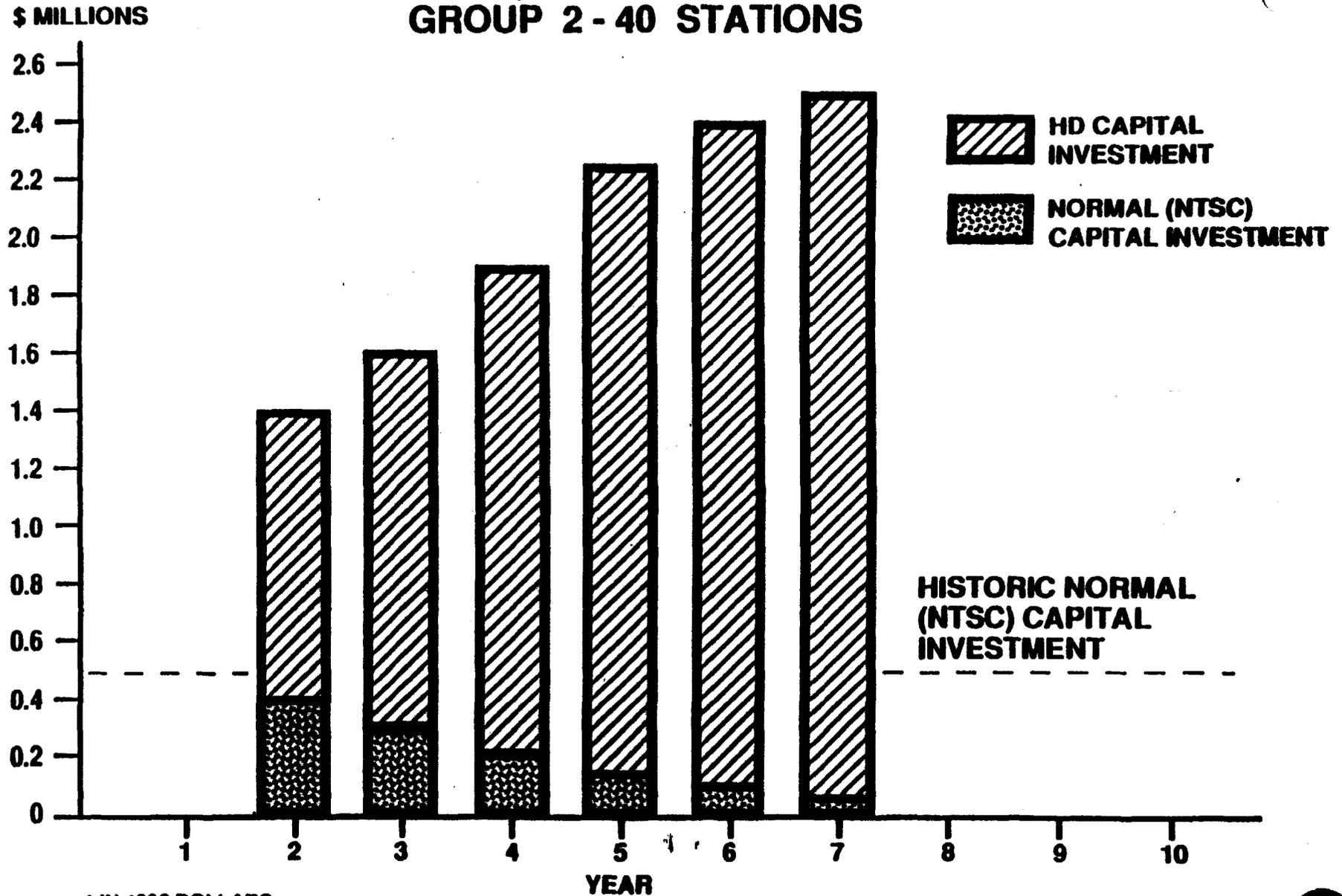
\* IN 1990 DOLLARS

FIGURE 5



# ANNUAL CAPITAL INVESTMENT IN HD EQUIPMENT

\$ MILLIONS\*  
GROUP 2 - 40 STATIONS

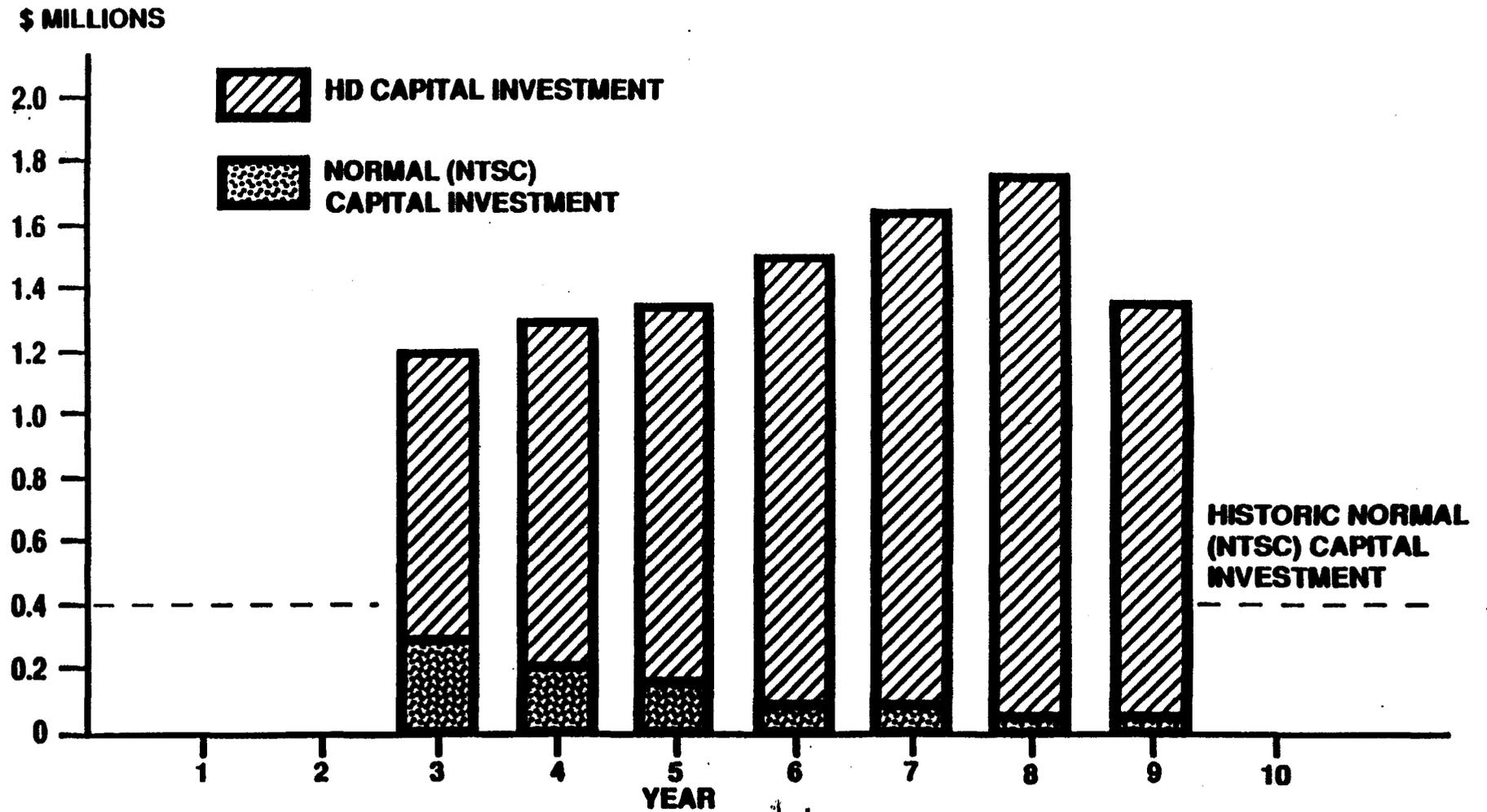


\* IN 1990 DOLLARS

FIGURE 6



# ANNUAL CAPITAL INVESTMENT IN HD EQUIPMENT \$ MILLIONS\* GROUP 3 - 80 STATIONS

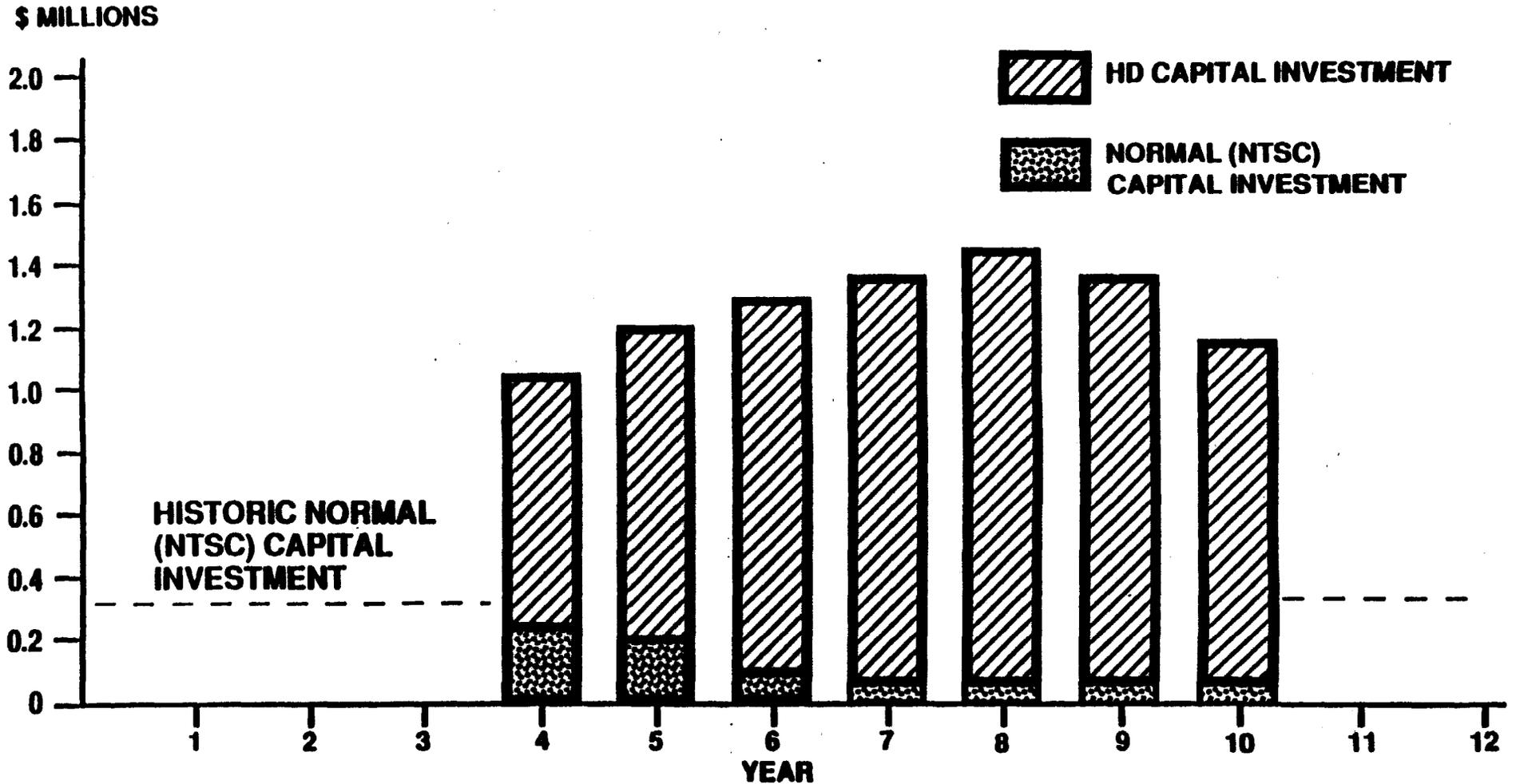


\* IN 1990 DOLLARS

FIGURE 7



# ANNUAL CAPITAL INVESTMENT IN HD EQUIPMENT \$ MILLIONS\* GROUP 4 - 160 STATIONS

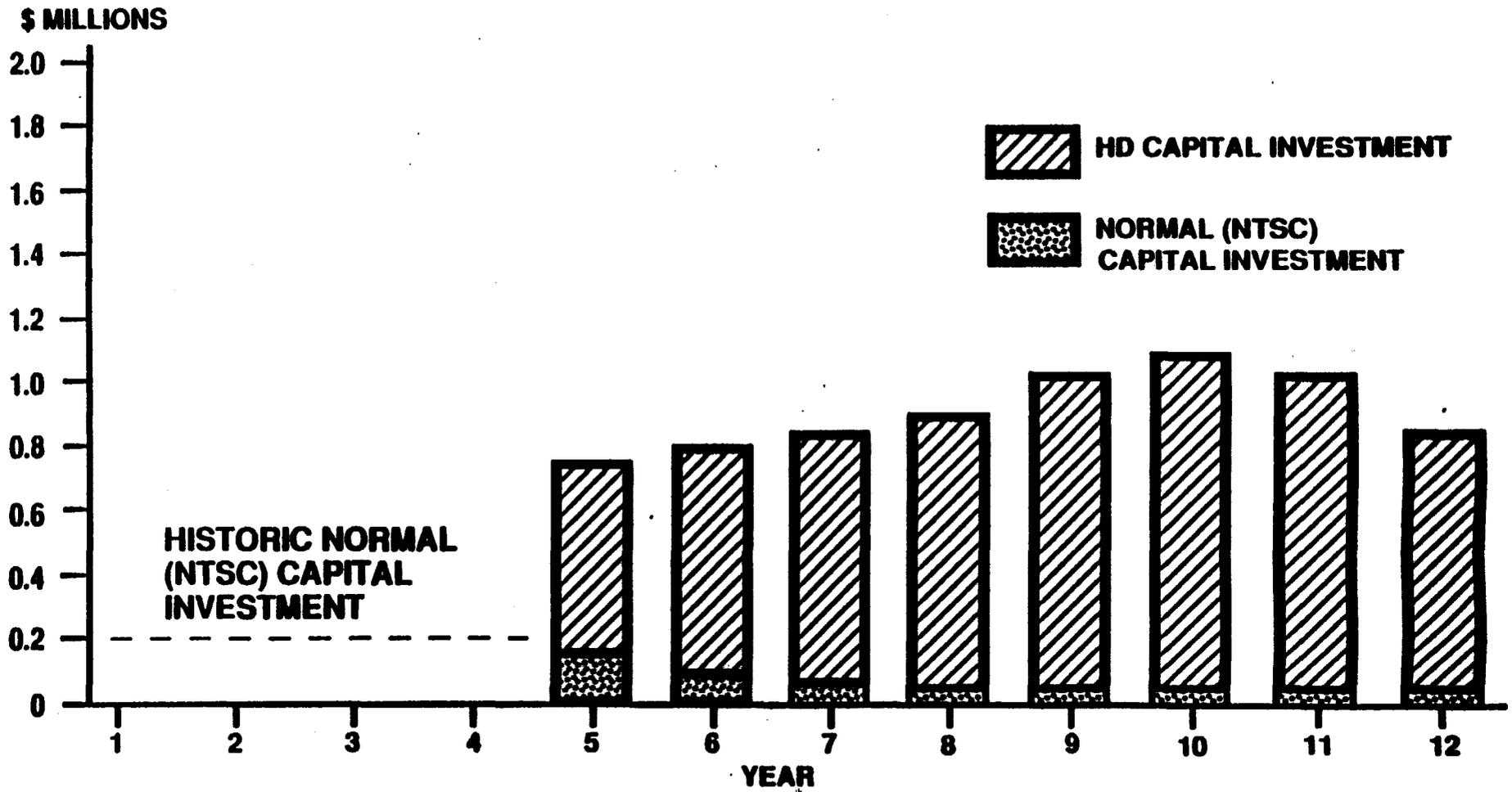


\* IN 1990 DOLLARS

FIGURE 8



# ANNUAL CAPITAL INVESTMENT IN HD EQUIPMENT \$ MILLIONS\* GROUP 5 - 320 STATIONS



\* IN 1990 DOLLARS

FIGURE 9



Figures 7, 8, and 9 show similar data for successively larger groups of stations (Groups 3, 4, and 5) which start the conversion program in later years and which spread the conversion process over longer periods. Thus in Group 5, the 160 stations involved are assumed to start conversion in Year 5 and to complete the conversion in Year 12, 8 years later (Figure 9).

#### 6.1. Incremental Capital Cost

While the total capital investment in HD equipment is 11.6 million for each station in Group 1, shown in Figure 4, the incremental cost for the five-year period is the sum of the expenditures above the historic normal capital investment in NTSC equipment, which is assumed to be 1.0 million per year, or \$5.0 million over the five-year conversion period. Thus the incremental cost of conversion, based on these assumptions, is 11.6 million less \$5.0 million, or 6.6 million, plus the remaining cost of maintaining some NTSC equipment during the conversion, shown in Figure 5. This analysis produces a total incremental cost of \$8.9 million.

For the 40 stations in Group 2, the total capital investment in HD equipment is \$10.4 million, (Fig. 4), and the historic level of capital investment in NTSC equipment is \$0.5 million for year (Figure 6). The total net incremental cost for a station in this group is then  $\$10.4 - (6 \times 0.5) = \$7.4$  million, to which must be added the remaining NTSC equipment cost of \$1.2 million, for a total of \$8.6 million.

For the 320 stations in Group 5, whose total capital investment in HD equipment is \$6.9 million, the net incremental cost of the transition is found to be \$5.85 million. These projections are presented in Figure 10.

For all the 630 stations included in Groups 1-5, the average capital investment in HD equipment is 8.0 million per station, while the average total incremental cost over the assumed capital investment in maintaining and updating NTSC equipment is 5.8 million per station, to which must be added the remaining \$0.8 million cost of maintaining some NTSC equipment during the transition, for a total net incremental cost of \$6.6 million.

#### 6.2. Capital Depreciation Charges

The impact of capital depreciation charges against revenues during the conversion period is significant. Assuming a 5-year straight line depreciation rate for HD equipment, the total depreciation charges for the 630 stations considered amount to \$2,680 million, or an average total depreciation charge of \$4.3 million per station. For tax purposes, this reduces the average total net cash flow for the acquisition of HD equipment to \$3.7 million per station, considering only the period of conversion. Additional depreciation charges will, of course, be taken in the five years following the last year of the conversion program.

# INCREMENTAL CAPITAL COST OF HDTV EQUIPMENT PER STATION \$ MILLIONS\*

STATION GROUP	NO. OF STATIONS	HD EQUIPMENT CAPITAL INVESTMENT	HISTORIC NTSC CAPITAL INVESTMENT DURING TRANSITION PERIOD	REMAINING NTSC INVESTMENT DURING TRANSITION	NET INCREMENTAL CAPITAL COST
1	30	11.6	5.0	2.3	8.9
2	40	10.4	3.0	1.2	8.6
3	80	9.3	2.8	0.9	7.4
4	160	8.1	2.1	0.75	6.75
5	320	6.9	1.6	0.55	5.85

\* IN 1990 DOLLARS

FIGURE 10



7. TRANSITION SCHEDULES

Each station is expected to implement its transition to HDTV over a period of several years, thus spreading the capital investment required over a period of from five to nine years, depending upon marketplace and competitive considerations.

The first stations to introduce HDTV service will probably be large stations in the top television markets. These are likely to be followed by stations in progressively smaller markets.

For example, the transition schedule may follow the pattern shown in Figure 11. Starting in Year 1, with the first group of 30 stations to convert, all of which serve the top ten television markets, the number of television households served, and the percentage of all TV households (TVHH), are presented.

Assuming this scenario, each group of stations will take several years to implement full conversion, with the first group of 30 stations taking 5 years, and the last Group 6 of 640 stations, many of whom will be in smaller markets, completing the conversion in 9 years. In this scenario, the timing of conversion for each group is shown in Figure 12.

# HDTV TRANSITION SCHEDULE

START YEAR	GROUP NO.	STATIONS EQUIPPED	MARKET RANKINGS SERVED	TV HOUSEHOLDS SERVED (MILLIONS)	PERCENT TVHH SERVED
1	1	30	1-10	28	31
2	2	+40=70	1-30	48	53
3	3	+80=150	1-100	76	83
4	4	+160=310	1-150	84	95
5	5	+320=630	ALL	88	98
6	6	+640=1270	ALL	90	100

FIGURE 11



# HD CONVERSION SCHEDULE BY PHASES FOR EACH GROUP OF STATIONS

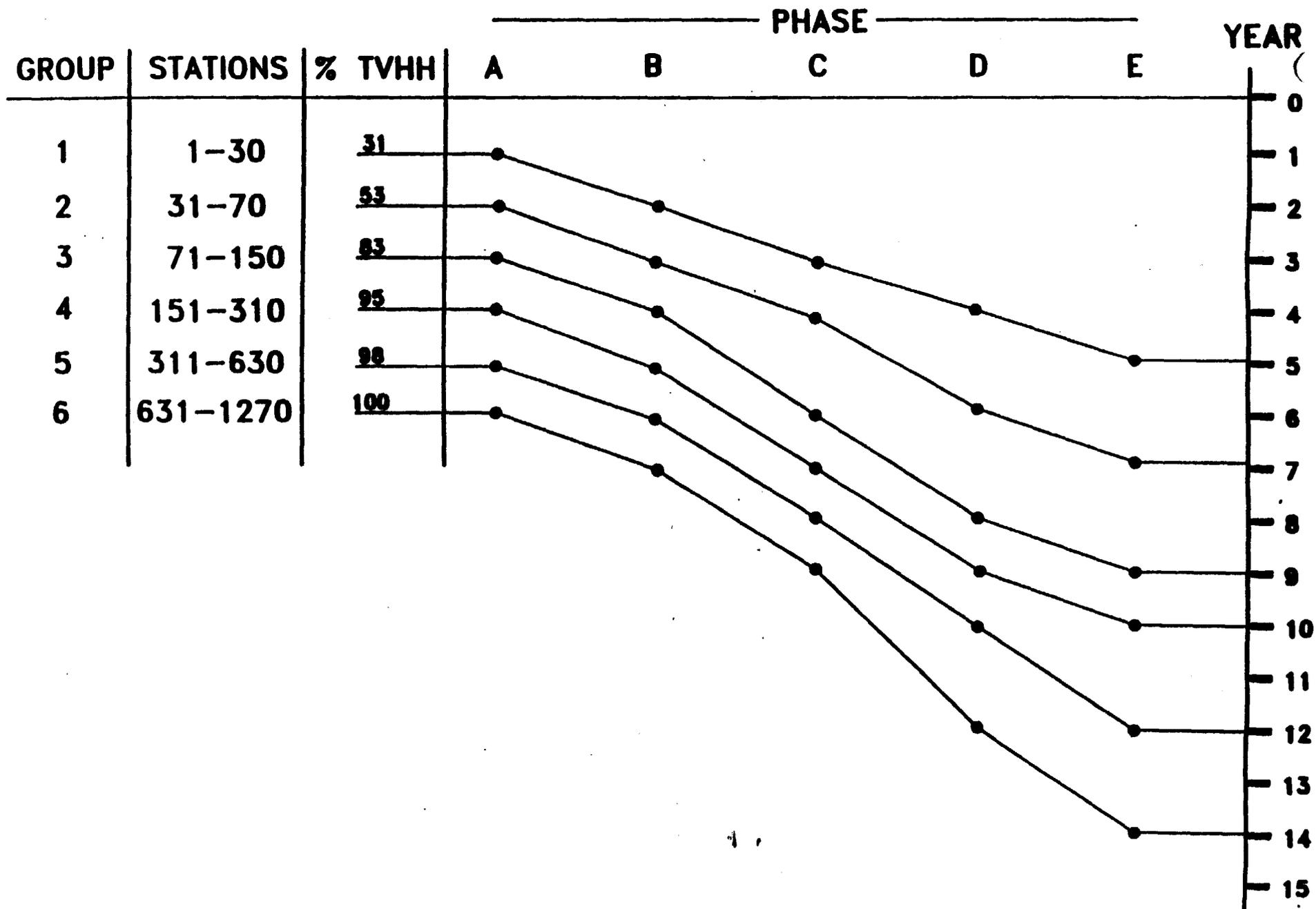


FIGURE 12



8. CONCLUSIONS

At this point in the study, the following working premises are put forward for industry discussion.

- (i) Phasing the transition to simulcast HDTV over several years is essential so that stations can time and pace their transition program based on their financial capacity and marketplace considerations. Such a transition scenario appears feasible.
- (ii) The transmitter power for HDTV broadcast will be much less than for a NTSC transmitter, and the transmitting antenna will thus be smaller than its NTSC variant. New tower requirements for HDTV broadcast will therefore be minimal.
- (iii) Equipment costs will decline significantly over the period of industry conversion to HDTV broadcasting.
- (iv) The total capital investment required for transition to simulcast HDTV may range from \$11.6 million for major market stations converting early to \$6.9 million for small market converting later.
- (v) The incremental capital investment required for the transition to simulcast HDTV may range from \$9 million for major market stations to \$6 million for small market stations.

These projections of capital cost are presented in Figure 13.

# SIMULCAST HIGH DEFINITION TERRESTRIAL BROADCAST CAPITAL INVESTMENT REQUIRED \$ MILLIONS

		GROUPS OF STATIONS ACQUIRING EQUIPMENT				
GROUP		1	2	3	4	5
NO. OF STATIONS		30	+40=70	+80=150	+160=310	+320=630
% TVHH SERVED		31	53	83	95	98
A -	TOTAL CAPITAL COST PER STATION	11.6	10.4	9.3	8.1	6.9
B -	TOTAL INCREMENTAL COST OVER HISTORIC NORMAL NTSC CAPITAL COST	8.9	8.6	7.4	6.8	5.9

• IN 1990 DOLLARS

FIGURE 13

