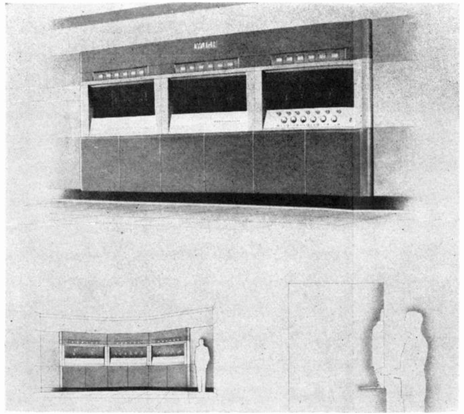

Proposed design for a 10-kw f-m transmitter, based on survey replies.

cuit breakers for overload protection.

2. Consoles

Interviewed: *Future operators.*

Question: *What shape console do you prefer?*

Curved	48%
Flared sides	40%
Straight	12%

Approximately 50% of those interviewed stressed that operator's comfort should be taken into consideration.

Interviewed: *Present and future operators.*

Question: *What special features would you like to see on your console?*

Voluntary comments . . .

Built-in clock (6).
File drawer for FCC reports (7).
Antenna light signal at console (8).
Circuit indicator lights on console (9).
Power light indicator (9).
Provision for microphone on console (11).
Adequate drawer space (16).
Space for long-carriage typewriter (18).
Swivel chair designed for console (20).
Turntable on console (20).
Space for log book (21).
Built-in telephones (24).
Adequate knee and leg room (40)

3. Controls

Interviewed: *Present and future operators.*

Question: *Where would you prefer to have your power controls?*

Console	60%
Transmitter	20%
Both	20%

Question: *Where would you like to have your r-f controls?*

Transmitter	60%
Console	34%
Both	6%

Other featured included . . . guarded controls (8); controls requiring vernier adjustment to be at transmitter, locked (7); concealed transmitter controls (5); console controls grouped according to functions (3).

Interviewed: *Future operators.*

Question: *Do you prefer manual or automatic controls?*

Manual	43%
Automatic	39%
Both	18%

4. Meters

Interviewed: *Present and future operators.*

Voluntary comments:

Black faces (4).
Monitor meters visible from console (5).
Non-reflecting glass on meters (6).
More meters (7).
Sloped meters (7).
Duplicate meters on console (8).
Every important circuit to be individually metered (10).
Meters at eye level (16).
Illuminated faces (19).
Stainless faces (20).
Larger faces on meters (25).

5. Tubes

Interviewed: *Future managers and operators.*

Question: *Do you think the tubes should be visible?*

Yes	96%
No	4%

Operators stressed the importance of visible tubes for operational procedure while the managers stated that station visitors would be interested in seeing the tubes.

Interviewed: *Present and future operators.*

Question: *Do you prefer air-cooled or water-cooled tubes?*

Air-cooled	94%
Water-cooled	6%

Others wanted . . . Stand-by (spare) tubes wired to switch into circuit (12); easier tube replacement (8); life of tube guaranteed (5); provide means for using tube heat to heat building (5); standardized tube socket (4); tubes individually metered (3).

Air cooled tubes were preferred because they are less messy and do away with complicated water system plumbing, electrolysis, and sweating. They give less mechanical difficulty, are clean, economical, easy to maintain and compact. Those who spoke out for water-cooled tubes, however, felt that over 5 kw the necessary blowers and fans cost as much to maintain as a water system.

6. Monitors

Interviewed: *Future operators.*

Question: *Should the frequency and modulation monitors be incorporated in the transmitter or furnished as a separate unit?*

Separate	57%
Incorporated	43%

Separate units were preferred because they eliminate shielding difficulties. Of those favoring separate units, approximately 25% suggested that the monitors be incorporated in the console. Five said that monitor meters should be visible from console.

7. Antenna

Interviewed: *Future operators.*

Question: *Do you require any special type of f-m antenna?*

No	71%
Yes	22%
Don't know	7%

Others wanted . . . directional antenna for local requirements (8); de-icers on antenna (4); and electrical storm protection (4).

Interviewed: *Future operators.*

Question: *What type of transmission line do you expect to use?*

Coaxial	83%
Other	17%

Interviewed: *Future operators.*

Question: *What will be the impedance of your transmission line?*

70 ohms	48%
72 ohms	15%
Don't know	19%
Assorted answers	18%

Interviewed: *Future operators.*

Question: *Will the transmission line be pressurized?*

Yes	67%
No	9%
Don't know	24%

Others wanted leak-proof insulation (3); and open-line transmission (2).

Services

1. Planning

Interviewed: *Future managers and operators.*

Question: *Would you like assistance in planning your complete f-m installation?*

Yes	54%
No	46%

Two asked that stations submit design for approval by manufacturer.

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Supervisory assistance was asked for by eighteen; sixteen wanted a final check of installation, while twelve asked that the manufacturer handle complete installation.

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No	13%

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Question: *Would you like assistance in studio design?*

Yes	60%
No	40%

Three asked for printed precautions and suggestions for studio designers.

Interviewed: *Future managers and operators.*

Question: *Would you like continued servicing from manufacturer's engineers?*

Yes	88%
No	12%

Engineer - trained representatives were requested by five; four wanted servicing calls not included in original over-all expense; three wanted repair service and two asked for periodic calls.

A very common complaint was that the average local distributor was not thoroughly familiar with answers to broadcasting problems. Requests were made for factory representatives, talking the broadcasting engineer's language, to make periodic service calls, and always be available in case of trouble.

General Comments

Interviewed: *Present and future managers and operators.*

Question: *What do you think of f-m?*

Good opinion	64%
Poor opinion	36%

Favorable comments:

Local service better than a-m.
Break for small stations.
Noise-free reception.
Low power consumption.
Better quality reception.
Very good for poor channel a-m stations.

Unfavorable comments:

Over-rated.
Bad for rural areas.
Over-publicized.
Splits audiences with a-m.
Too many technical difficulties.

Interviewed: *Present managers.*

Question: *What is the public reaction to f-m?*

Good	75%
Poor	5%
Don't know	20%

Comments:

Noise free feature should receive stronger stress than quality in f-m ads.
With cheap receivers, f-m will not surpass a-m.

BROADCAST TRANSMITTER DESIGNS

As Determined by a Market Survey

Reprint 4392

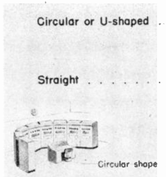
REPRINTED FROM AUGUST 1946 ISSUE OF *COMMUNICATIONS*

INDUSTRIAL ELECTRONICS DIVISION

WESTINGHOUSE ELECTRIC CORPORATION

BALTIMORE, MD.

Printed in U.S.A



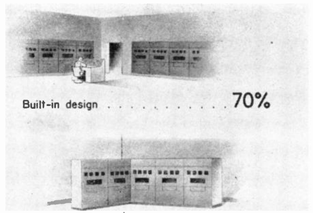
Circular or U-shaped 64%

Straight 36%

Circular shape . . . 44%

U shape 20%

* Curved design is only practicable for 10 kw or larger, from meters. For such transmitters, a circular or U-shaped layout locates dials and meters at an equal distance from the operator and eliminates parallax errors.



Built-in design 70%

Free-standing 20%

Don't know 10%

BROADCAST TRANSMITTER DESIGNS As Determined by a Market Survey

by M. R. BRIGGS

Manager Broadcast Engineering, Industrial Electronics Division
Westinghouse Electric Corporation

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The latest a-m designs utilize cubicle type of construction with emphasis placed on accessibility, ease of operation and maintenance. These designs represent mostly the thoughts and ideas of the radio *design* engineer. If the engineer has had practical experience in the operation of a broadcast transmitter, it is usually found reflected in the transmitter design.

With the advent of f-m, the design of f-m transmitters appeared not to follow the evolved standard practices of a-m transmitter construction. Circuits were complicated, equipment was reduced in size, and servicing became a major problem.

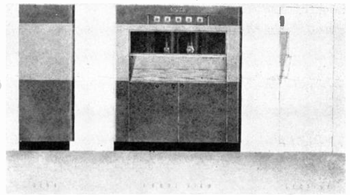
It was felt that a comprehensive survey conducted among managers and operators who had extensive f-m experience as well as those who, because of a broad broadcasting background, were familiar with the art, would indicate preferences and requirements directly affecting the design and construction of future f-m equipment. While the survey plans were particularly pointed towards f-m transmitter design, it was believed that many of the comments, preferences and suggestions would be applicable to a-m transmitter designs. The survey results proved that many of the design requirements had dual applications.

The survey, conducted by Cushing and Nevell under our auspices, covered 91 f-m stations and license applicants located in 56 cities and 22 states. Of the stations visited, 24 are presently operating f-m; 67 are prospective f-m operators. Personnel interviewed totalled 162, including 21 present managers, 51 future managers, 28 present operators and 62 future operators. (The term *operators* includes chief engineers as well as transmitter operators.)

Separate questionnaires, prepared for each of the four classifications of persons interviewed, solicited information and opinions concerning all phases of installations, management, operation and maintenance of f-m equipment. Questions were phrased either to obtain a direct *yes* or *no* response, or to invite opinions and suggestions which would indicate definite reactions and trends.

All persons interviewed showed keen interest in the survey, cooperated fully, and offered further assistance if desired. The majority of those interviewed wanted to be informed as to what manufacturer would eventually make use of the findings for the design of equipment. In no case, however, were we disclosed as the sponsor; as a matter of fact, in many cases the agents making the survey did not know for whom it was being done.

The survey contained three main sections . . . *equipment, services,* and *general comments.* Questions, answers and suggestions within these sections were classified by subject matter.



Above, left.
Illustrating reply to type of transmitter design inquiry.

Above, right.
Illustrating reply to inquiry regarding preferences for a built-in or free-standing transmitter.

Proposed design for a 1-kw f-m transmitter, based on survey data.

Equipment

1. Transmitter

Interviewed: *Future managers and operators.*

Question: *Will the transmitter station be open to visitors?*

Yes	71%
No	18%
Don't Know	11%

Of the present operators interviewed on this subject, 55% stated that their f-m stations were open to visitors. Chief items of interest to visitors include general appearance, oscillograph, tubes, meters, antenna, and operational procedure.

Interviewed: *Future managers.*

Question: *What do you expect to pay for your complete installations?*

Price Estimate	Size of transmitter station					
	1 kw	3 kw	5 kw	10 kw	25 kw	50 kw
Don't know ...	3	3	1	6	1	4
$ 15,000- 25,000	1	1	..	..	..	..
$ 25,000- 30,000	..	2	..	..	..	..
$ 30,000- 50,000	1	..	..	4	..	..
$ 50,000- 75,000	1	..	..	7	..	..
$ 75,000-100,000	1	2*	1	1	..	..
$100,000-150,000	..	..	..	..	..	..
$150,000-175,000	..	..	..	..	..	3
$175,000-300,000	..	..	..	1	..	2

Interviewed: *Future operators.*

Question: *What power will be available at your transmitter?*

220 volts, 60 cycles, 3 phase	65%
230 volts, 60 cycles, 3 phase	8%
440 volts, 60 cycles, 3 phase	6%
Don't know	21%

Interviewed: *Future operators.*

Question: *Will there be an alternate supply?*

No	46%
Own generator	21%
Two lines	21%
Don't know	12%

*This estimate includes cost of complete building.

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Question: *What do you expect to pay for your transmitter?*

Price Estimate	Size of transmitter station					
	1 kw	3 kw	5 kw	10 kw	25 kw	50 kw
Don't know ...	4	4	2	8	1	5
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$ 15,000- 20,000	..	..	..	5	..	..
$ 20,000- 25,000	..	..	..	6	..	..
$ 25,000- 50,000	..	..	..	..	..	..
$ 75,000-100,000	..	..	..	..	..	2
$100,000-125,000	..	..	..	..	..	1
$125,000-150,000	..	..	..	..	..	1

Interviewed: *Present managers and operators.*

Question: *When do you plan to buy new f-m equipment?*

Do not know	28%
5 years	34%
10 years	8%
10-15 years	6%
Not at all	8%
When more power is desired	16%

Many of those planning to remodel intend to add more power to their station.

Interviewed: *Present and future managers and operators.*

Question: *Do you consider the appearance of the transmitter important?*

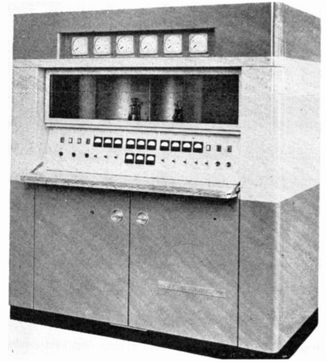
Yes	89%
No	11%

The morale building feature of neat appearing equipment was greatly stressed by chief engineers and by managers. Appearance was also considered an important factor in stations open to visitors. Many managers and operators felt that the prestige of the station is enhanced by its appearance, and an impressive appearance helps convince an advertiser that a good job will be done for his product. However, others emphasized that looks help, but performance counts, and that appearance must not interfere with engineering.

Interviewed: *Future managers*

Question: *Do you favor a conventional or modern treatment in the design and layout of your station?*

Modern	84%
Conventional	16%



Typical f-m transmitter designed in accordance with suggestions proposed during survey.

Interviewed: *Future managers and operators.*

Question: *Do you favor a built-in or free standing design and layout in your transmitter room?*

Built-in	70%
Free standing	20%
Don't know	10%

Interviewed: *Future operators.*

Question: *Do you favor a straight, circular or a U-shaped design for your transmitter?*

Circular	44%
Straight	36%
U-shaped	20%

It was determined that circular or U-shaped design was only practical for transmitter larger than 10 kw. For such transmitters, a circular or U-shaped design places dials and meters at an equal distance from the operator and eliminates parallax errors.

Interviewed: *Future managers and operators.*

Question: *Do you have any preference about the use of color on your f-m equipment?*

Yes	96%
Immaterial	4%
*Grey	32%
Blue-grey	30%
Umber-grey	13%
Blue	10%
Green	6%
Brown	3%
Others	6%

Other characteristics were: non-reflecting surface (8[1]); colors standardized for chain (4); non-reflecting glass (3); and no chrome (2).

*Grey was used by many people in expressing a preference for blue-grey or umber grey.

Interviewed: *Future operators.*

Question: *Do you prefer a compact or roomy transmitter?*

Roomy	96%
Compact	4%

Storage space for spare parts and tools was requested by fourteen, space around hot equipment by three.

Roomy transmitters were preferred especially because they afford easy access to parts, and also permit better ventilating and more thorough cleaning. Engineers, operators and even managers of broadcasting stations were painfully aware of the lack of accessibility in their equipment and were definite in their opinion that future transmitters must be roomier.

Interviewed: *Present operators.*

Question: *Do you think that dust protection is important?*

Yes	71%
No	29%

More space to facilitate cleaning was requested by fifteen; use of the precipitron as standard equipment by nine; more efficient screens on blowers by four; and cleaning equipment as part of ventilating system by three.

Operators stressed dust protection, stating that a large percentage of repair and overhaul was due to dust and dirt.

Interviewed: *Present and future managers and operators.*

Question: *What features and special features would you like to have incorporated in your transmitter?*

[1]Number of persons offering information.

Voluntary comments . . .

Controlled tube cooling after shutdown (2).
Point-to-point wiring (2).
Better quality insulation (3).
Sliding or rolling doors (3).
Wireless link from studio (3).
Legends for controls printed directly on panel (4).
Manufacturer's name on nameplate (4).
Diagrams on transmitter doors (5).
Nameplate legends should be more legible (5).
Standardized design for chain stations (5).
Standardized tube sockets (5).
Trough conduits instead of pipe conduits (5).
Thermostatic control of ventilation (5)
Provision for using tube heat-to-heat building (6).
Greater accessibility to mounting nuts and bolts (7).
Overload alarms (7).
Sturdier and more accessible terminal connections (7).
Diagrams on rollers or door panels (8).
Micro-switch cut-off on doors (8).
Thermometers as standard equipment in cubicle interior (8).
Circuit breakers to replace fuses (10).
Parts not in open vertical arrangement mounted on sliding shelves (11).
Oscillograph (12).
Trough lights on front of transmitter (14).
Inside lights and outlets (15).
Quieter operation of blower system (16).
More adequate ventilation (19).

The general feeling was that circuit breakers give lower maintenance and less trouble than fuses. They also give a visual indication of trouble, and hence a quicker return to normal operation. Some operators suggested circuit breakers for all main circuits and fuses with neon lights for others. A total of 258 out of 274 operators and managers, however, preferred cir-

BROADCAST TRANSMITTER DESIGNS

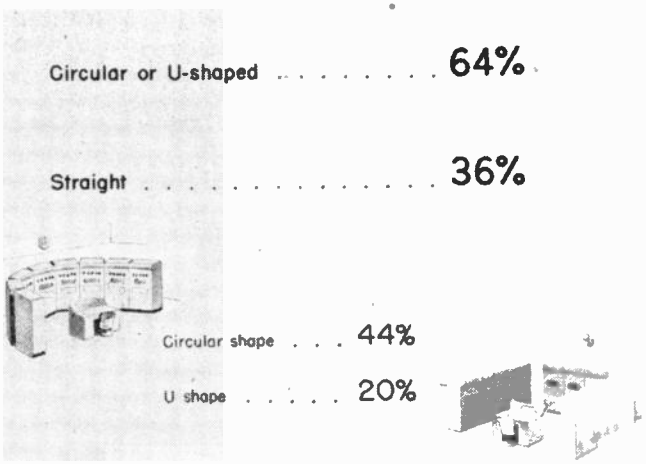
As Determined by a Market Survey

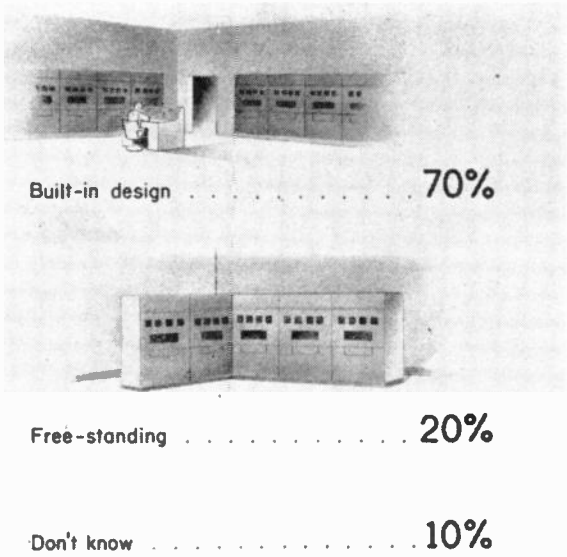
Reprint 4292

REPRINTED FROM AUGUST 1946 ISSUE OF *COMMUNICATIONS*

INDUSTRIAL ELECTRONICS DIVISION

WESTINGHOUSE ELECTRIC CORPORATION BALTIMORE, MD.





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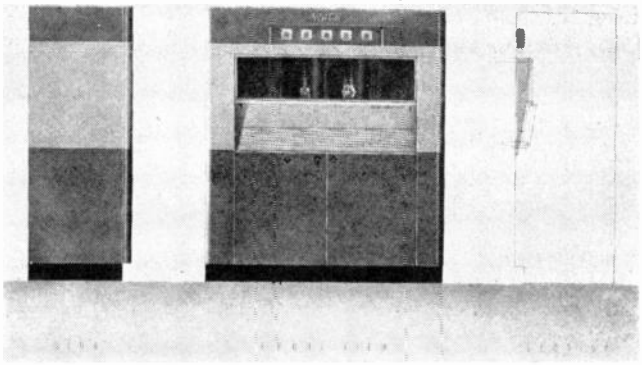

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Supervisory assistance was asked for by eighteen; sixteen wanted a final check of installation, while twelve asked that the manufacturer handle complete installation.

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Question: *Would you like assistance in studio design?*

Yes 60%
No 40%

Three asked for printed precautions and suggestions for studio designers.

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Question: *Would you like continued servicing from manufacturer's engineers?*

Yes 88%
No 12%

Engineer - trained representatives were requested by five; four wanted servicing calls not included in original over-all expense; three wanted repair service and two asked for periodic calls.

A very common complaint was that the average local distributor was not thoroughly familiar with answers to broadcasting problems. Requests were made for factory representatives, talking the broadcasting engineer's language, to make periodic service calls, and always be available in case of trouble.

General Comments

Interviewed: *Present and future managers and operators.*

Question: *What do you think of f-m?*

Good opinion 64%
Poor opinion 36%

Favorable comments:

Local service better than a-m.
Break for small stations.
Noise-free reception.
Low power consumption.
Better quality reception.
Very good for poor channel a-m stations.

Unfavorable comments:

Over-rated.
Bad for rural areas.
Over-publicized.
Splits audiences with a-m.
Too many technical difficulties.

Interviewed: *Present managers.*

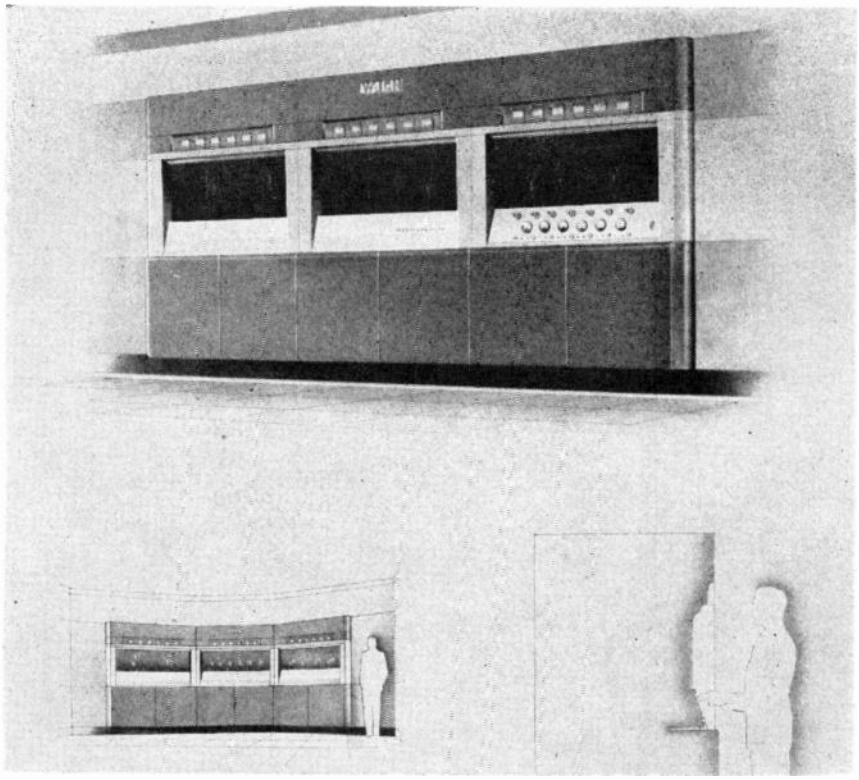
Question: *What is the public reaction to f-m?*

Good 75%
Poor 5%
Don't know 20%

Comments:

Noise free feature should receive stronger stress than quality in f-m ads.

With cheap receivers, f-m will not surpass a-m.



Proposed design for a 10-kw f-m transmitter, based on survey replies.

cuit breakers for overload protection.

2. Consoles

Interviewed: *Future operators.*

Question: *What shape console do you prefer?*

Curved	48%
Flared sides	40%
Straight	12%

Approximately 50% of those interviewed stressed that operator's comfort should be taken into consideration.

Interviewed: *Present and future operators.*

Question: *What special features would you like to see on your console?*

Voluntary comments . . .

Built-in clock (6).
File drawer for FCC reports (7).
Antenna light signal at console (8).
Circuit indicator lights on console (9).
Power light indicator (9).
Provision for microphone on console (11).
Adequate drawer space (16).
Space for long-carriage typewriter (18).
Swivel chair designed for console (20).
Turntable on console (20).
Space for log book (21).
Built-in telephones (24).
Adequate knee and leg room (40)

3. Controls

Interviewed: *Present and future operators.*

Question: *Where would you prefer to have your power controls?*

Console	60%
Transmitter	20%
Both	20%

Question: *Where would you like to have your r-f controls?*

Transmitter	60%
Console	34%
Both	6%

Other featured included . . . guarded controls (8): controls requiring vernier adjustment to be at transmitter, locked (7): concealed transmitter controls (5); console controls grouped according to functions (3).

Interviewed: *Future operators.*

Question: *Do you prefer manual or automatic controls?*

Manual	43%
Automatic	39%
Both	18%

4. Meters

Interviewed: *Present and future operators.*

Voluntary comments:

Black faces (4).
Monitor meters visible from console (5).
Non-reflecting glass on meters (6).
More meters (7).
Sloped meters (7).
Duplicate meters on console (8).
Every important circuit to be individually metered (10).
Meters at eye level (16).
Illuminated faces (19).
Stainless faces (20).
Larger faces on meters (25).

5. Tubes

Interviewed: *Future managers and operators.*

Question: *Do you think the tubes should be visible?*

Yes	96%
No	4%

Operators stressed the importance of visible tubes for operational procedure while the managers stated that station visitors would be interested in seeing the tubes.

Interviewed: *Present and future operators.*

Question: *Do you prefer air-cooled or water-cooled tubes?*

Air-cooled	94%
Water-cooled	6%

Others wanted . . . Stand-by (spare) tubes wired to switch into circuit (12); easier tube replacement (8); life of tube guaranteed (5); provide means for using tube heat to heat building (5); standardized tube socket (4); tubes individually metered (3).

Air cooled tubes were preferred because they are less messy and do away with complicated water system plumbing, electrolysis, and sweating. They give less mechanical difficulty, are clean, economical, easy to maintain and compact. Those who spoke out for water-cooled tubes, however, felt that over 5 kw the necessary blowers and fans cost as much to maintain as a water system.

6. Monitors

Interviewed: *Future operators.*

Question: *Should the frequency and modulation monitors be incorporated in the transmitter or furnished as a separate unit?*

Separate	57%
Incorporated	43%

Separate units were preferred because they eliminate shielding difficulties. Of those favoring separate units, approximately 25% suggested that the monitors be incorporated in the console. Five said that monitor meters should be visible from console.

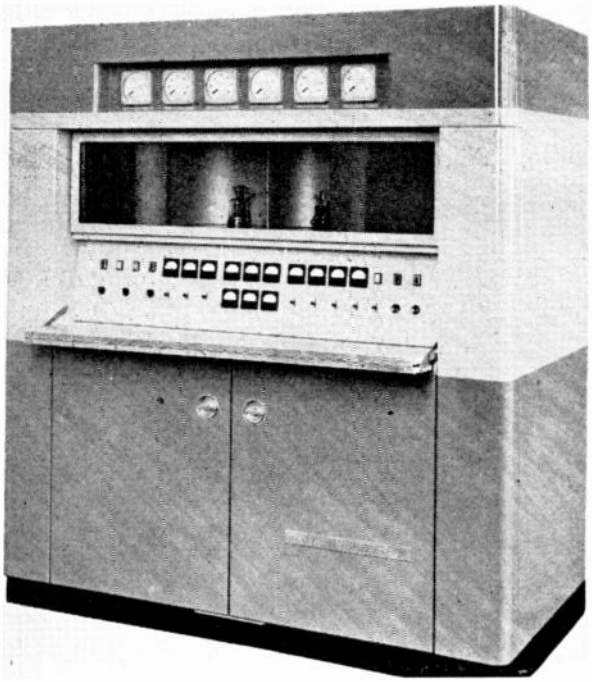
7. Antenna

Interviewed: *Future operators.*

Question: *Do you require any special type of f-m antenna?*

No	71%
Yes	22%
Don't know	7%

Others wanted . . . directional an-



Typical f-m transmitter designed in accordance with suggestions proposed during survey.

Interviewed: *Future managers and operators.*

Question: *Do you favor a built-in or free standing design and layout in your transmitter room?*

Built-in	70%
Free standing	20%
Don't know	10%

Interviewed: *Future operators.*

Question: *Do you favor a straight, circular or a U-shaped design for your transmitter?*

Circular	44%
Straight	36%
U-shaped	20%

It was determined that circular or U-shaped design was only practical for transmitter larger than 10 kw. For such transmitters, a circular or U-shaped design places dials and meters at an equal distance from the operator and eliminates parallax errors.

Interviewed: *Future managers and operators.*

Question: *Do you have any preference about the use of color on your f-m equipment?*

Yes	96%
Immaterial	4%
*Grey	32%
Blue-grey	30%
Umber-grey	13%
Blue	10%
Green	6%
Brown	3%
Others	6%

Other characteristics were: non-reflecting surface (8[1]); colors standardized for chain (4); non-reflecting glass (3); and no chrome (2).

*Grey was used by many people in expressing a preference for blue-grey or umber grey.

Interviewed: *Future operators.*

Question: *Do you prefer a compact or roomy transmitter?*

Roomy	96%
Compact	4%

Storage space for spare parts and tools was requested by fourteen, space around hot equipment by three.

Roomy transmitters were preferred especially because they afford easy access to parts, and also permit better ventilating and more thorough cleaning. Engineers, operators and even managers of broadcasting stations were painfully aware of the lack of accessibility in their equipment and were definite in their opinion that future transmitters must be roomier.

Interviewed: *Present operators.*

Question: *Do you think that dust protection is important?*

Yes	71%
No	29%

More space to facilitate cleaning was requested by fifteen; use of the precipitron as standard equipment by nine; more efficient screens on blowers by four; and cleaning equipment as part of ventilating system by three.

Operators stressed dust protection, stating that a large percentage of repair and overhaul was due to dust and dirt.

Interviewed: *Present and future managers and operators.*

Question: *What features and special features would you like to have incorporated in your transmitter?*

[1]Number of persons offering information.

Voluntary comments . . .

Controlled tube cooling after shutdown (2).
Point-to-point wiring (2).
Better quality insulation (3).
Sliding or rolling doors (3).
Wireless link from studio (3).
Legends for controls printed directly on panel (4).
Manufacturer's name on nameplate (4).
Diagrams on transmitter doors (5).
Nameplate legends should be more legible (5).
Standardized design for chain stations (5).
Standardized tube sockets (5).
Trough conduits instead of pipe conduits (5).
Thermostatic control of ventilation (5)
Provision for using tube heat-to-heat building (6).
Greater accessibility to mounting nuts and bolts (7).
Overload alarms (7).
Sturdier and more accessible terminal connections (7).
Diagrams on rollers or door panels (8).
Micro-switch cut-off on doors (8).
Thermometers as standard equipment in cubicle interior (8).
Circuit breakers to replace fuses (10).
Parts not in open vertical arrangement mounted on sliding shelves (11).
Oscillograph (12).
Trough lights on front of transmitter (14).
Inside lights and outlets (15).
Quieter operation of blower system (16).
More adequate ventilation (19).

The general feeling was that circuit breakers give lower maintenance and less trouble than fuses. They also give a visual indication of trouble, and hence a quicker return to normal operation. Some operators suggested circuit breakers for all main circuits and fuses with neon lights for others. A total of 258 out of 274 operators and managers, however, preferred cir-