APPENDIX

CATALOG OF POTENTIAL EXPENSES AND ESTIMATED COSTS

2017 Update

Catalog of Potential Expenses and Estimated Costs

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Catalog of Potential Expenses and Estimated Costs

I. ABOUT THIS CATALOG

This catalog of expenses (Catalog) contains descriptions of the expenses that broadcasters and MVPDs are most likely to incur as a result of broadcaster repacking. While we believe the Catalog is relatively comprehensive, it does not cover every expense, for every situation, nor is it an exhaustive list of all expenses that may potentially qualify for reimbursement.

Widelity, Inc. (Widelity) developed the original Catalog in 2013 for the Federal Communications Commission (FCC) as part of the Widelity Report, which was published for comment in 2014 (DA/FCC: DA-14-389). As part of the ongoing Broadcast Television Incentive Auction, the FCC engaged Widelity to update the Catalog to reflect the current pricing for the equipment and services that repacked broadcasters may need to purchase to facilitate the moves to their new channel assignments, and the current pricing for equipment and services that MVPDs may need to purchase to continue to carry broadcasters. Widelity first developed the information contained in this Catalog based on its research and interviews with industry stakeholders, conducted in 2013, and later updated in August of 2016, pursuant to its contract with the FCC. The categories and costs contained in the Catalog are intended to serve as a reference guide, and are not intended to identify the particular expenses for which individual broadcasters or MVPDs would be eligible for reimbursement.

Individual broadcasters and/or MVPDs will incur only some of the expenses listed in the Catalog, depending upon the broadcaster's or MVPD's existing equipment and the particular transition changes that the entity must make. Some of the expenses will apply only in limited situations, such as, for example, broadcasters operating on a shared antenna or those that require additional power to support an interim transmitter.

Supply and demand constraints may have an impact on future costs.

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II. BROADCAST COSTS

A. TRANSMITTERS AND IN-BUILDING EXPENSES

1. Retuning Existing Transmitters

Depending on a broadcaster's new channel assignment, it may be able to retune its existing transmitter to transmit on the new channel rather than replace it. Transmitters can be retuned only to channels within the same band (*e.g.*, UHF transmitters can only be retuned to channels within the UHF band). *See* Widelity Report pp. 17-18 regarding banding issues. Whether retuning is feasible depends on a number of factors, including the type of transmitter, the range of channels (sub-band) for which it and its component parts are designed, and whether replacement parts and manufacturer support are available. In some cases, replacement may be the preferred option if the cost of retuning exceeds the cost of a new transmitter. The transmitter output mask filter is channel-specific and must be replaced to accommodate any channel change.

Our discussions indicate that there are a number of potential issues with Inductive Output Tube (IOT) transmitter retuning, including:

- IOT tubes that have been in service for an extended period may not "come back up" on the new channel once they have been powered down necessitating replacements that cannot be predicted before starting the retuning process.
- The lead time for delivery of new IOT tubes can be as long as 6 to 9 months.
- The skill set to retune IOT transmitters is no longer broadly available. This will cause resource constraints as stations consider retuning their existing IOT transmitters.
- Manufacturer support and certain parts necessary for retuning existing IOT transmitters may no longer be available.

	Range of Estimated Costs (*in dollars*)
UHF – Inductive Output Tube (IOT) Transmitter (Price would include banded drivers, RF system, and labor. The price does not include the cost of IOT tubes, finger stock and/or tube trolleys. Cost varies by manufacturer.)	
One IOT system (30kW)	115,000 – 226,000
Two IOT systems (60 kW)	145,000 – 339,000
Three IOT systems (90 kW)	160,000 – 452,000
IOT replacement tube with accessories (*price per tube*)	75,000 – 121,000

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Solid State Transmitter Prices based on specific channel move and would include field engineering and parts to retune the RF system but would not include the cost of a new mask filter, which is a separate line item below. Costs vary widely by manufacturer and power level. Retuning solid state transmitters is usually only feasible if the banding issues are minor. Stations that use solid state transmitters that have major banding issues will likely need a replacement solid state transmitter.	**Range of Estimated Costs (*in dollars*)**
UHF and VHF – minor banding issues	10,000 – 100,000
New Mask Filter – A new mask filter is required for any channel change	
1.5 kW mask filter	2,800
3 kW mask filter	3,950
7 kW mask filter	5,900
10 kW mask filter	7,900
30 kW mask filter	31,000
60 kW mask filter	85,000
90 kW mask filter	95,000
New Exciter – In a few cases, a station may need to purchase a new exciter if the existing exciter cannot be retuned.	
Single frequency agile exciter	20,000
Dual exciter system with change over	45,000

2. New Transmitters

If retuning is not possible or if the cost of retuning exceeds the cost of replacement, a new transmitter may be required. The price of a new transmitter includes installation, mask filter, and proof of performance testing.

	Range of Estimated Costs (*in dollars*)
UHF – IOT Transmitter	
One IOT system (30 kW)	475,000 – 549,000
Two IOT systems (60 kW)	835,000 – 907,000
Three IOT systems (90 kW)	1,275,000 – 1,345,000
UHF – Air Cooled Solid State Transmitter	
1 – 2.5 kW	40,000 – 120,000

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4 - 6 kW	157,000 – 225,000
10 – 12 kW	245,000 – 320,000
15 kW	392,500
20 kW	555,000
UHF – Liquid Cooled Solid State Transmitter	
4.9 – 6.5 kW	225,000 – 260,000
8.2 - 13 kW	270,000 – 470,000
14.2 - 20 kW	495,000 – 650,000
21 - 31 kW	675,000 – 900,000
35 - 50 kW	1,000,000 – 1,400,000
52 - 61 kW	1,550,000 – 1,700,000
68.5 - 75 kW	1,750,000 – 1,900,000
86.8 – 106 kW	2,100,000 – 2.500,000
High VHF – Air Cooled Solid State Transmitter	
1.1 – 4.4 kW	47,000 – 145,000
6.5 – 12.5 kW	175,000 – 315,000
16.6 – 20.7 kW	400,000 – 500,000
24.5 kW	650,000
High VHF – Liquid Cooled Solid State Transmitter	
3.3 – 6.5 kW	135,000 – 237,000
8.5 – 12.5 kW	291,000 – 425,500
16.6 – 20.7 kW	540,000 – 675,000
24.5 – 31.6 kW	877,500 – 950,000
48.0 kW	1,350,000
62.0 kW	1,700,000

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3. Other Transmitter Expenses

In limited situations, these expenses may apply in addition to those listed in Sections II.A.1 or II.A.2, above.

	Range of Estimated Costs (*in dollars*)
Combiners for Shared (Broadband Panel) Antenna (UHF/VHF)	
New combiner, cost per channel (without antenna)	50,000 - 80,000
Adding a module to existing combiner (without antenna)	50,000 – 80,000
Combiner output splitting/switching for dual feed lines, if applicable	120,000
Electrical Service – A station installing replacement transmitter equipment may have to increase the power supply to the transmitter or perform other electrical work (*prices include labor and installation*).	
Service entrance 3 phase/800 amp/208 volt	13,700
Switchgear – industrial 800 amp	36,300
Transformer 3 phase/480v – 150 KVA	24,300
Transformer 3 phase/480v – 300 KVA	35,000
Transformer 3 phase/480v – 500 KVA	46,000
2” Rigid Conduit and Wiring (Cost per foot)	25
3” Rigid Conduit and Wiring (Cost per foot)	49
4” Rigid Conduit and Wiring (Cost per foot)	96
HVAC Service – Cooling only – A station installing replacement transmitter equipment may need additional cooling capability (*prices include labor and installation*).	
5 Ton system	19,250
10 Ton system	37,000
15 Ton system	53,000
25 Ton system	87,000
50 Ton system	164,000
HVAC Service – Heating and Cooling – A station installing replacement transmitter equipment may need additional air-handling capacity that includes both heating and cooling capability (*prices include labor and installation*).	
10 Ton system	57,500
15 Ton system	84,000

20 Ton system	110,000
30 Ton system	158,000
50 Ton system	253,000
Transmitter Building Addition – In limited situations, expansion of the transmitter building may be required to accommodate new equipment.	
Approx. 600-1500 square foot addition (costs vary with location, site access, and construction type)	variable

B. ANTENNAS

Most stations moving to a new channel will require new antennas. The price of an antenna does not include installation or removal of existing antennas (for those expenses, *see* Section II.D, Tower Equipment and Rigging). In some cases, new transmission lines will also be required (for those expenses, *see* Section II.C, Transmission Lines).

	Range of Estimated Costs (*in dollars*)
UHF – High Power Top Mount (200-1000 kW)	
One station antenna, horizontally polarized	150,000 – 235,000
One station antenna, elliptically or circularly polarized	180,000 – 275,000
Two station broadband panel antenna, horizontally polarized	240,000 – 520,000
Two station broadband panel antenna, elliptically or circularly polarized	325,000 – 730,000
Four station broadband panel antenna, horizontally polarized	285,000 – 740,000
Four station broadband panel antenna, elliptically or circularly polarized	528,000 – 1,036,000
UHF – Lower Power Side Mount	
One station –200-500 kW, horizontally polarized	125,000 – 180,000
One station –200-500 kW, elliptically or circularly polarized	150,000 – 216,000
One station antenna – medium power (50-200 kW), horizontally polarized	50,000 – 85,000
One station antenna – medium power (50-200 kW), elliptically or circularly polarized	56,000 – 98,000
Class A single station antenna – basic	12,000 – 25,000
Class A broadband panel (cost per panel)	825 – 1,200
Class A broadband panel (multiple channel array - example 4 panel complete array)	6,000 – 8,000
UHF – Broadband Slot, Side Mount	
8 bay, 5 kW input, directional, horizontally polarized	10,000
8 bay, 20 kW input, directional, horizontally polarized	42,000 – 57,000
8 bay, 20 kW input, directional, elliptically or circularly polarized	82,000

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16 bay, 8 - 10 kW input, directional, horizontally polarized	20,000 – 36,000
16 bay, 16 kW input, directional, horizontally polarized	43,000
16 bay, 40 kW input, directional, horizontally polarized	64,000 – 123,000
16 bay, 40 kW input, directional, elliptically or circularly polarized	157,000
24 bay, 15 kW input, directional, horizontally polarized	30,000
24 bay, 60 kW input, directional, horizontally polarized	145,000 – 181,000
24 bay, 60 kW input, directional, elliptically or circularly polarized	235,000
32 bay, 16 kW input, directional, horizontally polarized	71,000
32 bay, 32 kW input, directional, horizontally polarized	85,000
32 bay, 60 - 65 kW input, directional, horizontally polarized	120,000 – 200,000
UHF – Broadband Panel, Side Mount Aux/Interim	
10 kW input, low gain, horizontally polarized	30,000 – 45,000
45 kW input, low gain, horizontally polarized	100,000 – 135,000
High-VHF	
One station antenna – top mount, horizontally polarized	250,000 – 325,000
One station antenna – top mount, elliptically or circularly polarized	280,000 – 374,000
One station antenna – side mount, horizontally polarized	62,000 – 180,000
One station antenna – side mount, elliptically or circularly polarized	68,000 – 207,000
Shared broadband panel antenna – 5 station, elliptically or circularly polarized	700,000 – 890,000
High-VHF, Low Power	
Class A basic slot antenna – side mount, horizontally polarized	19,000 – 23,000
Class A basic slot antenna – side mount, elliptically or circularly polarized	23,000 – 26,500
Class A broadband panel (cost per panel) , horizontally polarized	4,000 – 5,000
Class A broadband panel (multiple channel array - example 4 panel complete array), horizontally polarized	16,500 – 19,800
Other	
Sweep test of transmission line and antenna	4,500 – 6,400
Elbow complex, single channel, at antenna input, per 3-1/8” feedline (if needed)	7,400
Elbow complex, broadband, at antenna input, per 3-1/8” feedline (if needed)	8,880
Elbow complex, single channel, at antenna input, per 4-1/16” feedline (if needed)	9,100
Elbow complex, broadband, at antenna input, per 4-1/16” feedline (if needed)	10,400

Elbow complex, single channel, at antenna input, per 6-1/8" feedline (if needed)	11,700
Elbow complex, broadband, at antenna input, per 6-1/8" feedline (if needed)	13,000
Elbow complex, single channel, at antenna input, per 7-3/16" feedline (if needed)	13,200
Elbow complex, broadband, at antenna input, per 7-3/16" feedline (if needed)	16,000
Elbow complex, single channel, at antenna input, per 8-3/16" feedline (if needed)	14,500
Elbow complex, broadband, at antenna input, per 8-3/16" feedline (if needed)	18,000
Side mount brackets for high power antennas (if not included in antenna base cost)	7,500 – 22,000
Pattern scatter analysis for side mount high/med power antennas (if not included in antenna base cost)	3,800 – 5,000
Note: For stacked antennas, the cost of the bottom antenna will likely double due to the increased cost of structural components, such as heavier steel and longer structures	

C. TRANSMISSION LINES

In some situations, transmission lines can be reused in the event of a channel change (*e.g.*, if the move is to a non-prohibited channel or if the transmission line is broadband capable). *See* Fig. 1 below. New transmission lines, if needed for purchase, are generally priced per foot, based on a length of 1,000 feet. The price generally includes elbows and hangers.

	Range of Estimated Costs (*in dollars*)
Flexible Transmission Line	
Line Diameter:	
7/8" foam dielectric	10
1 5/8" foam dielectric	23
7/8" air dielectric	17
1 5/8" air dielectric	31
3" air dielectric	56
4" air dielectric	70
5" air dielectric	100
Rigid Transmission Line – copper	
Line Diameter:	
3 1/8"	77 - 99
4 1/16"	99 - 135

6 1/8”	158 - 192
7 3/16”	276
8 3/16”	280 - 330
3 1/8” broadband	89 – 114
4 1/16” broadband	114 - 155
6 1/8” broadband	182 – 221
7 3/16” broadband	317
8 3/16” broadband	322 – 379

D. TOWER EQUIPMENT AND RIGGING

If replacement or additional antennas are required, it may be necessary to modify the existing tower or to construct a new tower. In addition to these expenses, a broadcaster replacing or adding an antenna would incur rigging costs.

	Range of Estimated Costs (*in dollars*)
Existing Towers – Towers without sufficient documentation of tower specifications may need to be mapped prior to completion of a tower load study.	
Tower mapping for an undocumented/poorly documented tower and preparation of documentation necessary for tower load study	16,000 - 25,000
Structural engineering tower load study for documented tower	5,000 - 12,000
Structural engineering tower load study for a documented tower with candelabra	15,000 - 19,000
Minor tower reinforcement/modifications (*see* Fig. 2 for sample minor modifications)	100,000 – 150,000
Major tower reinforcement/modifications (*see* Fig. 2 for sample major modifications)	300,000 – 400,000
Serious tower reinforcement/modifications (*see* Fig. 2 for sample serious modifications)	500,000 – 1,000,000
New Towers – Cost includes constructing a new tower, priced per foot.	
New tower between 1000’ and 1500’ without elevator, presumptive soil conditions	2,500
New tower between 1500’ and 2000’ without elevator, presumptive soil conditions	3,000
Note: Costs may be higher for tower sites with difficult soil or other site conditions and for towers with an elevator. Costs may be lower for towers under 1,000 feet	

Tower Rigging – Costs include fees paid to expert tower crews for equipment removal and installation, such as removing an existing antenna and installing a replacement antenna, and removing an existing transmission line and installing a replacement transmission line.	
Tall Tower (greater than 500')	100,000 – 200,000
Short Tower (less than 500')	60,000 – 80,000
Complex Tower (includes, *e.g.*, towers with candelabras and/or stacked antennas)	100,000 – 400,000
Helicopter Lift (*e.g.,* for a rooftop tower, complex tower, tall structure, or terrain constrained location requiring helicopter lift)	variable

E. INTERIM FACILITIES

Stations may need to use interim facilities in order to avoid prolonged off-air periods during the repacking or to enable stations to meet their construction deadlines. Some stations currently either have a licensed auxiliary facility or own backup equipment that they can repurpose for this use post-auction, while others may need to purchase or rent equipment or facilities.

	Range of Estimated Costs (*in dollars*)
Transmitter	
Stations may need additional transmitters for interim use on either their pre- or post-auction channels to permit continued operation during construction of their post-auction facilities. Existing auxiliary or backup transmitters may require retuning or replacement. Transmitter retuning and replacement costs are listed above.	
Antenna	
Interim antenna rental and installation – Costs will depend on antenna size and height and/or complexity of the tower.	35,000 - 110,000
For purchase of interim antennas and/or replacement of existing auxiliary antennas, *see* Section II.B.	
Transmission Line	
For additional transmission line, *see* Section II.C.	
Tower Equipment and Rigging	
Costs will be similar to those described in Section II.D, Tower Equipment and Rigging, above.	
Interior RF Systems – A station that needs an additional transmitter for interim use may need an additional interior RF system.	
UHF inside RF system including switching	140,000
VHF inside RF system including switching	75,000

F. SPECIAL CASES

1. Channel 14

Television broadcasters operating on Channel 14 are required to guard against interference with mobile use on frequencies 467-470 MHz. (*See* 47 CFR § 73.687(e))

	Range of Estimated Costs (*in dollars*)
RF Consulting Engineer (to determine correct mask filter to avoid interference)	5,000
Channel 14 Mask Filter	180,000
Additional field engineering time, 10-30 days (to test for interference after mask filter is installed)	20,000 – 60,000

2. Distributed Transmission Services (DTS)

Television stations operating DTS systems will incur engineering costs related to each DTS site (instead of, and not in addition to, the RF consulting engineer category in Section II.H, Professional Services, below).

	Range of Estimated Costs (*in dollars*)
RF Consulting Engineer (*priced per DTS site*)	
Critical Facility: "Critical" refers to operations that have signal overlap between adjacent DTS sites that are not terrain-shielded; such facilities will require exact power levels, signal synchronization, and antenna directional and elevation patterns to minimize interference between sites.	2,000 – 8,000
Terrain-Shielded Facility: "Terrain-shielded" refers to operations that serve regions that are terrain blocked from each other, resulting in less interference as compared to critical facilities.	1,000 – 2,500

3. AM Pattern Disturbance

Stations constructing or making significant modifications to an antenna tower in the immediate vicinity of an AM radio station are required to analyze whether such construction or modification would result in disturbance to the AM station's radiation pattern. If it would, the television station is required to notify the AM station of the disturbance and take measures to correct it. (*See* 47 CFR § 1.30000 et seq.)

	Range of Estimated Costs (*in dollars*)
Impact study: to assess the potential impact of tower construction or modification on AM radio stations.	2,500 – 7,500

Remedy: price includes installing the detuning apparatus or adjusting the existing detuning apparatus as necessary to restore proper operation of the directional or non-directional AM antenna, including before and after field measurements.	5,000 – 20,000

G. MISCELLANEOUS EXPENSES

1. DTV Medical Facility Notification

DTV broadcasters are required to notify nearby medical facilities of DTV channel changes pursuant to a condition in their construction permit.

	Range of Estimated Costs (*in dollars*)
Medical Facility Notification	2,000 – 11,000

2. Other

	Range of Estimated Costs (*in dollars*)
Obtain building permits from local zoning authorities (cost of preparation, submission, and prosecution of necessary forms or applications)	variable
Obtain local permits other than for zoning (cost of preparation, submission, and prosecution of necessary forms or applications)	variable
Coordinate with Bureau of Land Management and National Forest Service (this may be necessary for towers located on land managed by these agencies and would include the cost of preparing and submitting the relevant forms)	variable
Disposal Cost (for equipment and other waste, if applicable)	variable
Equipment Delivery and Handling Charges	variable
Equipment Storage	variable
Develop and Air Announcements of Upcoming Channel Change	variable
Notification to MVPDs of channel change	variable
Other Miscellaneous expenses	variable

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H. PROFESSIONAL SERVICES

Stations without sufficient internal resources, either at the station itself or at an affiliated station or company, may have to obtain professional services from an outside source to complete the station's channel relocation.

	Range of Estimated Costs (*in dollars*)
RF Consulting Engineer Fees	
Perform engineering study for new channel assignment and antenna development	2,000 – 7,000
Prepare engineering section of FCC Form 2100, Construction Permit Application	1,000 – 3,000
Prepare engineering section of FCC Form 2100, License to Cover Application	500 - 1,500
Prepare engineering section of FCC Form 2100, Construction Permit Application for an Auxiliary Antenna	500 – 2,000
Prepare engineering section of FCC Form 2100, License to Cover Application for an Auxiliary Antenna	500 - 1,500
Prepare request for Special Temporary Authorization	1,000 - 1,500
Attorney Fees	
Prepare and File FCC Form 2100, Construction Permit Application	750 - 5,000
Prepare and File FCC Form 2100, License to Cover Application	750 - 2,250
Prepare and File request for Special Temporary Authorization	750 - 3,500
Prepare and File FCC Form 2100, Construction Permit or License Application for an Auxiliary Antenna	500 - 2,000
Negotiation of Lease and other matters for Shared Locations	2,200 - 4,000
FCC Filing Fees (*adjusted biennially*)	
FCC Form 2100, license to cover application	325
Special Temporary Authorization request	190
Other Transition-Related Professional Service Costs	
Project management of the transition, if needed (cost per hour)	50 - 150
Prepare and/or review reimbursement form	750 - 2,500
Address transition timing and coordination issues with other stations and wireless	900 - 2,500
Field Engineering Fees	
Comprehensive coverage verification via field study, if needed	20,000 – 80,000

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RF Exposure Measurements (for sites where post-construction measurements have customarily been required or conducted)	3,000 – 20,000
Change in Structure Height Services: Modification to Antenna Structure Registration (ASR) (costs can be much higher for new towers)	
NEPA Section 106 environmental review, if needed	3,000 – 6,000
Environmental Assessment, if triggered by NEPA Section 106 review or for certain structures over 450 feet (cost in addition to NEPA review)	5,000 – 10,000
ASR modification (prepare FCC Form 854)	500 – 2,000
FAA consultant, including cost of preparing FAA Form 7460 (Notice of Proposed Construction), if needed for height increase	750 – 2,000

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MVPD COSTS

MVPDs that receive signals over-the-air may be required to make changes to their receive facilities in order to continue to receive a television station's signal that is changing channels. This table identifies the kinds of changes MVPDs may be required to make in order to continue delivering a repacked broadcaster's signal to its customers after the broadcaster has delivered its signal to the MVPD. Costs in this section will vary based on market size and the type of system utilized.

	Range of Estimated Costs (*in dollars*)
Equipment Costs	
New Receive Antenna – Installed. Necessitated if existing antenna is channel-specific or uses directivity to minimize interference from other stations. Some UHF and VHF broadband receive antennas should be able to continue receiving stations that are not changing bands.	1,500 – 2,000
New Receive Antenna – Hi-Gain Quad Antenna, installed	5,000 – 6,000
New Receive Antenna – uninstalled	500 – 1,000
New Receiver or other RF Processing Equipment (such as pre-amplifiers)	300 – 3,500
Coaxial cable – cost per foot (for MVPDs that install new receive antennas and/or receivers)	2 - 3
Structural or Capacity Augments for Towers (to meet new tower loading requirements as a result of installation of replacement equipment)	Varies by tower construction.
Tower Rigging – two-man crew (price includes removal of existing antenna and transmission line, if necessary, and installation of replacement equipment)	3,000 -5,500
Professional Services	
Structural Study of tower capacity (to determine if additional support is necessary for any replacement equipment)	1,500 -5,500
Engineering Study (to estimate receive strength of new channel assignments, capabilities of current equipment, and determine whether and what replacement equipment may be necessary)	1,500 – 3,500

III. FIGURES

Figure 1: Rigid coaxial line section lengths and the channels not supported.

Transmission line connects the transmitter or combiner output to the antenna, running from the equipment building up the tower to the antenna. While lines typically come in lengths of about 20 feet, the exact section length is determined by the station's assigned channel due to VSWR buildup from the repetitive connections between sections. After repacking, the transmission line may have to be replaced depending on whether the new channel is allowable for the existing line section length. This is principally an issue for lines that have been in use to feed a single-station antenna. Transmission line is usually "broadbanded" for use with shared antennas by making minor, non-repeating changes to the section lengths, designed for the channels involved.

The accompanying charts provide transmission line section lengths, and the channels that are prohibited for each length, based on two guard band intervals. Traditional practice was to utilize a guard band of approximately 3 MHz, while a smaller guard band can be considered for repacked stations to employ existing lines that are in in good condition. For a smaller guard band, stations should consult with the line's manufacturer and/or perform a sweep test of the transmission line to determine whether the line should be replaced for use on a new channel.

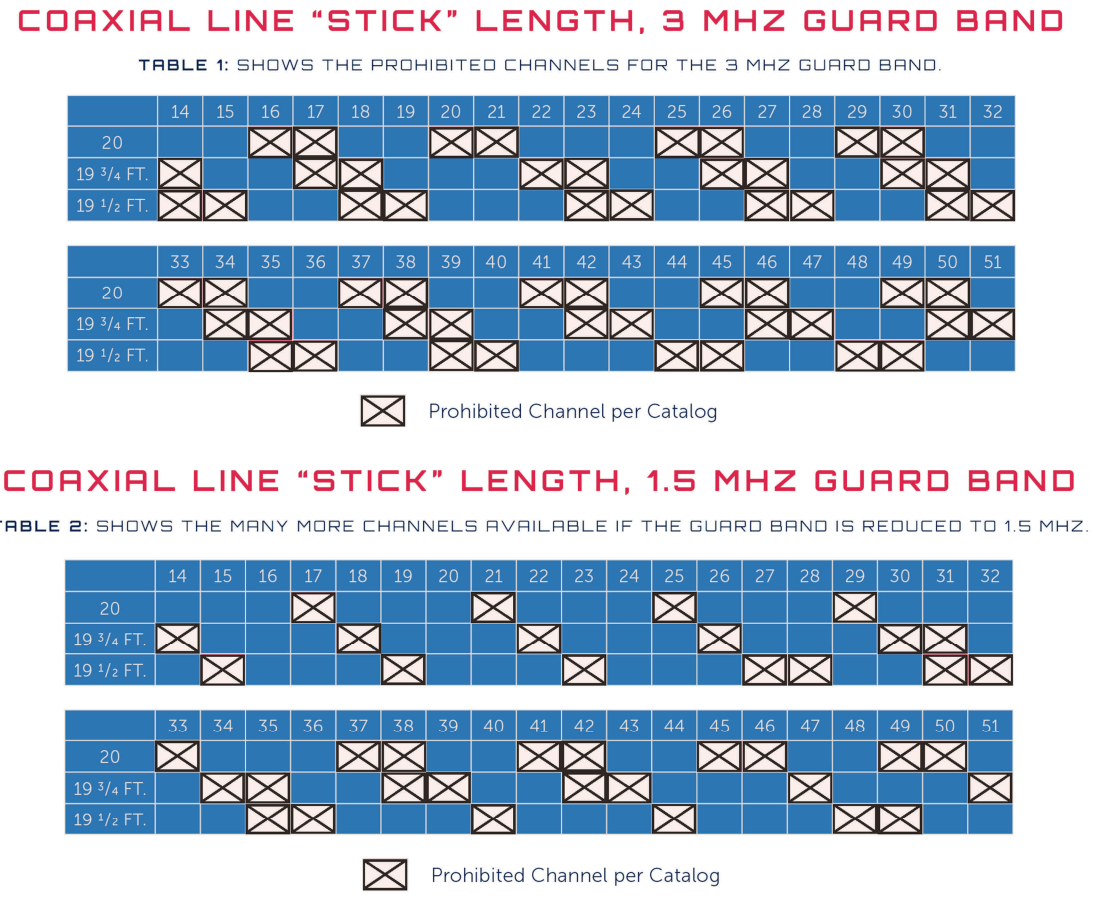

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Figure 2: Tower Modifications

This chart provides representative samples of minor, major, and serious tower modifications.

Tower Modifications		
Minor	**Major**	**Serious**
Guy wire retensioning	Guy wire replacement 2 to 3 levels	Guy wire replacement > 4 levels
Tension Diagonal replacement < 12 bays	Tension Diagonal replacement > 15 bays	Addition of guy levels
Horizontal (struts) reinforcing < 12 levels	Horizontal (struts) reinforcing > 15 bays	New Anchors for new guy levels
Leg reinforcing (addition of redundants)< 12 levels	Horizontal (struts) replacement > 15 bays	Replacement of tower sections
Minor foundation reinforcing at anchors	Leg reinforcing (addition of redundants) > 15 bays	Tension Diagonal replacement > 15 bays
	Leg reinforcing (requiring welding)	Horizontal (struts) reinforcing > 15 bays
	Tension/Compression Diagonal replacement	Horizontal (struts) replacement > 15 bays
	Tension/Compression Diagonal -requiring welding	Leg reinforcing (addition of redundants) > 15 bays
	Minor foundation reinforcing at base and anchors	Leg reinforcing (requiring welding)
		Tension/Compression Diagonal replacement
		Tension/Compression Diagonal -requiring welding
		Foundation reinforcing at base and anchors