

NGWS Equipment List

ATSC 3.0 Equipment

The following equipment may be necessary for a station to upgrade to ATSC 3.0¹. FEMA is not recommending any specific equipment vendor(s). This list was last updated May 8, 2023.

| Item | Category/Type | Description | Notes | Req/Depends/Opt |
|-------------------------------|---------------------|--|---|-----------------|
| Antenna Change | Labor and Equipment | Addition of vertical polarity antenna to increase coverage | Provides better support for indoor and mobile reception of ATSC 3 NextGen TV | Optional |
| Tower Structural Study | Labor | Tower integrity | Needed if any antenna or line modifications are required | Depends |
| Environmental Impact Study | Labor | Environmental Impact | Needed if any tower structural modifications are required | Depends |
| Tower Upgrade | Labor and Equipment | Structural work (includes rigging) | If needed based on antenna changes | Depends |
| Transmission Line Upgrade | Labor and Equipment | Handle increased power (based on 1,000') | Only if V-pol is added | Depends |
| Mask Filter | Labor and Equipment | Handle increased bandwidth | Only if sharp tuned filter | Depends |
| Transmitter | Labor and Equipment | Handle increased power (Solid State) | Depends on existing transmitter power rating and licensed ERP (50 kilowatts to 5 megawatts) Can be as low as \$15k per watt up to 5 kilowatts | Depends |
| Exciter | Labor and Equipment | ATSC 3.0 capable | Newer exciters may be software upgradable for ~\$5000 | Required |
| HVAC System | Labor and Equipment | Handle increased power | Depends on if transmitter power changes | Depends |
| Transmitter Building Addition | Labor and Equipment | 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) | Depends |
| Interim Facilities | Equipment | To maintain new and existing broadcasts during build-up/ switchover period | Required to maintain service if flash-cutting to ATSC 3.0 | Depends |

¹ Sources for the information include: 1) [PearlTV Host Station Manual v12](#); 2) [NAB-ATSC-3.0-Guide_Final.pdf](#); and 3) [Incentive Auction Task Force and Media Bureau Update Price Ranges In Catalog of Reimbursement Expenses for Full Power and Class A TV Stations and Multichannel Video Programming Distributors](#)

| Item | Category/Type | Description | Notes | Req/Depends/Opt |
|---|---------------------|--|--|-----------------|
| MVPD (Multi-channel Video Programming Distributor) | Equipment | Provide reception for redistribution | Consumer antenna and receivers for ATSC 3.0 broadcasts for those MVPDs who need it. In general, MVPDs or cable operators receive content via direct IP connection. Required if flash-cutting to ATSC 3.0 | Depends |
| STL Transmitter/Receiver | Labor and Equipment | Change to IP-based system | This could require an upgraded STL microwave/fiber link | Required |
| Scheduler/Broadcast Gateway | Equipment | Converts to ATSC 3.0 standard | Encapsulates data and works with ATSC 3.0 exciter | Required |
| Program Guide Generator | Equipment | Program schedule insertion | Provides electronic service guide data in XML | Required |
| Live Content Encoders | Equipment | HEVC/AC-4 standard for each program stream | Some existing encoders may be upgradable to HEVC/AC-4. Includes servers for transcoding and mezzanine content delivery | Required |
| Support Equipment including servers, racks, and virtualization software | Equipment | Equipment to support required function that may be virtualized | Some ATSC 3.0 function may involve physical equipment or may be virtualized | Optional |
| Support Equipment including IP Network equipment, UPSs, cables, and accessories | Equipment | Glue to connect everything, e.g., switches, routers, racks, power, UPS, cables, etc. | Specified for applicable protocols and speed | Required |
| UHD Net Pass-Thru | Equipment | Gear to pass-thru UHD | Depends on how network delivers UHD material, required if Master Control has not been upgraded to manage UHD | Depends |
| System Manager Software, Systems, and Services | Equipment | Handles setup and monitoring of system equipment | Automation and Orchestration Solutions for ATSC 3.0 | Optional |
| Non-Real-Time Encoders | Equipment | For optional second screen and apps | On-demand content, ad insertion, second screen | Optional |
| Emergency Alerting | Equipment | EAS Encoder/Decoder | Stations should already have this, extra expense only if existing needs replacement or upgrade | Optional |
| Advanced Emergency Alerting | Equipment | ATSC 3.0 Standard firmware upgrade to existing EAS gear | Opportunities for picture in picture, device wake up, extended imagery, etc. | Optional |
| Broadcaster Application | Labor and Equipment | ATSC 3.0 requires an application to "Watch TV" | Development of a branded application with features including support for advanced emergency alerting | Required |

| Item | Category/Type | Description | Notes | Req/Depends/Opt |
|---------------------------|-------------------------|---|--|-----------------|
| Watermarking | Equipment | ATSC 3.0 Watermarks | Audio and Video Watermarks are useful for broadcasters to deliver data | Optional |
| A3SA Certificates | Licensing/ Subscription | ATSC 3.0 Security Authority | Signal and Application signing are part of the ATSC 3.0 standards | Optional |
| System Integration | Labor | Contractor to install, configure and test | Putting all the pieces together | Required |
| Monitoring | Equipment | ATSC 3.0 specific notifications for issues affecting consumer reception | Servers to monitor for SNMP Traps, deliver email notifications, etc. | Optional |
| Test & Measurement | Equipment | Validation and troubleshooting for ATSC 3.0 broadcasts | Verification and validation of broadcast quality signal | Required |
| Resiliency and Redundancy | Equipment | Equipment to support better resiliency | Improve the overall resiliency (uptime) of broadcasts | Optional |
| RF Engineering | Labor | Expertise required for measuring RF contours | Required by FCC to show actual contours of RF reach. | Required |
| FCC and Legal | Labor | Filing fees, consultant, etc. | Permitting for construction, FCC filings, etc. | Required |

Radio Equipment

The following equipment may be necessary for radio stations desiring to upgrade existing or build-out new facilities for AM/FM, and/or HD Radio technologies². FEMA is not recommending any specific equipment vendor(s). This list was last updated May 23, 2023.

| Item | Category/Type | Description | Notes |
|--|---------------------|--|--|
| Air Cooled Solid State FM Transmitter | Labor and Equipment | 10 Watts - 40 kW Analog | For upgrading or replacing analog FM Transmitters, dependent on transmitter wattage consumption for desired station spectrum contours (smallest = 10 Watts) |
| Air Cooled Solid State FM Transmitter | Labor and Equipment | 10 Watts - 40 kW Hybrid | For upgrading or replacing hybrid (analog and digital) FM Transmitters, dependent on transmitter wattage consumption for desired station spectrum contours |
| Air Cooled Solid State FM Transmitter | Labor and Equipment | More than 40 kW Analog or Hybrid | Variable (requires a quote). For the largest stations to increase spectrum contours. |
| Liquid Cooled Solid State FM Transmitter | Labor and Equipment | 10 kW - 40 kW Analog | For larger stations upgrading or replacing analog FM Transmitters, dependent on transmitter wattage consumption for desired station spectrum contours (smallest = 10 kilowatts) |
| Liquid Cooled Solid State FM Transmitter | Labor and Equipment | 10 kW - 40 kW Hybrid | For larger stations upgrading or replacing hybrid (analog and digital) FM Transmitters, dependent on transmitter wattage consumption for desired station spectrum contours |
| Liquid Cooled Solid State FM Transmitter | Labor and Equipment | More than 40 kW Analog or Hybrid | Variable (Requires a quote). For the largest stations to increase spectrum contours. |
| HD Importer | Labor and Equipment | Manage Diversity Delay in HD Radio implementations | Importer and Exporter can be combined where feasible to manage Radio buffer delays between analog and digital. Cost is dependent on multiple factors, including the manufacturer, the amount of buffering, and external clocking (e.g., 10 MHz GPS disciplined clock source) |

² Sources for the information include: 1) Radio Station Construction Costs (doc.gov) https://www.ntia.doc.gov/legacy/otiahome/ptfp/application/equipcost_Radio.html; 2) Widelity Catalog of Potential Expenses and Estimated Costs for LPTV Stations, FM Stations, and Translators: <https://docs.fcc.gov/public/attachments/DA-19-176A2.pdf>; and (3) Broadcast Radio Links: <https://www.fcc.gov/media/radio/broadcast-radio-links#AM>

| Item | Category/Type | Description | Notes |
|---|---------------------|---|---|
| | | | required to synchronize the analog and digital signals for HD Radio. |
| HD Exporter | Labor and Equipment | Manage Diversity Delay in HD Radio implementations | Importer and Exporter can be combined where feasible to manage Radio buffer delays between analog and digital |
| Combined HD Importer/Exporter | Labor and Equipment | Manage Diversity Delay in HD Radio implementations | Combined Importer/Exporter for HD Radio |
| Additional Exciter | Labor and Equipment | Prepare the audio signal for transmission by boosting the power, amplitude and frequency modulation | If required for redundancy; most transmitters are shipped with one exciter. |
| Transmitter Installation | Labor | Includes daily rates and expenses | Varies depending upon geographic areas, transmitter sizes, and cooling requirements |
| Transmitter Building Site Survey | Labor | Includes daily rates and expenses | Varies dependent upon geographic areas, transmitter sizes |
| Service Entrance 3 Phase/800 amp/208 volt | Labor | Labor for transmitter modifications | A station replacing transmitter equipment may have to increase the power supply to the transmitter or perform other electrical work. Generally contracted at a fixed price. |
| Switchgear - industrial 800 amp | Labor | Labor for transmitter modifications | A station replacing transmitter equipment may have to increase the power supply to the transmitter or perform other electrical work. Generally contracted at a fixed price. |
| Transformer 3 phase | Labor and Equipment | 480V - 150 KVA = \$24,900 480V - 300 KVA = \$35,850 480V - 500 KVA = \$47,100 | A station replacing transmitter equipment may have to increase the power supply to the transmitter or perform other electrical work. Generally contracted at a fixed price per transformer size |
| Rigid Conduit and Wiring at 2", 3", 4" widths | Labor and Equipment | Cost per Width/Foot 2" = \$26/Foot 3" = \$50/Foot 4" = \$98/Foot | A station replacing transmitter equipment may have to increase the power supply to the transmitter or perform other electrical work. Generally contracted at a fixed price per foot for conduit width and length. |
| HVAC Service - Cooling Only | Labor and Equipment | Pricing based on tonnage: 5 Ton System = \$19,700 10 Ton System = \$37,900 | A station installing replacement transmitter equipment may need additional cooling capability. Generally contracted at a fixed price per HVAC tonnage. |

| Item | Category/Type | Description | Notes |
|------------------------------------|---------------------|--|--|
| | | 15 Ton System = \$54,300 25 Ton System = \$89,100 50 Ton System = \$168,000 | |
| HVAC Service - Heating and Cooling | Labor and Equipment | Pricing based on tonnage: 10 Ton System = \$37,900 15 Ton System = \$54,300 25 Ton System = \$89,100 50 Ton System = \$168,000 | A station installing replacement transmitter equipment may need addition air-handling capacity that includes both heating and cooling. In limited situations, expansions of the transmitter building may require accommodating new equipment (costs vary with location, site access, and construction type). Pricing includes labor and installation |
| Transmitter Building Modification | Labor and Equipment | Expansion of existing buildings to house new equipment. Variable costs are per ft ² | In limited situations, expansions of the transmitter building may require accommodating new equipment (costs vary with location, site access, and construction type). Pricing is per square foot. |
| Remote Control | Labor and Equipment | Remote site management and tower control for lighting and positioning | For stations that must rebuild permanent facilities only |
| RDS Encoder | Labor and Equipment | Radio Data System encoders send broadcast data at 1187.5bps over the FM subcarrier at 57KHz | For stations needing a replacement or redundant RDS encoder. The RDS encoder can also deliver emergency alerts when connected to EAS Systems |
| Audio Processing | Labor and Equipment | Analog Basic Analog/HD Basic Analog/HD Upgraded | For stations that must rebuild permanent facilities only. Pricing varies based on the type of audio being processed. Audio processing includes compression and limiting, exciters, and pre-emphasis which should be disabled for HD Radio |
| AM Antennas | Labor and Equipment | Refer to Existing Tower Reinforcement and New Tower Costs | AM antenna is the tower itself to allow for proper ground radiation of AM signals. Directional AM stations require 2 or more antenna towers, plus lightning protection, and directional sampling loops. Variable costs (requires a quote) dependent on FCC approved class of station and contours (power and size) and tower(s) locations. |

| Item | Category/Type | Description | Notes |
|--|---------------------|--|--|
| FM Low-Power Antennas | Labor and Equipment | 200 Watt to 1 kW Log-Periodic 200 Watt to 1 kW Yagi 200 Watt to 5 kW Vertical, Horizontal or Circularly Polarized | Most FM stations building a separate facility will require a new antenna. The price of an antenna does not include installation or removal of existing antennas. Antenna prices do not include radomes or de-icing equipment. All antennas are rated based on input power and priced per bay. |
| FM High-Power Antennas - Circularly Polarized | Labor and Equipment | 6 kW to 10 kW 11 kW to 25 kW 26 kW to 50 kW 51 kW to 100 kW 26kW to 50 kW Panel (3 panels per bay) | Most FM stations building a separate facility will require a new antenna. The price of an antenna does not include installation or removal of existing antennas. Antenna prices do not include radomes or de-icing equipment. All antennas are rated based on input power and priced per bay. All High-Power Antennas are Circularly Polarized |
| Translators - 51 to 100 kW Panel (3 panels per bay) | Labor and Equipment | Low-powered FM retransmission complements primary FM service | Extends the coverage of the primary FM station |
| Translators - more than 100 kW | Labor and Equipment | Complements the primary FM service | Extends the coverage of the primary FM station. Variable costs (requires a quote) dependent on size and location of translator station |
| Translators - Directional antenna fabrication and testing | Labor and Equipment | Complements the primary FM service | Extends the coverage of the primary FM station. Variable costs (requires a quote) dependent on size and location of translator station |
| Translators - Dual polarization antennas, H-only or V-only antennas more than 2 kW | Labor and Equipment | Complements the primary FM service | Extends the coverage of the primary FM station. Variable costs (requires a quote) dependent on size and location of translator station |
| Translators - Broadband (community or combined) antennas | Labor and Equipment | Complements the primary FM service | Extends the coverage of the primary FM station. Variable costs (requires a quote) dependent on size and location of translator station |
| Other Antenna-Related Items - Antenna Sweep | Labor and Equipment | Calculate the response of the antenna across frequencies | Dependent on antenna type and polarization |
| Other Antenna-Related Items - New FM Combiner | Labor and Equipment | Combine signals of several transmitters and translators into one antenna system | Depends on power input and minimum frequency separation. Cost is per channel. |

| Item | Category/Type | Description | Notes |
|--|---------------------|---|---|
| Other Antenna-Related Items - FM Band Pass Filter | Labor and Equipment | Reject frequencies outside of the FM range 87.5 to 108 MHz | Depends on power input and number of sections. |
| Other Antenna-Related Items - Notch Filter | Labor and Equipment | Stop frequency interference within the narrow FM channel range | Depends on power input and number of sections. |
| Other Antenna-Related Items - Mounting Brackets | Labor and Equipment | | Variable costs (requires a quote) depend on number and types of brackets. |
| Other Antenna-Related Items - De-Icers | Labor and Equipment | | Pricing per bay |
| Other Antenna-Related Items - Radomes | Labor and Equipment | Weatherproof Antenna enclosures | Pricing per bay |
| Flexible or Rigid Transmission Line | Labor and Equipment | Flexible transmission line foam dielectric - 1/2" to 1-5/8" Flexible transmission line air dielectric - 1-5/8" to 4" Rigid transmission line - 7/8" to 4-1/6" | RF plumbing for inside the transmitter building between transmitter and transmission line leaving the building. Prices generally include elbows and hangers. Cost is per foot. New transmission line, if needed, is priced per foot based on a length of 1,000 ft |
| Existing Tower Reinforcement - tower mapping and report for structural engineer | Labor | Towers without sufficient documentation of tower specifications may need to be mapped prior to completion of a tower load study. | FM Broadcasters replacing or adding an antenna may incur rigging, installation, and removal costs. In addition to these expenses, it may be necessary to modify the existing tower or construct a new tower to accommodate the additional antennas. |
| Existing Tower Reinforcement - structural engineering study for guyed or free-standing tower | Labor | Towers without sufficient documentation of tower specifications may need to be mapped prior to completion of a tower load study. | FM Broadcasters replacing or adding an antenna may incur rigging, installation, and removal costs. In addition to these expenses, it may be necessary to modify the existing tower or construct a new tower to accommodate the additional antennas. |
| Existing Tower Reinforcement - structural | Labor | Towers without sufficient documentation of tower | FM Broadcasters replacing or adding an antenna may incur rigging, installation, and removal costs. In addition to these expenses, it |

| Item | Category/Type | Description | Notes |
|--|---------------------|---|--|
| engineering study for candelabra tower | | specifications may need to be mapped prior to completion of a tower load study. | may be necessary to modify the existing tower or construct a new tower to accommodate the additional antennas. |
| Existing Tower Reinforcement - tower reinforcement | Labor and Equipment | Towers without sufficient documentation of tower specifications may need to be mapped prior to completion of a tower load study. | Variable costs (requires a quote) dependent on location, size, and power requirements. FM Broadcasters replacing or adding an antenna may incur rigging, installation, and removal costs. In addition to these expenses, it may be necessary to modify the existing tower or construct a new tower to accommodate the additional antennas. |
| New Tower Construction | Labor and Equipment | towers shorter than 500' towers between 500' and 1000' towers over 1000' | Costs includes constructing a new tower, per foot; costs may be higher for tower sites with difficult soil conditions. Footings, piers and foundations, and guy anchors may not be included in price |
| Rigging and Antenna Installation/Removal | Labor and Equipment | towers shorter than 500' towers between 500' and 1000' towers over 1000' Complex tower (candelabras, stacked antennas, terrain-constrained) | Fees paid to tower crews to install/remove antennas and/or transmission line |
| Rigging and Antenna Installation/Removal | Labor and Equipment | Helicopter installation/removal (for antennas on top of high-rise buildings, a complex tower, or tower that is terrain-constrained so that antennas cannot be lifted using a gin pole or winches) | Variable costs (requires a quote) dependent on location, size, power. Fees paid to tower crews to install/remove antennas and/or transmission line. |
| Temporary Tower Rent | Licensing | | Variable costs (requires a quote) dependent on location, size, power requirements. |
| RF Consulting Engineer Fees | Labor, Licensing | Prepare Engineering Section of Construction Permit | 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 vendor to complete the various aspects of the station's channel relocation |
| RF Consulting Engineer Fees | Labor, Licensing | Prepare Engineering Section of License to Cover | |

| Item | Category/Type | Description | Notes |
|-----------------------------|------------------|--|---|
| RF Consulting Engineer Fees | Labor, Licensing | Prepare Engineer STA | |
| RF Consulting Engineer Fees | Labor, Licensing | Prepare Form 601 | |
| Attorney Fees | Labor, Licensing | Prepare and file Construction Permit | |
| Attorney Fees | Labor, Licensing | Prepare and file License to Cover | |
| Attorney Fees | Labor, Licensing | Prepare and file STA | |
| Attorney Fees | Labor, Licensing | Lease negotiations or other legal matters | |
| Other Professional Fees | Labor | Project Management, if needed | Costs per hour |
| Other Professional Fees | Labor | Prepare and/or review reimbursement forms | |
| Other Professional Fees | Labor | Form 399 assistance or other Program Management Costs | Variable costs (requires a quote) depend on assistance needed |
| Field Engineering | Labor | Outside engineering assistance | Cost per day |
| Field Engineering | Labor | Coverage verification of new primary facility | |
| Field Engineering | Labor | AM Pattern disturbance study/remediation | |
| Field Engineering | Labor | RF Exposure Measurements | |
| FCC Filing Fees | Labor, Licensing | FCC Form 301/340 Minor/ Major Change Construction Permit | From 2018 Filing Fee Guide. |
| FCC Filing Fees | Labor, Licensing | FCC Form 302 or 350 FM License to Cover (non-directional or directional antenna) | From 2018 Filing Fee Guide. |

| Item | Category/Type | Description | Notes |
|--|---------------------|---|--|
| FCC Filing Fees | Labor, Licensing | - FCC Form 359 FM Translator Major Change Construction Permit | From 2018 Filing Fee Guide |
| Equipment Disposal, Storage, Delivery and Handling | Labor and Equipment | | Variable costs (requires a quote) dependent on location and amount, types, and sizes of equipment |
| Point to Point Microwave (STL/ICR) - Frequency Coordination | Labor and Equipment | Microwave Studio to Transmitter Link | Per license - 2 needed for bi-directional link |
| Point to Point Microwave (STL/ICR) - Unlicensed systems | Labor and Equipment | Microwave Studio to Transmitter Link | Includes antennas attached to radios. Larger antennas are additional |
| 6/11 GHz Licensed Part 101 Systems | Labor and Equipment | Microwave Studio to Transmitter Link | Price includes 6-foot antennas. Single link and redundant systems are included in this price range |
| 950 MHz Licensed Part 74 Systems | Labor and Equipment | Microwave Studio to Transmitter Link | Price includes 6-foot antennas. Single link and redundant systems are included in this price range |
| 1 pair IP-only Codecs for fiber, internet, or IP microwave systems | Labor and Equipment | Microwave Studio to Transmitter Link | System to support IP-based streaming for STL. |