



Orange County Sheriff's Department Technology Division



Emergency Responder Radio Communications Systems

Subject: BDA - Implementation Guidelines & Support

6-19-2024

The Orange County Sheriff's Department, Technology Division is responsible for the operation and maintenance of the Countywide Coordinated Communications System (CCCS) 800MHz Simulcast P-25 trunked radio system. As the license custodian, the department issues authorization for all radio transmitters communicating through this system in accordance with FCC regulation CFR 47 Part 90. This includes all In-Building Emergency Responder Radio Communications Systems (e.g. ERRCS, ERCES or BDA systems).

As required by NFPA, CFC, County of Orange, and local City ordinances the owner of any building within the county is responsible for the installation and maintenance of an ERRCS system if radio coverage within their building is inadequate to support reliable two-way radio communications via the CCCS or any other dedicated Public Safety radio system(s) serving the building in question.

The intent of this document is to assist the building owner and their contracted system installation team in securing approval for construction, verification of operation and ultimately approval for continuing operation of the required ERRCS.

It is the responsibility of the contractor to execute all steps in proper order and secure all permissions and permits PRIOR TO construction or activation. Failure to do so may result in delays, penalties or denial of approval to operate a given system.

The system shall not be left in a powered-on state, with donor antenna connected, except for testing during regular business hours, until final inspection has been completed and final approval has been issued by OCSD/COMM.

This document is effective 1 July 2024 for all initial submittals or projects received on or after that date.

ALL email correspondence regarding ERRCS matters should be directed to ERRCS@ocsheriff.gov. Correspondences to other addresses may not be reviewed or responded to.



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Conventions used in this document:

AHJ	Agency Having Jurisdiction
ALC	Automatic Level Control
Band 14	Specific frequencies in the 700MHz range dedicated to First Net operation
BBU	Battery Back-Up Unit
BDA	Bi-Directional Amplifier
CCCS	Orange County 800 MHz Countywide Coordinated Communications System
CFC	California Fire Code
CLASS "A"	A signal booster designed to retransmit channelized signals within a narrow (<75KHz) frequency band
CLASS "B"	A signal booster designed to retransmit any signals within a wide frequency band
DAQ	Delivered Audio Quality "A measure of audio quality over a transmission medium"
DAS	Distributed Antenna System - Distributed antennas within the facility fed by the BDA
DL	Down Link – signal from hilltop repeater/base station to portable
DONOR ANTENNA	Primary antenna providing the R.F. link between the BDA and the Local Cell signal
DONOR SITE	Assigned repeater site providing down-link signal to be amplified throughout the subject building
ERCES	Emergency Responder Communications Enhancement System
ERRCS	Emergency Responder Radio Communications System
ESMR	Frequencies in the 816-824MHz and 861-869MHz now allocated to Common Carrier use
FACP	Fire Alarm Control Panel
FBER	Frame Bit Error Rate
FCC	Federal Communications Commission
GROL	FCC General Radio Operator License
IBWAVE	Telecom radio system planning software
LOS	Line of Sight
LBR	Link Budget Report
NICET	National Institute for Certification in Engineering Technologies
NFPA	National Fire Prevention Association
OCFA	Orange County Fire Authority
OCS	Orange County Sheriff's Department
OCS/COMM	Orange County Sheriff's Department – Technology Division
PDF	Portable Document Format
POTS	Plain Old Telephone Service
RANPLAN	Network planning and optimization software
SINR	Signal to Interference Plus Noise reference value
TPC	Third Party Contractor
TPT	Third Party Test
TSU	Technical Services Unit – OCS, Technology Division
UL	Uplink – Signal from portable to repeater
UPS	Uninterruptable Power Supply



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Application and Approval Process

- 1) For initial submittal, OCSD/COMM requires the ERRCS/BDA/DAS system designer to provide the following for pre-evaluation and issuance of Cell-Site assignment for each individual project:
 - a. Project Name.
 - b. Site address.
 - c. Project description, size of building, number of floors above and below grade, proposed ERRCS design description.
 - d. Contractor contact information including name, address, phone and email address for both designer and installation provider.
 - e. Proposed BDA Model (S/N if available).
 - f. Proposed mode of operation (Class A or Channelized Class B).
 - g. Proposed project timeline.

This information is to be submitted via email to errcs@ocsheriff.gov.

- 2) OCSD/COMM will respond with a Project Initiation form containing:
 - a. A case number to be used in all correspondence regarding the project.
 - b. A list of required frequencies to be supported and donor site(s) to be used.
 - c. Instructions and credentials to be used for transferring plans and associated documents directly to a dedicated portal established for the project.
- 3) Designer will then complete the design and submit plan set in digital format to the assigned portal for approval.
 - a. See APPENDIX A for minimum design requirements.
 - b. See APPENDIX B for submittal format requirements.
 - c. NOTE: Local ordinance will determine whether contractor is to submit to local jurisdiction or OCSD/COMM at this point.
 - d. Submittal must be compliant with the local Fire Jurisdiction and planning department's requirements and at minimum shall be based on Architectural size D (36" x 24") building prints (in PDF) and must include:
 - I. Site Address
 - II. Building number assigned to project (if available)
 - III. Description of building (number of floors above/below grade, type of construction)
 - IV. Proposed location of all powered system equipment within structure
 - V. BDA type, model#, (SN# if available)
 - VI. BDA FCC ID# (Type Acceptancy Approval for the device)
 - VII. Customer contact (name, tel., address)
 - VIII. Contractor contact (name, tel., address)
 - IX. Proposed operational configuration (Class A or Channelized Class B)



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- X. Full materials list
 - XI. Schematic (Riser) drawing of system including
 - a. Up and down link power projections at all junctions
 - b. All building floors/levels including those without system components
 - XII. Floor plans for all floors (including those without BDA components)
 - XIII. Exterior elevations for all exposures
 - XIV. Proposed heat maps (typ. IBWAVE or RANPLAN) for all floors
 - XV. Manufacturer's data sheets for all components except small hardware
 - XVI. Proposed project completion date
- 4) OCSD/COMM will review design to determine acceptability for operation within the CCCS and any requirements for modification or correction. Once accepted a letter of approval will be provided by OCSD/COMMS. Construction may not commence until receipt of approval. Additional permits may be required by the AHJ for each project.
- 5) Submit as hard copy (per local planning department requirements) the appropriate number of plan sets for stamping, if required. This step may have been required in item 3 by local ordinance.
- a. Deliver and retrieve plan sets at our Service Desk
OCSD Technology Center
1382 Bell Ave.
Tustin, CA 92780
- 6) On completion of construction, the contractor is to request via e-mail to OCSD/COMM for a unique Site ID and FCC Registration Number. This submittal shall contain the following as-built details:
- a. Project Name, Site Address and case number.
 - b. BDA location within building (Floor & Room #).
 - c. BDA type, model# and Serial Number(s) of all active components.
 - d. On-site customer contact available 24/7 to provide access to all equipment (building owner/manager, name, telephone number, address, email).
 - e. Installation Contractor contact (name, telephone number, address, email).
 - f. Actual operational configuration (Class A or B) including number of filters and bandwidth(s) used in 700/800MHz.
 - g. Phone number of line used for auto dialer.
 - h. Digital images of system installation showing:
 - i. Amplifier(s) (all)
 - ii. Power Supply
 - iii. AC Service Disconnect(s)
 - iv. Auto Dialer



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- v. Donor Antenna(s) showing LOS path to Donor Site(s)
- vi. Required labeling (image must be readable)
- i. Final As-Built documents.
 - i. Full plan and materials submittals with any changes or variances noted.

NOTE: Items a-g are to be listed on a single page, or as email content. The images required in item h are not to be used to provide the required information, only as visual verification.

(Note: please allow a minimum of 3-5 working days for grant of Site ID and FCC Registration Number.)

- 7) On acceptance of the submittal in item 6, OCSD/COMM will issue the ORANGE COUNTY SITE ID and FCC Site Registration Number. The BDA auto dialer will be programmed by the contractor or third-party technician with the assigned ORANGE COUNTY SITE ID to call the County paging system and demonstrate operation with OCSD Communications staff. No Approval to Operate will be granted without successful completion of this test.
 - a. **NOTE: New systems shall not be enabled without prior coordination with OCSD/COMM System Watch (714) 628-7020. NO EXCEPTIONS!**
 - b. See APPENDIX D for details on proper configuration and testing of the auto-dialer.
- 8) For final approval a third-party evaluation and report must be submitted to OCSD/COMM and the Fire Agency having jurisdiction.
 - a. Test and report requirements are described in APPENDIX E
 - b. Test date is to be coordinated in advance with both the Fire Agency having jurisdiction and OCSD/COMM, NO EXCEPTIONS.
 - c. The Third Party Test is to be performed by an FCC licensed General Radio Telephone Operator (GROL) who is qualified and certified to inspect BDA installations to ensure compliance with operational specifications as called out in CFR 47, Part 90 §90.219. Proof of FCC license and ERRCS training must be included with the report.
 - 1. At present, OCSD/COMM does not perform the third party testing.
 - 2. Submit in PDF form the third party test report to OCSD/COMM for review.
 - d. In order to assure that the portable devices used to perform DAQ (voice quality) testing most closely match the performance of units used by agencies operating on the OC CCCS OCSD Technology Division provides test kits consisting of two Motorola portable radios for loan to testing agencies on a 48 hour basis. These units can be secured by contacting our Service Desk (714 704-7999) and requesting the "BDA test radio Kit" for loan.
 - 1. It is not currently the County's policy to allow non-Public Safety entities to provide their own radios for programming on this system.
- 9) On review and acceptance of the Third Party Test Report and As-Built documents OCSD/COMM will provide written confirmation and approval to operate the ERRCS system. This approval is valid for one year from grant date and must be renewed by receipt of a compliant annual review from a qualified Third-Party testing agent.
- 10) Make and store copies on site as shown in Appendix C Section 11.
 - Please contact this office if you have any questions.



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APPENDIX A

BDA System Design Requirements:

- 1) Refer to APPENDIX B for detailed submittal requirements.
- 2) Contractor is fully responsible for the 700/800MHz BDA system design and compliance with the requirements set forth in CFC 510 and CFR 47, FCC Part 90, §90.219 and this document.
- 3) BDA coverage shall be based on operation with fire door(s) closed.
- 4) BDA system shall be fully capable of frequency modification and programming without requiring removal from property.
- 5) Shall be capable of supporting both analog and digital modulation.
- 6) Class B devices must support Channelization capable of encompassing all assigned frequencies.
 - a. Each filter must be capable of independent gain adjustment and uplink squelch operation.
 - b. Each filter must exhibit channel delays less than 20us.
 - c. Filters shall not exceed 150kHz bandwidth without written approval.
 - d. Filter bandwidth of 75KHz is considered optimal.
- 7) Operational Frequencies:
 - a. Must be operational on both 700MHz and 800MHz Public Safety bands.
 - b. Operate on all assigned CCCS 800MHz and 700MHz frequencies and sites assigned during initial submittal.
 - c. Frequencies not specifically assigned by OCSD are not to be passed by system without approval from the appropriate licensee in addition to OCSD approval for operation on OC frequencies.
 - d. Intentional retransmission of any frequencies other than those assigned by OCSD/COMMS must have approval from the license custodian of those frequencies.



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- 8) System Gain and Transmitted Power
 - a. System shall be designed to minimize amplifier downlink gain required to achieve required signal strength in all areas.
 - i. Service antenna placement and downlink gains shall be designed to prevent RF leakage and to avoid downlink levels exceeding -75dBm at or near the building interior perimeter
 - ii. Service (DAS) antennas shall be located to minimize the range of uplink power presented to the DAS antenna input of any amplifier, which should vary by not more than 20dB (minimum to maximum projected signal from portable devices operating within the structure(s)) and arrive at the amplifier fully within the device's functional AGC range.
 - iii. RF Leakage from the system shall not present a measured level in excess of 15dB below the measured Donor signal from any assigned Cell at ground level in the immediate area (3-25') from the building perimeter.
 - b. Uplink gain is not to exceed 65dB without prior approval.
 - c. Uplink transmissions are not to exceed 27dBm at donor port of amplifier and not to exceed 37dBm ERP without prior approval from OCSD COMMS.
 - d. Uplink transmissions are to reach the assigned Donor site(s) at per-channel levels not less than -95dBm and not greater than -75dBm.
 - e. Design is to assume a portable transmit level of 34dBm.
- 9) Uplink Muting shall be utilized with the Mute threshold set between -75dBm and -85dBm. The system shall be designed to provide reliable operation presenting uplink signal from any interior location to the amplifier input at not less than -80dBm.
- 10) BDA system shall be new product and supported by manufacturer for seven years after installation.
- 11) BDA system shall be equipped with Battery backup (preferred) or Uninterruptable Power Supply (UPS) system providing not less than 24 hour operation of amplifier and all peripheral devices at full power.
- 12) Alarms and Error Reporting
 - a. The BDA alarm outputs shall be connected to the facility FACP as required by current Fire Code(s).



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- i. If FACP is not located in view of master amplifier, a local status display must be provided showing all monitored alarm conditions. This may be integrated to the amplifier, Battery Backup Unit, or external device.
- b. Amplifier and BBU alarms shall be interconnected so that all alarms are delivered to both units and any external devices.
 - i. All BDA alarms shall be transferred to BBU for display and logging if BBU is so equipped.
 - ii. All BBU alarms shall be delivered to Master Amplifier for the purpose of alarm logging and status display allowing user connected to remote management port on amplifier to view both BDA and BBU alarms.
- c. BDA system shall be equipped with auto-dialer system driven by the system alarm outputs. The BDA auto dialer shall be programmed to report the assigned SITE ID to the County 900MHz paging system via dedicated telephone line (POTS) or cellular auto dialer. In the event of loss of commercial power, the Auto dialer will be supported by battery backup, providing a minimum of 24 hours of operation.
 - i. The Auto-dialer back up battery shall be fitted with a properly sized, intelligent battery charger which will automatically recharge the Auto-dialer backup battery upon restoration of power. The Auto-Dialer may be powered by the master amplifier's BBU provided sufficient run-time can be provided.
 - ii. The system shall be capable of providing SNMP based alarms to specified servers.
- d. NOTE: It is the County's intent to discontinue use of the auto dialer driven paging system within the next 5 years. Details regarding replacement of existing systems and implementation of alternative status reporting will be provided in future releases. To this end, all new installations must be capable of supporting SNMP based alerting and remote operation via IP connectivity.

13) Programming and Error Log Access

- a. The system shall support programming (local and remote) via Ethernet connection for the purpose of programming and error log review (universal browser based interface preferred).

14) Donor antenna(s) to be minimum 13dBd (15dBi) gain directional, have 30dB front to back ratio, designed to operate through the 700 and 800MHz bands and must be one of the following designs:

- a. Exterior rated enclosed panel (preferred).
- b. Welded construction Yagi with anodized finish (with written approval).



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- c. Corner reflector with anodized finish (with written approval).
- 15) Indoor antennas shall be at the minimum 700 / 800 MHz compliant.
- a. Indoor multi-band antennas for BDA/DAS and cell phone coverage may be approved based on the building owner requirement and overall system design.
- 16) BDA system design shall not utilize reactive "Tee" type connectors exhibiting less than 20dB isolation between ports for power division. Inductive couplers or isolated splitters are required.
- 17) Power dividers must be rated for maximum possible system power.
- 18) All antennas shall be assigned unique alpha-numeric identifiers which shall be shown in all line drawings, documentation and floor plans.
- 19) All antenna feed line segments, fiber optic cables and signal jumpers in excess of 6' shall be assigned unique alpha-numeric identifiers which shall be shown in line drawings, documents and floor plans.
- 20) Systems shall be capable of supporting the maximum number of 700 / 800 MHz frequency pairs as assigned to the project by the FCC licensee(s). The Loma Ridge site, for example, comprises three trunked systems with a total of 53 channels. The composite power of 53 carriers is approximately 17dB higher than a single carrier.
- 21) The BDA system shall include anti-oscillation circuitry and be designed with adequate isolation to preclude BDA oscillations that impair / degrade the donor public safety 700 / 800 MHz systems.
- 22) The BDA system shall include ALC circuitry on the uplink, as a minimum, to ensure that intermodulation and other spurious products are not generated and transmitted to the donor site.
- 23) The BDA system shall be designed and tested to ensure that noise and spurious emissions do not degrade the performance of the donor site or any other FCC licensed system.



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- 24) The transmitted noise and spurious interference, measured within a 10 kHz bandwidth at the donor antenna shall not exceed -43dBm and in no case shall result in a calculated noise level at the donor site greater than -150dBm.
- 25) The constructing contractor is to be responsible for addition of any additional filtering or devices required to prevent interference to unrelated systems or frequencies not approved for retransmission under the Approval to Operate document provided on completion of construction and testing.

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APPENDIX B

Minimum Submittal Requirements

The Orange County Sheriff's Department, Communications and Technology Division is responsible for the operation and maintenance of the Countywide Coordinated Communications System (CCCS) 800MHz Simulcast P-25 trunked radio system. As the license custodian, the department is responsible to issue authorization for all radio transmitters not requiring individual FCC licensing for operation within this system. This includes all In-Building Emergency Responder Radio Communications Systems (ERRCS) (BDA systems).

As required by NFPA, CFC and Orange County ordinances the owner of any building within the county is responsible to install an ERRCS system if radio coverage within their building is inadequate to support normal two-way radio communications through the CCCS.

It is the intent of this document to assist the building owner or their contracted system installation team in securing approval for construction, verification of operation and ultimately approval for continuing operation of the required In-Building (ERRCS) system.

Prior to construction of an in-building radio amplifier System (ERRCS), the Orange County Sheriff's Department, Communications Division as the license custodian for the 800MHz radio system (CCCS) must review and approve the design prior to the commencement of installation.

The use of a standardized format and content in all submittals will greatly reduce the potential for delays caused by repeated resubmittals required to assure complete and accurate documentation. To that end, the following minimum requirements for standardized submittals have been established.

1. All submittals for OCSD review shall be submitted in PDF form.
 - a. Preferred format is a single document containing all required content.
 - b. As an alternative, the submittal may consist of two files, one containing the BOM and all Material data sheets and the second containing all other content.
2. Filenames shall contain the project name and date of filing, revision number may also be included in file name.
3. If submitted as separate Plans and Materials Files, the file name must indicate the content.
 - a. If submitted as separate files, both files must contain matching materials lists.
4. Every effort to maintain the file size below 100MB is to be made, including using multiple files for plan sets relating to multiple buildings.
5. File Resolution must provide clear images and text at Zoom levels to at least 250%.



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6. Supporting source files (Excel, Word, ibwave, Etc) may be submitted to assist in review but all content must be represented in the one or two pdf files described in para 1 a & b above.

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DESIGN SUBMITTAL

Construction of ERRCS systems require the contractor to obtain building permits from the local authority. Approval of the design by OCSD is often required as a precursor to grant of such construction permits.

Official Submittals are processed through the appropriate Building Permits Department for the city or county region in which the construction will take place. Multiple paper copies in the quantity required by the local authority and a digital copy for OCSD records will be submitted. These will either be forwarded to OCSD Communications by the City or by the contractor depending upon the locality involved.

System Design and As-built submittals shall be formatted as described below and include the following data:

1. Format – Construction (Engineering) print:
 - a. Size – As required by local jurisdiction
 - b. Minimum Architectural D (36" x 24")
 - c. All pages of digital copy must be of the same dimension.
 - d. Material data sheets may be submitted as a separate document in booklet format, 8.5" x 11.5" with cover sheet and full materials list included.

2. Cover page showing:
 - a. Project Name and Address
 - b. Building description including:
 - i. Usage
 - ii. Construction type
 - iii. Number of floors above and below grade
 - iv. Proposed Square footage
 - c. Property Owner Contact Information
 - d. Contractor's Contact information
 - e. Vicinity map showing property location
 - f. Scope of work
 - g. Proposed start and finish dates of project
 - h. Full description of concept including any phases represented or connection to existing or future elements
 - i. Document Index



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3. Subsequent pages shall each contain:
 - a. Project Name
 - b. Revision
 - c. Page Identifier
 - d. Page description

4. Floor Plans, Exterior Elevations and Area drawings shall also contain:
 - a. Legend
 - b. Scale / dimensions (graduated ruler, not relational scale ("1'=20'" is not acceptable))
 - c. Compass orientation
 - d. Unique identifier of all components shown including major cable segments.

5. Document content pages sufficient to provide:
 - a. Ordinance compliance statement(s)
 - b. Minimum Designer Qualifications to include:
 - i. Full Name of system Designer.
 - ii. FCC GROL License copy (must bear holder's signature).
 - iii. Nationally recognized training certification.
 1. Nicet, ETA, etc. (appropriate level for system design).
 - iv. Manufacturer training certification for system designer software e.g. IBwave, RanPlan etc. Certification is to be for iBwave Level 2, equivalent or higher, issued to individual specified as system designer.
 - v. Manufacturer training certification for exact product proposed.
 - c. Minimum Installation staff qualifications to include:
 - i. Full Name of Lead Installer
 - ii. FCC GROL License copy (must bear holder's signature).
 - iii. BDA Manufacturer training certification for proposed product.
 - d. Valid California C7 or C10 State Contractor's License (issued to organization or installation lead).
 - e. Materials list (All Active and passive components excluding small hardware), all required items must be included in list, "provided by others" does not exclude the requirement for listing items i-v below.
 - i. Full model or part number
 - ii. Manufacturer
 - iii. Manufacturer's description
 - iv. FCC ID# (Type Acceptancy Approval for Active devices)



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v. Quantities for each line item

6. Physical installation details and requirements:
 - a. Wall and floor penetration details
 - b. Equipment mounting details and construction standards
 - c. Electrical, ground and alarm cabling details
 - d. Fireproofing requirements
7. List of unique identifiers for all components and major cable segments.
8. System Schematic of proposed system showing Unique identifier of:
 - a. Active devices
 - b. Antennas
 - c. Splitters, taps, etc.
 - d. Cable segments
 - e. NOTE: Unique identifiers MUST be represented on all line drawings and floor plans.
9. Power projections for each antenna describing uplink at donor and downlink power at each DAS antenna.
 - a. Provide full calculations for each segment or point in tabular format
 - b. Provide Schematic representation showing power projections at each junction/connection point.
10. Anticipated attenuation for each cable segment and device port.
11. Battery Backup run time calculations based on equipment to be installed.
 - a. Provide in tabular format listing requirement for each powered device and capacity provided by proposed BBU.
 - b. Manufacturer's generic runtime statement is not sufficient.
12. Donor Site Signal Path(s)
 - a. List of all frequencies to be amplified by system
 - b. Area map showing donor site location and path to designated donor site
 - i. Show both vertical and horizontal path views
13. Floor plans for all levels (even those not covered by system)



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- a. Show all unique identifiers of components shown
 - b. Cable routes and identifiers
14. Installation detail of all Head End and Remote devices including
- a. Rack or wall mount elevations including attachment method and grounding details (graphic with notes).
 - b. Overhead view showing relative locations on floor plan projections.
15. Fiber optics layout, and interconnect (if applicable).
16. Heat maps for all assigned Cells (IBWave or similar) for every floor.
- a. Divide each floor into 20 or 40 equal signal grids as required by floor size.
 - i. Assign unique ID to each grid. This grid system shall be used for initial coverage calculations and all future test documentation.
 - b. Power projections are to be gradient with varying color for each 10dB range between -40dBm and -110dBm (greater ranges are acceptable outside -40 & -110dBm).
 - i. Include legend on each page defining color scheme for projections.
17. Manufacturer's Data Sheet for all
- a. Active components
 - b. Antennas
 - c. Passive coupling devices (Taps, Power Dividers, etc.)
 - d. Coaxial Cable
 - e. Coaxial Connectors
 - f. Fiber cable (if used)
 - g. Fiber connections (if used)
 - h. Enclosures to be provided by contractor



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APPENDIX C

System Installation Requirements

As Licensee and custodian for the Orange County CCCS 800MHz Radio System, The Orange County Sheriff's Department, Communications and Technology Division (OCSD/COMM) requires adherence to the following specifications as prerequisites to granting authorization for operation of Emergency Responder Radio Coverage Systems (ERRCS) supporting said radio system within the County of Orange, California. Application procedures for authorization to operate are defined in the "ERRCS/BDA/DAS system Guidelines" published by this entity and if provided, supplemental ordinance and guidelines applicable to incorporated Cities within the County.

Minimum Construction Requirements – Additional requirements may be applied by local Fire Jurisdiction

1. Must comply with current Orange County Fire Authority Ordinance, including adherence to CFC Chapter 5 (current version).
2. All active components shall be enclosed in NEMA 4/4X enclosures (NEMA 3R for batteries requiring venting are acceptable).
 - a. Exception may be granted for rack-mounted equipment if contained within a 2 hour rated area.
 - b. Power and signal cabling between the BDA, BBU and Power Distribution panel / disconnect must match the most restrictive rating of the connected equipment and are to be run in EMT (Electrical Metallic Tubing) or flexible conduit and terminated with approved fittings per the NEC and local building codes unless factory provided pre-terminated cabling are used.
3. Power to be provided by dedicated 120V 20A circuit.
 - a. Active components must be hard-wired to the dedicated branch circuit in the associated power distribution panel in accordance with NEC 310. No appliance cord connections are permissible.
4. A disconnect means shall be provided allowing all active devices to be isolated from the AC power source with lock-out/tag-out capability.
 - a. Shall be protected from accidental tripping by physical design or cover.
 - b. Shall be labeled to show equipment protected and source circuit(s) (panel & breaker ID).



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- c. No unique tool or key shall be required to disconnect or restore power except in the case of purposeful lockout by a qualified individual.
5. All active elements shall be provided 24 hour battery-based backup power unless alternative run time is required or approved by AHJ.
6. Alarm interface – Alarm display and logging shall conform to Appendix A paragraph 12
 - a. The BDA alarm outputs shall be connected to the facility FACP.
 - i. If FACP is not located in view of master amplifier, a local status display must be provided showing all monitored alarm conditions. This may be integrated to the amplifier, Battery Backup Unit, or external device.
 - b. Amplifier and BBU alarms shall be interconnected so that all alarms are delivered to both units and any external devices.
 - i. All BDA alarms shall be transferred to BBU for display and logging if BBU is so equipped.
 - ii. All BBU alarms shall be delivered to Master Amplifier for the purpose of alarm logging and status display allowing user connected to remote management port on amplifier to view both BDA and BBU alarms.
 - c. BDA system shall be equipped with auto-dialer system driven by the system alarm outputs. The BDA auto dialer shall be programmed to report the assigned SITE ID to the County 900MHz paging system via dedicated telephone line (POTS) or cellular auto dialer. In the event of loss of commercial power, the Auto dialer will be supported by a battery backup, providing a minimum of 24 hours of operation.
 - i. The Auto-dialer back up battery shall be fitted with a properly sized, intelligent battery charger which will automatically recharge the Auto-dialer backup battery upon restoration of power.
 1. The Auto-Dialer may be powered by the master amplifier's BBU provided sufficient run-time can be provided.
 - ii. The system shall be capable of providing SNMP based alarms to specified servers.
7. Grounding, Bonding, and Lightning Protection.
 - a. All active devices shall be grounded pursuant to NFPA 780 (2017) unless otherwise directed herein.
 - b. All active devices shall be grounded to the master building ground bus.
 - c. All ground bus bars shall be bonded to building ground via stranded copper wire no smaller than #2 AWG.



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- d. All ground bus bars shall be copper. Tinned copper is acceptable for exterior applications.
 - e. No copper wire shall come into direct contact with aluminum.
 - f. No copper bus bar shall come into direct contact with aluminum.
 - g. Conductors shall be connected to bus bars and equipment using crimp style, two-hole lugs wherever possible. Lug hole size shall match the hole or stud size of the bus bar / equipment.
 - h. All Fasteners (Bolts, Nuts, Washers) used for attachment of grounding conductors shall be Stainless Steel or Copper.
 - i. All hardware (Lugs, Bolts, Nuts, Washers, Etc.) shall be of appropriate dimension matching product served (Wire gauge, hole dimension, etc.), washers or other devices shall not be used to compensate for undersized hardware.
 - j. Surge protection shall be grounded to the master building ground bus.
 - k. Donor Antenna Surge Protector
 - i. To be installed internally to the building.
 - ii. Mounted within 24" of building entry point where possible.
 - 1. May be housed in a metallic NEMA 3R or NEMA4 enclosure at point of entry provided entire run to amplifier is enclosed in metallic conduit with prior approval.
 - a. Enclosure must be sufficiently large to permit entry and egress of coaxial cable and ground conductor(s) entry and exit without exceeding manufacturer's published bend radius restrictions.
 - b. Equipment will be mounted in such a manner as to permit free access for service to all components without the necessity of removing hardware or devices.
 - c. Enclosure(s) and conduit must be bonded to building ground.
 - l. Donor antenna feed line shall be bonded to building ground using a coaxial ground kit appropriate to the size and type of coaxial cable in use. The Ground kit shall be attached to the coax at the point of transition from vertical to horizontal routing or at the point of entry to the building or grounded metallic conduit.
 - m. Donor antenna mounting structures shall be grounded to the master building ground bus.
8. The Donor antenna shall be positioned to provide clear line of sight (LOS) with the designated donor site. The measured downlink carrier level (control channel) at the donor antenna shall be within 6 dB of the calculated LOS value.



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- a. The Donor antenna support structure is to be permanently attached to the building structure – non-penetrating rooftop “sled” mounts are not to be utilized without specific approval.
 - b. No part of the donor antenna shall extend below 8’ above any walkable surface.
 - c. The horizontal centerline of main transmission lobe of the antenna shall not transit less than 8’ above any walkable surface.
 - d. Excess feed line is to be removed from the installation. No more than one coil, not exceeding 6 total cable feet, is permitted in the Donor line. Any coil is to be secured and is not to extend beyond the footprint of the Donor antenna support structure.
 - e. Rain or service loops shall be installed to prevent touching or close proximity to the antenna’s radiating or reflecting components.
 - f. Exterior Donor cabling shall be enclosed in metallic conduit of appropriate diameter or in cable tray for any segments having more than 3’ of horizontal exposure or any length crossing established pathways. Said conduit or tray is to be suspended not less than 3” above the surface.
9. DAS (Service) Antenna System
- a. Antenna location must minimize exterior signal emissions.
 - b. Antenna location and quantity must minimize Near-Far effect.
 - c. Cabling must match building fire rating or as specified by AHJ.
 - d. Exposed cabling must be minimized.
 - e. Feed lines and flexible jumpers must be located to prevent overlapping runs or looping of jumpers.
 - f. Excess cable to be minimized.
10. Antenna Isolation (Donor to DAS)
- a. Shall be at a minimum, 20dB greater than amplifier’s maximum rated gain.
 - b. >100dB is desired.
11. Labeling
- a. All labels shall be moisture proof and indelible, easily readable and appropriately fixed to the device. Service antennas may be labeled in such a way as to not be visible in public areas.
 - b. Amplifier, battery enclosure, and ancillary enclosures must have visible identification showing:
 - i. Description “County of Orange ERRCS System”.
 - ii. Site ID (BDA and Auto Dialer only).
 - iii. FCC Registration number (Master and Remote amplifiers only)
 - iv. Full model and serial number of device.
 - v. Power distribution panel ID and circuit branch/breaker ID of power source.
 - vi. Operational class (A or B) (Amplifier(s) only).



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- vii. Date of most recent successful inspection (Amplifier only).
- viii. Contact information of current service provider.
- ix. Contact information for building representative with access to system components and records.
 - 1. Must be available 24/7 to provide access on demand.
- x. Location of system documents.
 - 1. NOTE: Recommend items vii-ix to be on label provided and affixed by contractor performing inspection.
- c. Donor Antenna
 - i. Engraved or Stamped brass tag
 - ii. Minimum 1" diameter
 - iii. Secured to antenna feed line using solid stainless steel safety wire or stainless steel tie at eye level on support structure or at easily accessed point as close to antenna as practical.
 - 1. Not to be attached directly to antenna radiating or directing elements.
 - iv. Stamped "OC 800MHz ERRCS Donor" or "OC 800MHz ERCES Donor".
- d. Power Distribution Panel (Circuit Breaker Panel)
 - i. Breaker(s) to be clearly and legibly labeled on the Panel Schedule and Dead Front.
 - ii. Label to state "ERRCS" and function (Amplifier, BBU, Etc.)
- e. Service Disconnect Device (switch)
 - i. Label stating
 - 1. "ERRCS AC Service Disconnect"
 - 2. Room, Panel and breaker number of source circuit.
- f. Components and cabling
 - i. Each item assigned a unique identifier is to be tagged showing "OC ERRCS" and the unique identifier of the component.
 - ii. Cable segments to be labeled with "OC ERRCS" and unique identifier within 18" of each end.

12. On Site Documentation

- a. System documentation to be located with head end amplifier
- b. May be in sealed container within BDA or BBU enclosure if a document pocket of sufficient size is provided.



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- c. If stored externally to equipment, installer must provide appropriate metallic or rigid plastic document holder.
- d. Must contain copies of System Diagrams required for commissioning consisting of but not limited to:
 - i. Floor plans showing all component locations and unique identifiers.
 - ii. System line drawings showing all components and unique identifiers
 - iii. Equipment programming details (initial and current)
 - iv. Commissioning test reports
 - v. Most recent annual inspection
 - vi. Supplemental reports as required
 - vii. Original documents should be maintained by property owner
- e. Manufacturer's manuals for
 - i. Amplifier
 - ii. BBU
 - iii. Auto Dialer
 - iv. Status Display
 - v. Any other active components
- f. Maintenance log containing:
 - i. Date(s) of service
 - ii. Service provider
 - iii. Name
 - iv. Contact phone number
 - v. Email
 - vi. Nature of service provided
- g. Copy of current OCSD issued ERRCS Approval to Operate form.



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Emergency Responder Radio Communications Systems

APPENDIX D

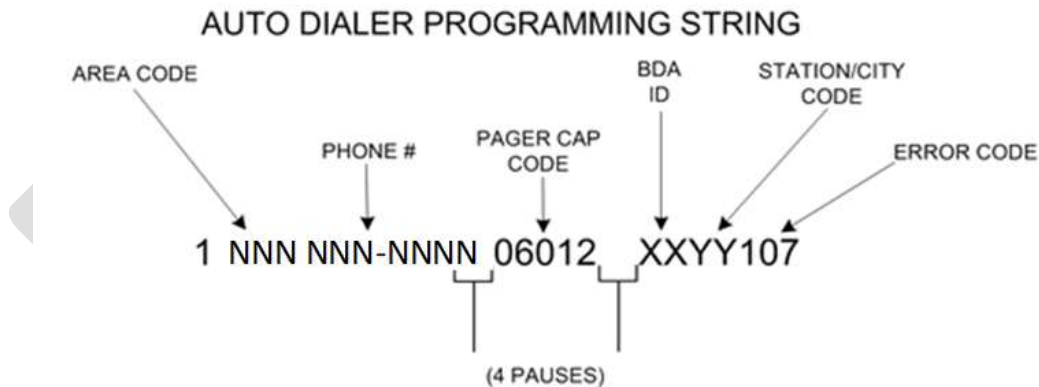
900 MHz Paging System Alarm Reporting

OCSD/COMM maintains an automated alpha-numeric paging system with coverage throughout Orange County for the reporting of alarms and system failures. Each ERRCS is to be equipped with an automated dial out (auto dialer) device capable of interacting with this system to generate a numeric page consisting of the site ID in the event of any monitored failure within the system. Normally this device requires a full time dedicated conventional analog (POTS) phone line. A cellular auto dialer is acceptable if reliable operation can be demonstrated.

Programming of the auto dialer is critical as the transmitted elements must be timed to coincide with specific input windows from the paging system.

Auto Dialer Configuration:

The assigned BDA ID for the auto dialer will be in the following format:



The OCSD/COMM 900 MHz Paging System phone number will be provided during plans review. You will need to program pauses (usually 4 each) between the number dialed, cap code and BDA ID for the auto dialer to function properly into the County's 900MHz paging system.

Upon notification by Pager in the event of a BDA failure the OSCD/COMM Technical Services Unit technician on duty will make notifications to the affected Law and/or Fire agencies as well as Control



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One alerting them of lack of coverage and a need for service in the future. Attempts will be made to contact the owner and service company of record to help facilitate corrective measures.

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Emergency Responder Radio Communications Systems

APPENDIX E

Commissioning and Annual Testing Report Requirements

It is the responsibility of the owner of a building containing or requiring an in-building Emergency Responder Radio Coverage System (ERRCS) to acquire, file and have available for inspection, copies of the annual inspection report, conducted within the previous 13 calendar months and Approval to Operate documentation provided by the appropriate FCC licensee for each radio network supported by the system. Annual testing and proof of compliance shall be in accordance with Section 510.6.1 of the current California Fire Code.

Annual testing should be conducted in preparation for the building's annual fire inspection unless the previous inspection or commissioning report was conducted within the previous 9 calendar months. The annual report must be filed with OCSD within 30 calendar days following successful completion of testing to be considered valid.

Initial Third Party tests shall be performed by a qualified testing entity not employed by the construction contractor nor any entity or individual related to the construction contractor. Subsequent annual testing may be performed by the installation contractor's qualified testing agent.

The report is to be filed with the Fire authority having jurisdiction (AHJ) and digital copies of all documents provided to OCSD/COMM (FCC Licensee) as shown in the current BDA Annual Inspection Form (APPENDIX F).

Copies are to be maintained by the building owner at the site and available for review on demand. Specific documents are to be stored with the head end equipment (APPENDIX C Item 12).

Inspections shall be conducted by OCSD/COMM or qualified testing agent. No person may conduct an annual test or inspection unless that person possesses a valid FCC GROL and certification from the equipment manufacturer for the device(s) under test and appropriate certification from a nationally recognized training agency.

All RF measurements are to be made using spectrum analyzer or communications monitors with proof of current calibration.

Downlink RF measurements are to be taken using control channel signals for both supported cells per site design.

Reports shall be submitted as bound 8.5 x 11" booklet format and shall contain the following:



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1. Cover page showing

- Site name and address
- Date(s) of Inspection
- Site Owner name address, phone number and email address
- On site (24/7) contact, Full Name, Address, Phone number & email address
- Testing company's contact information
- Inspector's name, contact address, phone number and email address

2. Inspector's proof of qualification (Minimum 3 items)

- FCC GROL
- BDA manufacturer's certification for the device under test
- Appropriate certification from nationally recognized agency

3. Test description

- Test requirements per applicable ordinances
- Test methodology
- Model, Serial Number and Calibration date for all test equipment

4. Site Description

- Site address
- Site Cell assignments
- Site ID Number
- Site FCC Registration Number
- Location of primary components within property
- Model, Serial number and FCC certification number of all active RF components including:
 - Amplifier or Master Unit
 - Remote Amplifiers
- Amplifier operating Class (A or Channelized B) including all filter bandwidths used
- Model and serial number of remaining powered components
 - Battery Backup Units
 - Remote Alarm Reporting Devices
 - Phone number of line used by auto dialer



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5. Inspection Result Summary Page

List requirements and Pass/Fail Result

- Interior Signal Strength (Downlink)
- Exterior Signal Strength (Uplink)
- RF Leakage <-95bDm
- SINR Values >20dB
- DAQ test
- Correct Frequency Filtering
- Uplink Muting Enabled
- Appropriate Uplink Mute Levels (-75dBm to -85dBm)
- Spurious Uplink Emissions Measurement
- Quiescent Noise Floor Measurement
- Donor Antenna Azimuth (specify degrees True or Magnetic)
- Donor antenna meets minimum height requirement (8' above walkable surface)
- Backup Power Supply Battery Condition
- Backup Power Supply Calculated Runtime
- Backup Power Load Test
- Physical Condition of Installation
- NEMA 4/3R compliance of Equipment Enclosures Inter-cabinet cabling
- AC Power Termination
- Appropriate Power Cut-Off device
- Grounding and Lightening Protection
- Interference Test
- Auto Dialer Test
- Isolation Tests
- Amplifier Gain Measurements
 - Uplink for all assigned frequencies
 - Downlink for all assigned frequencies
- Any other applicable test results



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6. Detailed Test Results

Donor Site Path Profile

- A. Local Site coordinates.
- B. Donor Site(s) coordinates
- C. Graphic representation of horizontal and vertical paths showing:
 1. Donor Site(s) Name
 2. Azimuth (degrees Magnetic) to Donor Site(s)
 3. Path Length to Donor Site(s) (Miles)
 4. Calculated Path Loss to each donor site

Graphic or tabular verification for all required tests (following)

- A. System primary and backup power
 1. One hour load test or pulse-load battery capacity test.
 2. Verify ALL active components operating on backup power
 - i. Amplifier/Master (Headend)
 - ii. Remote amplifiers
 - iii. Fault display
 - iv. Auto dialer
- B. System gain and measured RF power
 1. Uplink and downlink
 2. All assigned frequencies
 3. Near-far measurements (uplink only)
 - i. Measurements are to be taken at the Donor output port of the master amplifier
 - ii. Use Near and Far antennas identified in system design unless otherwise directed
 - iii. Identify antennas used for Near and Far measurements
 - iv. Near Measurement to be taken with standard transmitter (34dBm ERP) located 6-10' from "Near" antenna.
 - v. Far measurement to be taken with standard transmitter located 50-70' from "Far" antenna
 - vi. Show measurements taken during individual and simultaneous transmissions
 1. Near-far effect is difference between individual transmit value of the Far transmitter and the Value recorded during simultaneous transmissions



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- C. Ambient (Passive) noise floor
 - 1. Measured at BDA Donor antenna feed point and BDA service antenna feed point
 - 2. Amplifier powered off
 - 3. Active DAS, if used, powered on
 - 4. Show span of 15-20MHZ centered at 8596MHz (Downlink) and 8141MHz (Uplink)
 - 5. Provide a screenshot displaying noise entering BDA from donor antenna at both frequencies as described in item 3d D4 (above)
 - 6. Provide a screenshot displaying noise entering BDA from service antennas at both frequencies as described in item 3d D4 (above)
 - 7. If an active DAS is used, provide a screenshot of the noise entering the BDA from the active DAS

- D. Active noise floor
 - 1. Repeat item 3 with power applied to BDA, with all antennas connected.

- E. Antenna systems isolation
 - 1. Inject reference signal to DAS antenna system at 811MHz
 - 2. Show Injected power level
 - 3. Show Measured signal from Donor antenna system

- F. Downlink coverage measurement
 - 1. Conduct measurement on each floor with DAS antennas and each adjacent floor using 20 grid method. (Signal levels shall be no less than -95dBm in 95% of test grid areas).*
 - a. Use grid created in original plan set.
 - b. List recorded measurement in dBm.
 - 2. Measure and list SINR for each grid.
 - 3. Measure and list FBER for each grid.
 - 4. Floors not measured in item "A" above are to be measured as follows (annual testing only):
 - c. Divide the level into four quadrants, each facing a different compass direction, and measure the signal level as close to the center of each quadrant as possible.
 - d. Measuring the signal level at the point where the four quadrants meet, as close to the location of the center of the building as possible.



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G. Downlink RF Leakage Test

1. With the system disabled, measure active control channel signals from all assigned 800MHz Cells.
 - i. Measurements should be taken between 10-25 feet from outer walls and spaced at intervals of not more than 75'.
2. Inject Signal into Master amplifier Donor Antenna port on 864.000MHz at level equal to greatest measured DL signal from Assigned Cell-Sites control channel.
3. Measure received signal at ground level outside building(s) at same points used in step 1.
4. Measured signal should be NLT 20dB below measured control channel signal(s) measured with system disabled and in no case stronger than -95dBm.

H. Uplink free space loss calculation

1. Using Donor path distance determined by system design, estimate path loss to each assigned Donor site using appropriate free space formula for 814MHz.
2. Measure and record maximum uplink power output and noise (based on 10KHz bandwidth) generated at donor antenna port of amplifier with maximum estimated uplink input signal injected at DAS antenna port of system.
 - i. Use 814MHz signal injected to DAS port of the amplifier.
3. Calculate and record estimated uplink transmission and noise levels anticipated at the assigned donor site for each supported cell based on path losses determined in 6.G.1. (above).

I. Operations

1. Determine and document DAQ for all grids. Minimum acceptable is DAQ 3.4 in 95% of test grid areas on every floor and for all critical areas.

**For Commissioning, test all floors of all included structures, without exception using the 20 grid method.*

7. Inspect and document

A. Physical condition of equipment and installation

- i. Provide digital images of:
 - a. Headend and Remote equipment – showing required labeling
 - b. Headend and Remote cabling
 - c. Donor Surge Protector
 - d. Donor antenna and supporting structure
 - a. Show required donor tag



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- e. Donor antenna alignment and path to Donor site(s)
- f. Interior of BBU cabinet
- g. Typical DAS antenna
- h. Any items requiring repair or support

8. The Fire Marshal and/or the Fire Marshal's designee may, at any time during routine business hours, conduct independent testing of the in-building system to verify proper operation and shall be provided unimpeded access at any time 24 hours a day, 365 days a year, to investigate a case of interference with public safety communications systems.

J. Annual testing will be done at no expense to the City or County.

K. Annual tests results shall be filed with the AHJ/Fire Marshal and OCSD/COMM as directed.

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Emergency Responder Radio Communications Systems

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APPENDIX F

Approval to Operate Sample

Must be posted at primary amplifier & updated annually



Orange County Sheriff's Department Technology Division



Emergency Responder Radio System Authorization to Operate on Licensed Frequencies

In accordance with FCC Part 90, §90.219, as representative of license holder for the frequencies used by the Orange County CCCS under FRN # 0001527001 and assigned to the facility as shown below, approval to operate a single FM transmitter is granted for the device and location shown below. Continued approval to operate is conditional, based on continued compliance with NFPA 1853, 1854, 1855, 1856, 1857, 1858, 1859, 1860, 1861, 1862, 1863, 1864, 1865, 1866, 1867, 1868, 1869, 1870, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000.

Site ID: ### 107 FCC Site ID: 1900##

Property: Any Apartments Manufacturer: Xccx

On Site Contact: J. Doe Mfg Model: NNNNNNNNNN

Address: 12345 Anystreet Serial Number: A123456789

City: Anytown 90NNN Mfg Part #: B # Filters: 32

Phone: NNN NNN-NNNN Location: First Floor Electrical Room

Email: somebody@antmail.com Dial Out Line: NNN NNN-NNNN

Coordinates: NN°NN'NN.NN"N NN°NN'NN.NN"W

Site Coordinates: NN°NN'NN.NN"N NN°NN'NN.NN"W

Frequencies Assigned and Available:

Countywide WQZ938			With WZ481		
Channel	Downlink (MHz)	Uplink (MHz)	Channel	Downlink (MHz)	Uplink (MHz)
1	860.9625	810.7125	1	851.1750	806.1750
2	860.7125	810.4625	2	851.4250	806.4250
3	860.4625	810.2125	3	851.6750	806.6750
4	860.2125	810.9625	4	851.9250	806.9250
5	859.9625	810.7125	5	852.1750	806.1750
6	859.7125	810.4625	6	852.4250	806.4250
7	859.4625	810.2125	7	852.6750	806.6750
8	859.2125	810.9625	8	852.9250	806.9250
9	858.9625	810.7125	9	853.1750	806.1750
10	858.7125	810.4625	10	853.4250	806.4250
11	858.4625	810.2125	11	853.6750	806.6750
12	858.2125	810.9625	12	853.9250	806.9250
13	857.9625	810.7125	13	854.1750	806.1750
14	857.7125	810.4625	14	854.4250	806.4250
15	857.4625	810.2125	15	854.6750	806.6750
16	857.2125	810.9625	16	854.9250	806.9250
17	856.9625	810.7125	17	855.1750	806.1750
18	856.7125	810.4625	18	855.4250	806.4250
19	856.4625	810.2125	19	855.6750	806.6750
20	856.2125	810.9625	20	855.9250	806.9250
21	855.9625	810.7125	21	856.1750	806.1750
22	855.7125	810.4625	22	856.4250	806.4250

Down Link	Up Link
773.63125	803.63125
773.64375	803.64375
773.65625	803.65625
773.75625	803.75625
774.00625	803.00625
773.50625	803.50625
773.00625	803.00625

Approval Date: _____ By: Somebody at OCSD
FCC GROL PG NN NNNNN

Must be Posted at Primary Amplifier

OCSD/COMMS
Approval to Operate rev 2022



**Orange County Sheriff's Department
Technology Division**



Emergency Responder Radio Communications Systems

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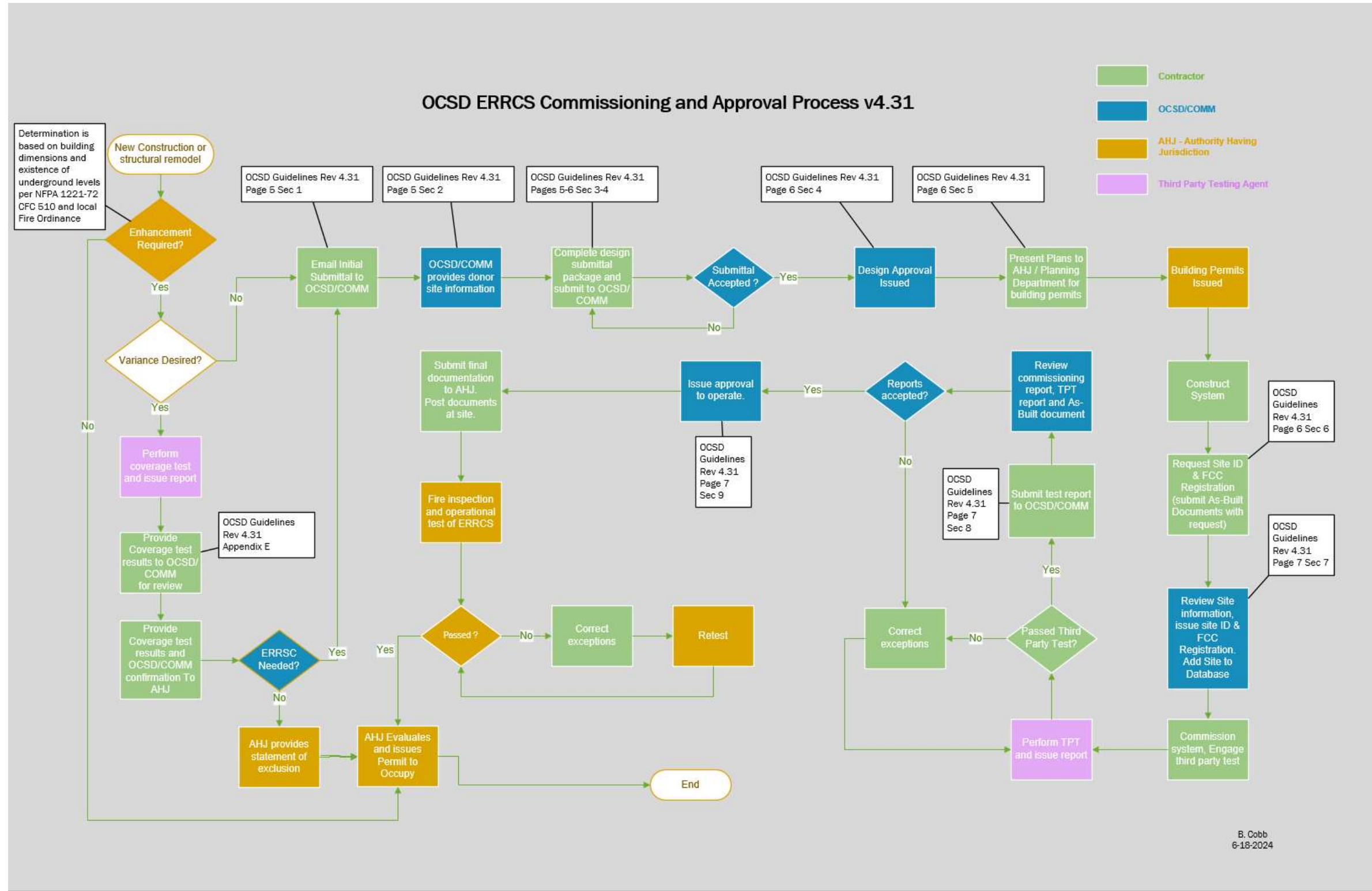


**Orange County Sheriff's Department
Technology Division**
Emergency Responder Radio Communications Systems



APPENDIX G

ERRCS Approval Flow Chart, Revised 6-18-2024





**Orange County Sheriff's Department
Technology Division**
Emergency Responder Radio Communications Systems



Orange County Sheriff's Department
Technology Division
1382 Bell Ave.
Tustin, CA
714-704-7999

Technical Services Unit

Gary Blankenship - Senior Telecommunications Engineer Technical Services Unit 714-704-7917