



Agenda Item # 19a
Date 2/22/23

Date: February 6, 2023

Dodge County Nebraska
435 N. Park
Fremont, NE 68025

Attn: *Bob Missel/Board of Supervisors; Tom Christensen*

Subject: Dodge County NE - Radio System Project Final Inspection Report

Dear Bob, Tom and Board Members:

The installation of the new Dodge County public safety radio system infrastructure was considered complete as of December 2022. In conjunction with the completion of the system equipment installation, optimization and testing, RFCC conducted a final inspection visit during the week of January 4th, 2023. This report is being submitted to Dodge County as the Final Inspection Report for this project. The purpose of the final inspection, along with this report, is to accomplish these tasks:

- *Verify that all the equipment required in the project contract has been delivered and installed.*
- *Verify that the equipment provided is of the correct make, model and specification*
- *Verify that the equipment has been properly installed, wired, programmed, and configured for its intended use*
- *Verify that it meets equipment specifications*
- *Observe that agency personnel understand how the new system works and have been instructed on its use.*
- *Verify completion of project equipment and labor for processing of contractual payment to vendor.*

In addition to the above items, we also attempt to verify that all project documentation has been completed, is accurate, and includes service manuals and other data.

The final inspection includes traveling to the 9-1-1 Dispatch and tower sites to visually and physically inspect all equipment. However, due to the complexity of these new systems, there is no need for a technician to be on site for testing of the equipment. Instead, the technical parameters of the new system have been documented and provided to the customer for future reference (Site Optimization Reports).

Additionally, the performance and coverage of the new system was measured and documented in October 2022 through the formal Coverage Testing process, the results of which are provided later in this report.

The goals of this new radio system are to provide a network with high levels of the following performance criteria:

- Coverage
- Channel capacity
- Network reliability
- Interoperability with neighboring agencies

The new radio system was designed to provide greater than 95% portable coverage throughout the Dodge County service area, as well as two miles outside of the county borders for use by fire agencies when providing Mutual Aid services.

The equipment for this project was supplied by Motorola Inc. and much of the installation and maintenance services provided by First Wireless of Omaha.

Radio System Review

The new radio system replaced the aging and unreliable VHF/UHF systems that had been used by Dodge County agencies for many years. This project consisted of numerous new primary radio equipment components:

- Four new tower sites and structures, with 330-foot self supporting towers, concrete equipment shelters and propane-fueled emergency power generators
- New "Prime site" system equipment located at the Dodge County Judicial Center
- 800 MHz Trunked Simulcast multi-site radio system, connected into the ORION regional radio network (Douglas, Washington, Sarpy and Pottawattamie counties)
- A new Fire/EMS Multi-site UHF Simulcast Paging system
- Additional Standby/Backup RF control stations at the Dispatch Center
- A combination 6 GHz Microwave radio system and Fiber optic links for connectivity of the sites and the ORION network
- New Mobile and Portable radios for Dodge County agencies using the system

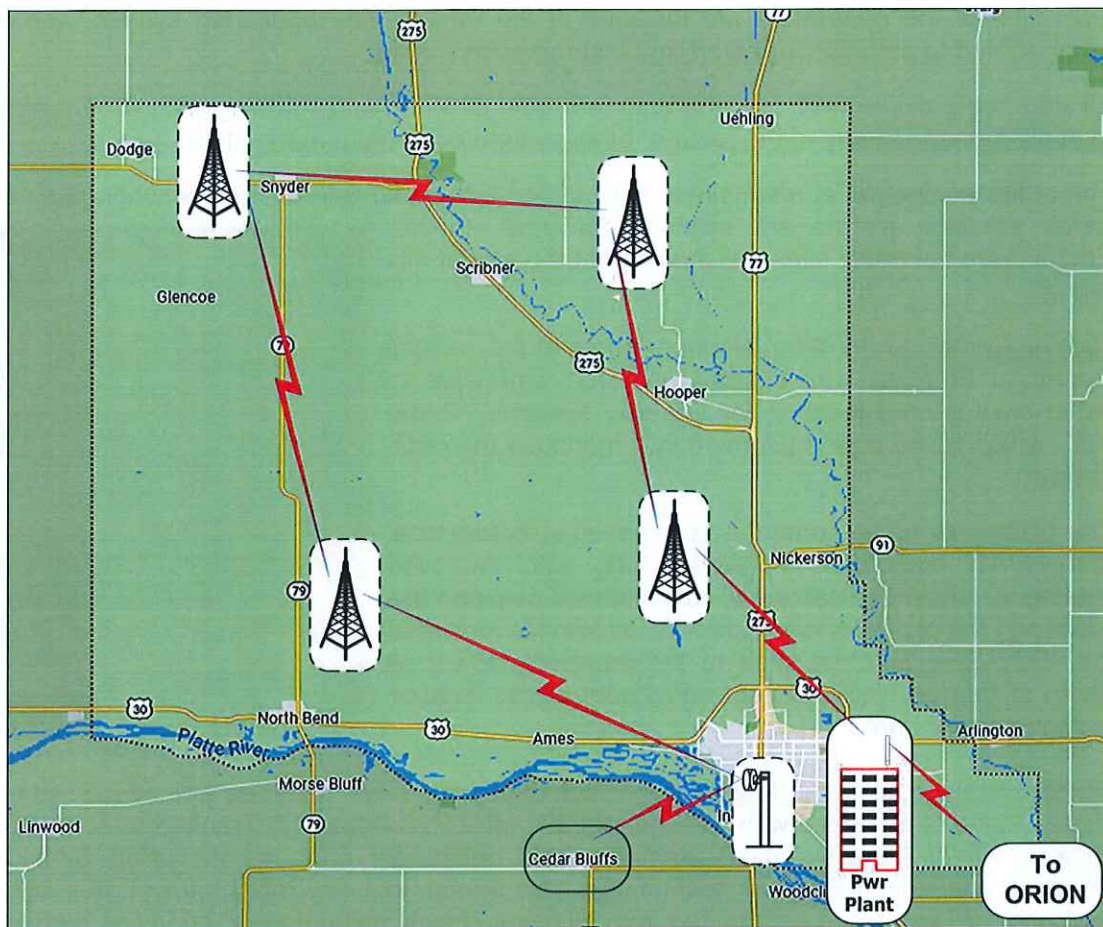
A brief review of each of these equipment categories is provided in this report, as well as photos of the equipment.

System Review and Inspection Results

The new 800 MHz radio system added four new tower sites as well as associated radio equipment to the existing Fremont Power Plant site, for a total of five radio sites providing radio coverage throughout the Fremont and Dodge County service area.

A high-level map of the new system is provided below.

Dodge County/Fremont 800 MHz Radio System Network Map



As shown in the drawing above, the four new tower sites are strategically placed around the county, and linked together via Microwave radio, as well as to the Judicial Center and Power Plant. From these locations the Microwave radio paths are routed to the ORION network through the Elkhorn water tower and Cedar Bluffs OPPD tower. Fiber optic connectivity is used between the Judicial Center and the Power Plant.

1. Tower Sites and Structures: New Valmont 330-foot self supporting towers were built for the North Bend, Dodge/Snyder, Uehling and Hooper sites. A full set of the manufacturer's engineering documents have been provided for each of these structures. **Note that these towers have been designed to allow additional antenna loading in the future for leasing to cellular carriers or other wireless services.**

Each tower is equipped with the FAA-required aircraft visual LED lighting systems. These LED lighting systems use less power and require significantly less maintenance than the older incandescent systems. These lighting systems are also connected to a remote alarm system that will provide an alert in the event of a lighting failure.

New ThermoBond concrete 12-ft x 26-ft shelters were supplied and installed at each of these sites. The shelters each have a Generac 35-KW propane fueled emergency generator, located in a separate room, and connected to a 1,000 gallon propane tank. Operation of the generators are included in the remote site monitoring system, and are programmed to automatically start and test run once a week.

All sites are provided with industry-standard ground wiring and lightning protection systems to avoid damage to any of the radio or other system equipment at the sites.

The entire compound at each site is surrounded with chain link fencing, security gates and locks. Intrusion alarms are included for each shelter. Photos from the tower sites are provided at the end of this report.

Judicial Center: An existing telephone room at the Judicial Center in Fremont was cleared out and remodeled to serve as a secure location for the new system's "Prime site", which is the core equipment that manages the radio system.

The old telephone equipment was removed, new electrical and HVAC equipment installed, along with improved lighting. An overhead cable tray was installed between this room and the old radio room (directly across) for routing of the Microwave antenna lines to the monopole tower. A photo of the new radio system equipment at this location is shown to the right.



2. Radio System Equipment (tower sites): Each of the new tower sites (as well as the Fremont Power Plant) is equipped with a 4-channel 800 MHz P25 "Phase 2" Trunked radio repeater system. All of the sites have identical radio equipment and operate using Simulcast Transmit and Voting Receiver technology. This means that any radio transmission from a field user or Dispatch is transmitted from all tower sites simultaneously, providing high-level countywide coverage for mobile and portable radios, outdoors as well as inside buildings.

The P25 "Phase 2" also includes TDMA technology, which allows two radio conversations per channel. As such, the system is capable of 6 conversations at the same time, but the Trunking technology also allows the system to have many more channels (known as Talk Groups) for Dodge County agencies. The new system is currently configured to provide over 37 voice channels for local agencies, and is expandable to provide more as needed.

3. 9-1-1 Dispatch Center (Fremont): The dispatch center was equipped with Motorola MCC7500 radio dispatch consoles prior to the new radio system project. However, some updates were needed to the consoles for operation with the expanded radio channels (Talk Groups) provided by the new system. New "backup" RF control station radios were added for the new radio channels included in the system.

A photo of the new Dispatch center radios is shown to the right.



System Coverage and Performance: Planning for the coverage to be provided by the new system is a two-step process:

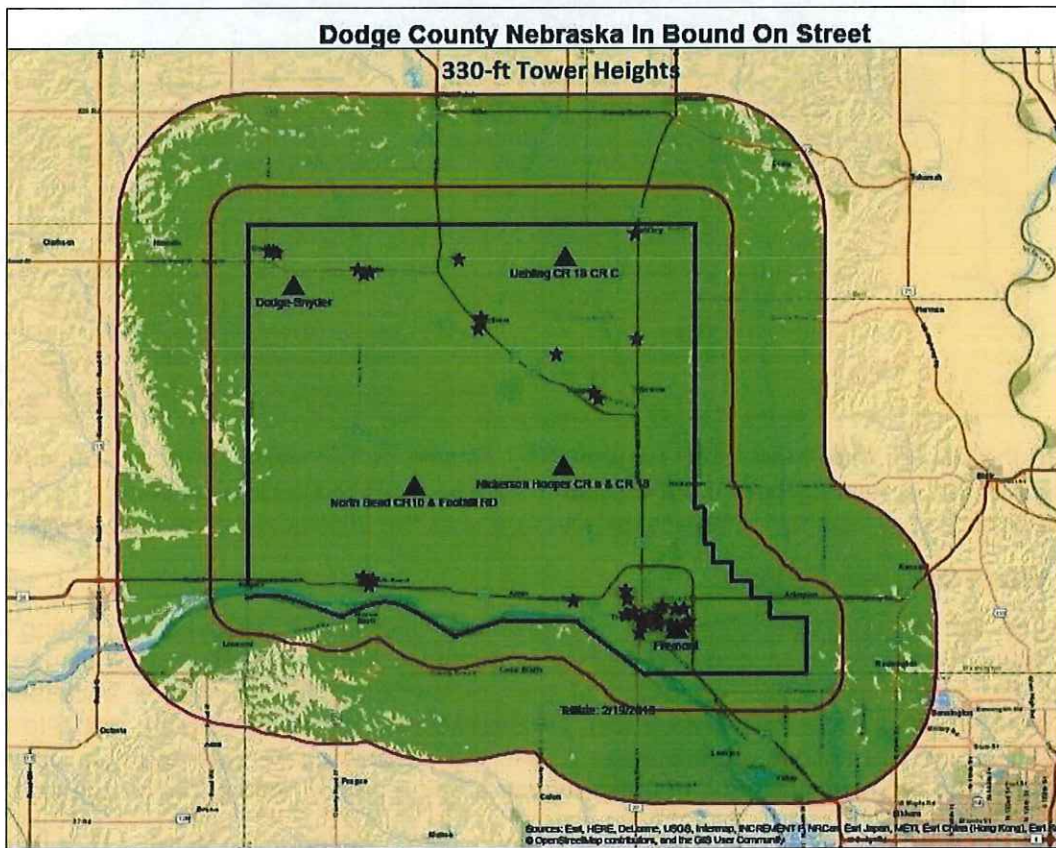
- Computer-based coverage calculations for the new system
- Actual field testing of the coverage provided by the new system

At the beginning of the project, the Motorola engineering team used a computer-based software program and determined that four new tower sites would be needed (along with the Fremont Power Plant site) to provide reliable coverage throughout the 540 square mile Dodge County (and Fremont) service area. The coverage goal for the new system was established at 95% for portable (hand held) radios throughout the county (95% is the public safety industry standard).

The benefit of these new digital systems is that the actual coverage provided by the completed system can be measured once it is complete.

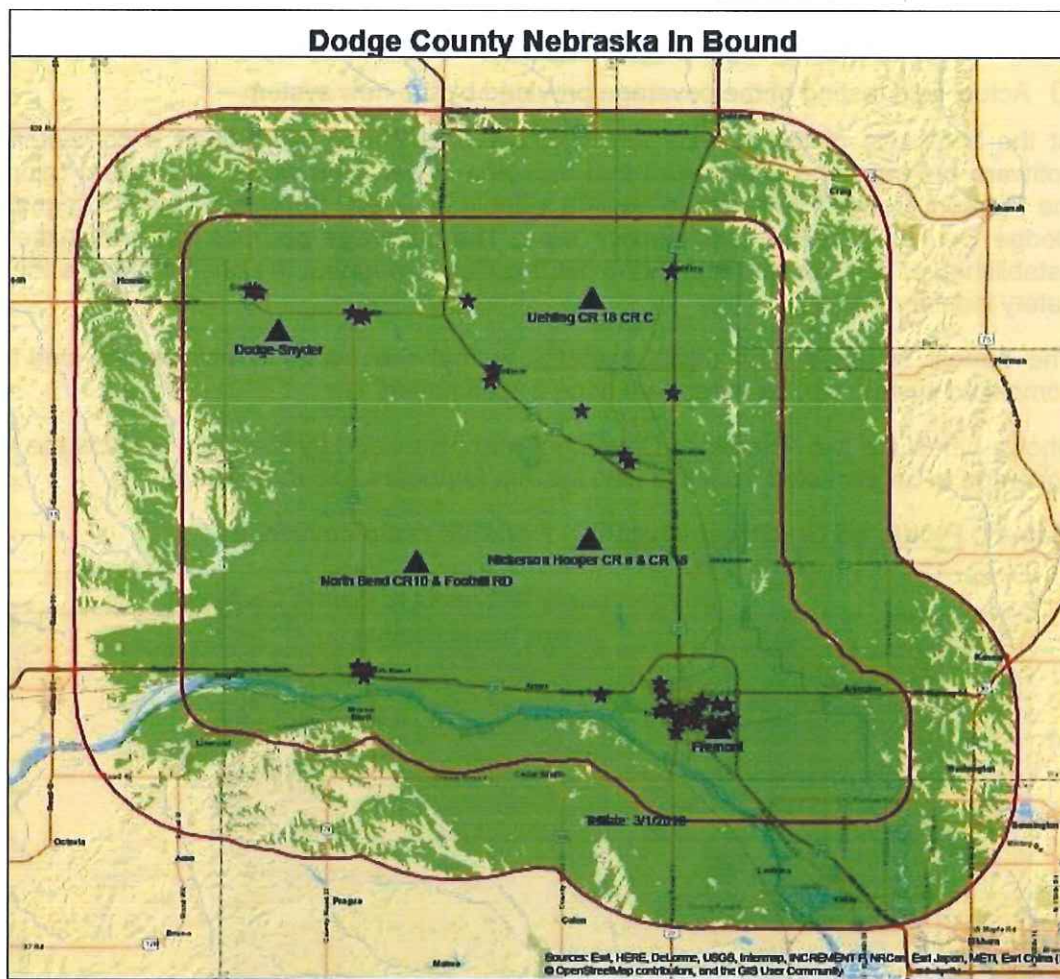
Shown below are two "Predicted Coverage" maps provided by Motorola to show the level of coverage to be expected from this new system (outdoors and In-building).

Map #1: Predicted On-Street (Outdoor) Portable radio coverage:



On these maps, the green area is where reliable coverage is predicted. As shown on this map, almost the entire county area as well as two miles (or more) outside of the county is green.

Map #2: Predicted “6 dB Loss” In-Building Portable radio coverage:



On the above map, most of the county area as well as two miles (or more) outside of the county still remains green, even though it shows “6 dB In-Building” coverage (homes and other similar structures). This level of coverage was the 95% goal for the new system.

System Coverage Testing

Once the system was completed and became operational, actual field testing of the system’s coverage was conducted. This is accomplished by creating a Grid map of the county and determining how much of the county land can actually be accessed by a standard vehicle (car or pickup truck). No significant effort is necessarily made to use off road vehicles to access remote areas due to the obvious challenges and risk with this, as well as the reduced likelihood of these remote areas requiring regular radio coverage.

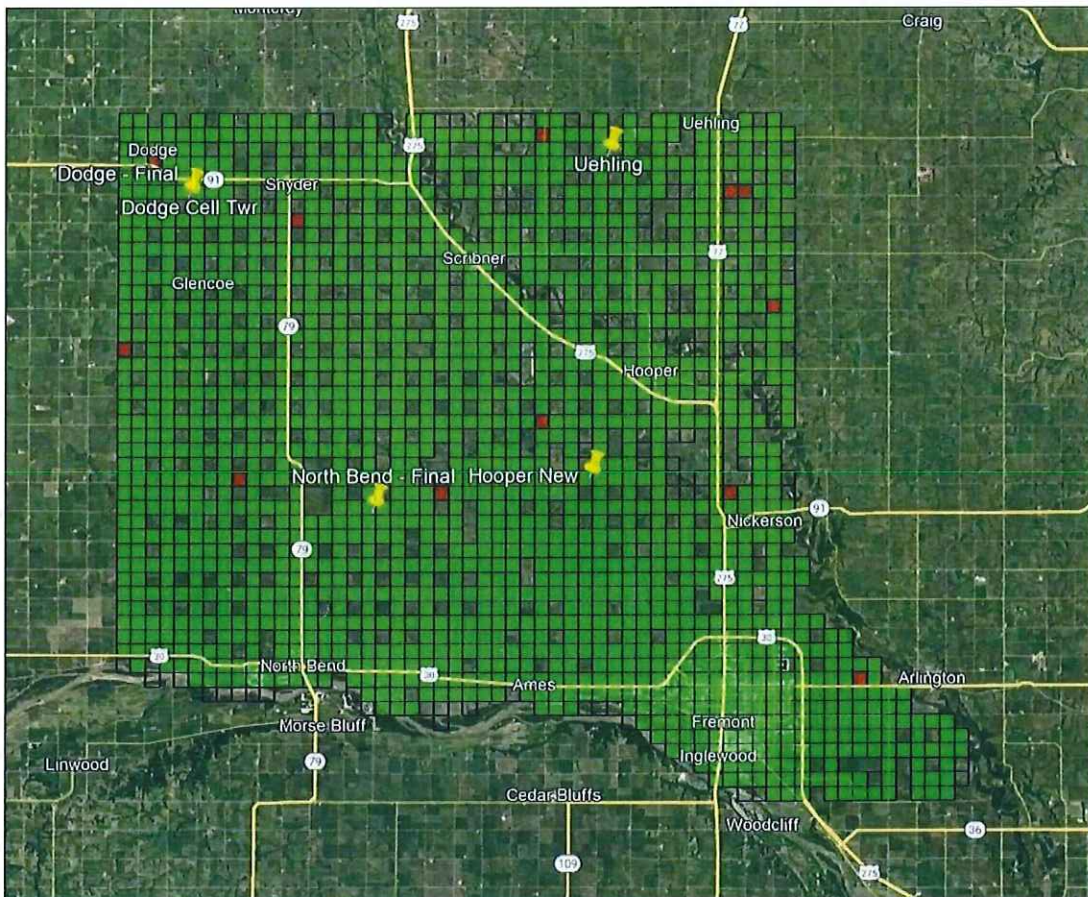
The Grid map used ½-mile square grids/tiles, which resulted in a total of 1,629 tiles to be tested. The testing was conducted by setting up two vehicles with 800 MHz radios, GPS units, and a computer that tracks the signals from the new system. The radio testing equipment sends and receives digital signals to and from the new system within each of the grids and measures the bit error rate, which results in a simple “pass or fail” recording. This data is logged and eventually plotted on a Google Earth map with green and red tiles for an easy view of the testing results.

Shown below is the grid map with the testing results of this process; green grids are “pass”, red grids are “fail”, and uncolored grids were not tested (due to lack of access). Note that some additional grids were added during the testing process when it (occasionally) was apparent that a gravel road or other opportunity allowed the test vehicle to drive into a grid area that did not previously appear to be accessible. Smaller grids were also used in the populated areas of the county.

Testing results:

- 1,629 grids tested
- 1,616 grids passed
- 13 grids failed
- 99.2% system coverage results

This is obviously an overwhelming success for coverage of the new radio system. The map below provides a graphic depiction of the coverage test results:



Of course, the real test is how well this data relates to “real world” usage; since the time the system was completed and the Sheriff’s Office personnel have started using the system, they have reported excellent radio coverage throughout the entire county. They have also been asked (somewhat jokingly) to “try and find places where it doesn’t work”. As this report is being prepared, no reports have yet been received!

User Agencies and Mobile/Portable Radios:

The new 800 MHz radio system required most agencies in Dodge County to purchase new mobile and portable radios to use the system; the only exception is Fremont Police and Fire departments, which had already moved to the new system several years back (using only the Power Plant repeater site). New mobile and portable radios were purchased for the Dodge County Sheriff's office as part of the core project, as they will be the single largest user of the radio system. Of course, the system is obviously intended for use by all public safety agencies within the county, but these other agencies are required to fund the purchase of their own radios. In an effort to promote initial use of the system, Dodge County purchased and issued two mobile and two portable radios for each agency in the county.

At the time of the inspection in January, the following local agencies are now using the new system on a full-time basis:

- Dodge County Sheriff's Office
- Fremont Police Dept.
- Fremont Fire Dept.
- Dodge/Snyder Police Dept.
- Fremont Rural Fire Dept.
- Hooper Police Dept.
- Nickerson Fire Dept.
- North Bend Fire Dept.
- Scribner Police Dept.
- Uehling Fire Dept.

The following agencies have now ordered radios and are preparing for use of the system:

- Hooper Fire Dept.
- Scribner Fire Dept.

There remain a few rural fire departments who have not yet committed to use of the system, but as others move forward with converting to the new system, it is hoped that these agencies will move from their existing UHF repeaters to the new system.

- Dodge Fire Dept.
- Snyder Fire Dept.
- Winslow Fire Dept.

As this report is being prepared, there are approximately 400 radios now operating on the new system. The system is capable of supporting of at least 700 radios with its current channel configuration, and is easily expanded for even greater capacity if needed in the future.

Training: To assist dispatch and other new radio system users with understanding the details and proper use of the new radio system, radio training was conducted by Tom Christensen for each agency as they prepared to use the system.

System Warranty and Maintenance:

The new 800 MHz Trunked radio system is complex network, far more than anything previously used by Dodge County, with numerous "high tech" components at all tower sites, the Dispatch center, as well as the mobile/portable radios used by the agencies. Much of the system is "software driven" and is again part of the larger ORION network, which requires that all equipment be kept up to date with current software versions. This system software is what

allows the vast functionality of the new systems. The system as purchased from Motorola includes a 1-year warranty period for all items supplied. This warranty period starts at the time the customer begins "beneficial use" of the system, which was on December 1st, 2022. The Warranty period provides comprehensive services for the entire system, to include active monitoring of the network, diagnostic review, remote and on-site technical support, software updates, proactive parts replacement, and routine maintenance.

Upon completion of the one-year warranty period a long-term maintenance plan will begin, which was purchased by Dodge County and will be provided by Motorola. The service work conducted on the system will be provided by a combination of Motorola technical staff and subcontract work by First Wireless of Omaha. This extended maintenance program will cover the system for a period of 10 years.

- The total cost of this 10-year maintenance program is \$2,195,036 (paid annually), which has been included in the long-term project budget. The first payment on this contract will be due in November 2023 (~\$183,649).***

This 10-year maintenance cost total breaks down as follows:

- \$ 704,193.63 ORION/Motorola SUA II/SUS Services Agreement
- \$1,066,638.31 Motorola Radio Network Maintenance
- \$ 53,163.64 Eltek 48VDC Power Plant maintenance
- \$ 371,040.59 Nokia Microwave Radio maintenance

Dodge County has also enlisted the services of Tom Christensen to work as the System Administrator and local service coordinator for the new system as well as the mobile and portable radios now being used by Dodge County agencies. As noted earlier, this is a complex radio system and even the mobile and portable radios will require ongoing attention. The radios will need occasional programming updates to align with operational changes, and having a local coordinator will greatly improve the timeliness of this work and reduce costs. Tom will also represent Dodge County's involvement with the ORION system administration.

Other ongoing Operational costs for the new radio system will include electrical service/use at the tower sites, maintenance of the tower lighting systems, generator maintenance, general building maintenance (HVAC systems, lights, etc.) and upkeep of the property at the tower sites (weed management). These items are not part of the Motorola maintenance program and will need to be included in annual operational budgets. Tom again will be the primary point of contact in tracking the need for and scheduling of these services.

Project Budget

The original amount budgeted for this radio system project was \$9,435,000, which Dodge County bonded for. This amount was based on the master radio system project proposal from Motorola, as well as additional items and work that would be needed to complete the project. During the course of the project there were various Change Orders executed with Motorola as needs changed and/or issues were encountered that needed to be addressed. Items outside of the Motorola contract were also encountered, such as the need for a new tower at the Douglas County Sheriff's Office, to support a new Microwave dish antenna at that site.

A high-level breakout of the overall project budget is as follows:

\$8,878,755	Original Motorola System Proposal
\$ 556,245	Estimated Costs – Other Items (see below)
\$9,435,000	Total Bonded Project Cost

A brief list of the Other Items and Motorola Change Orders needed for the project included:

\$ 87,359	HVAC, Electrical and Grounding upgrades at the Judicial Center for new radio room
\$ 42,030	New In-Building 800 MHz Radio Amplifier System for Courthouse
\$ 95,272	New Tower at Douglas County PSAP
\$ 64,253	Conduit for Fiber Optic at Power Plant and Misc Fiber Optic work
\$ 130,320	RFCC Project Management
\$ 30,000	County Roads work at tower sites
\$ 449,234	Subtotal of Other Items
Motorola Change Orders	
\$ 17,000	Uehling Tower Site Phase 2 Environmental Work
\$ 28,481	Additional 800 MHz RF Consolette Radios at Dispatch
\$ 105,428	Additional Concrete and Rebar at Tower New Sites
(\$ 150,000)	Delete Microwave Link to OPPD Tower
\$ 20,536	Radio Network Management Workstation
\$ 2,949	Misc other items
\$ 24,394	Subtotal of Motorola Change Orders
\$ 473,628	Grand Total of Other Items & Change Orders

Note that the total cost of the Other Items and Change Orders is \$82,617 less than the original estimated amount for these items and work.

Summary

Payment(s) to Motorola: With the system final inspection conducted and report, the project is considered “complete” and any final payment(s) submitted to Motorola, along with a signoff of the Project Acceptance documentation.

Dodge County has made a significant investment in this new 800 MHz radio system, and it will provide the highest level of radio communications performance available for the public safety agencies in the county. The system is designed and implemented to be extremely robust and able to continue operating during the most challenging weather and catastrophic events.

The RFCC team appreciates the opportunity to work with the Dodge County staff over the past few years, and looks forward to assisting you with any future radio system work that may be needed.

Radio system equipment and tower site photos are provided on the following pages.

Sincerely,

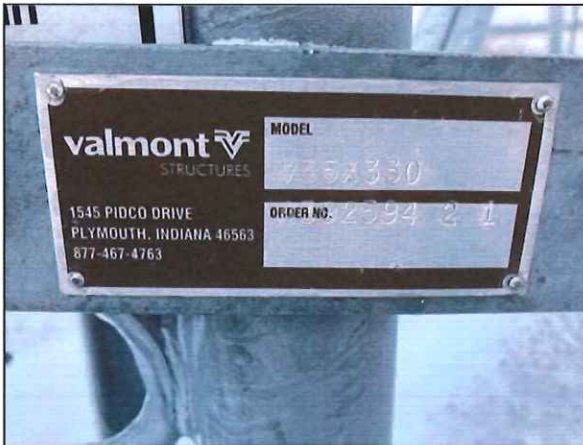
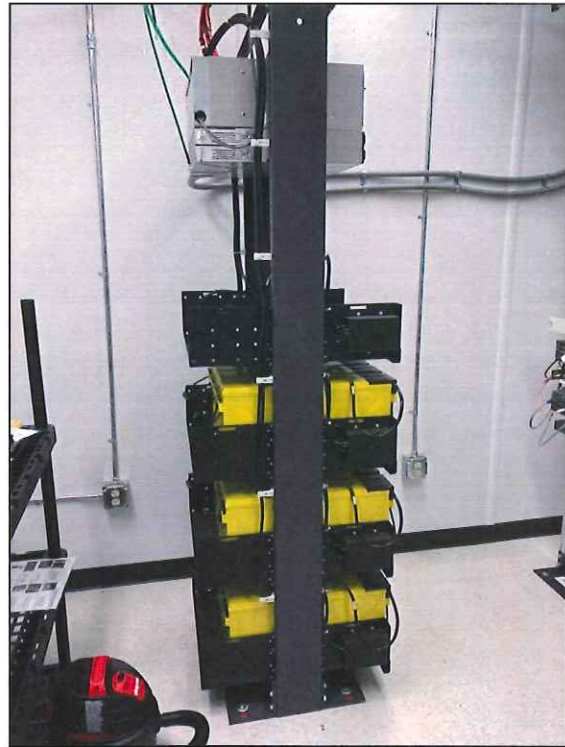
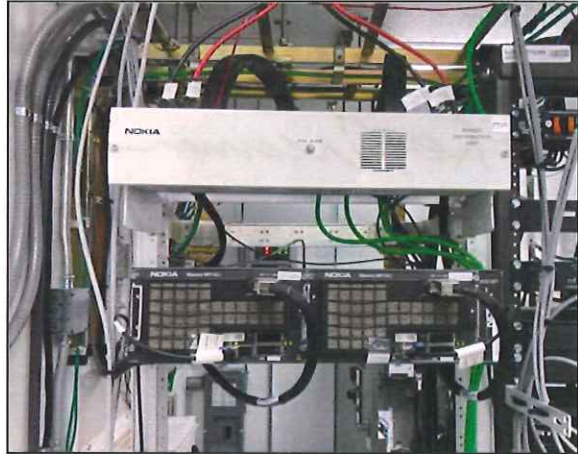
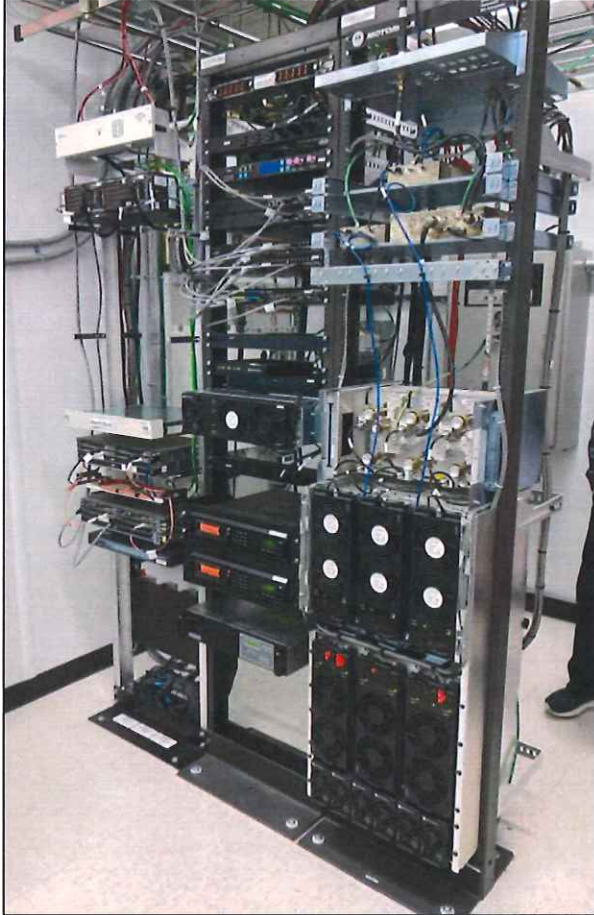
A handwritten signature in black ink that reads "Ray Freeman". The signature is written in a cursive style with a long horizontal flourish at the end.

rfeeman@cpinternet.com

952-541-0747

Dodge County Nebraska Radio System Photos

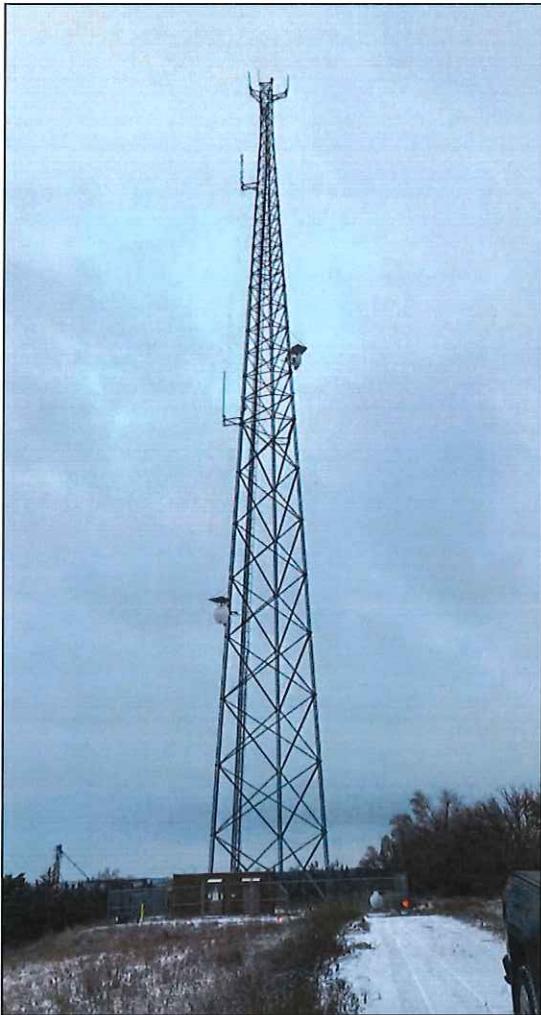
800 MHz Radio System Repeaters, Microwave Radio and 48 VDC Power Plants
(all four tower sites)



Tower Model/Serial Number Plate

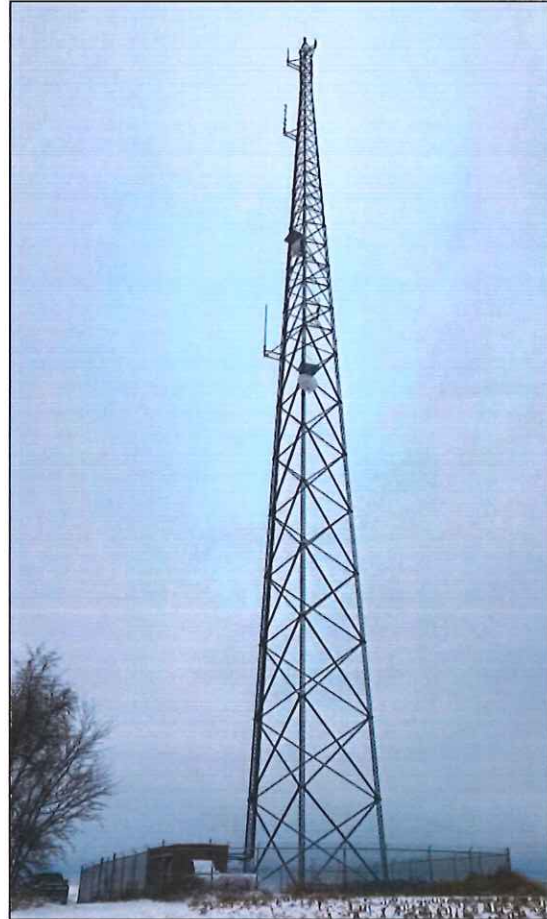
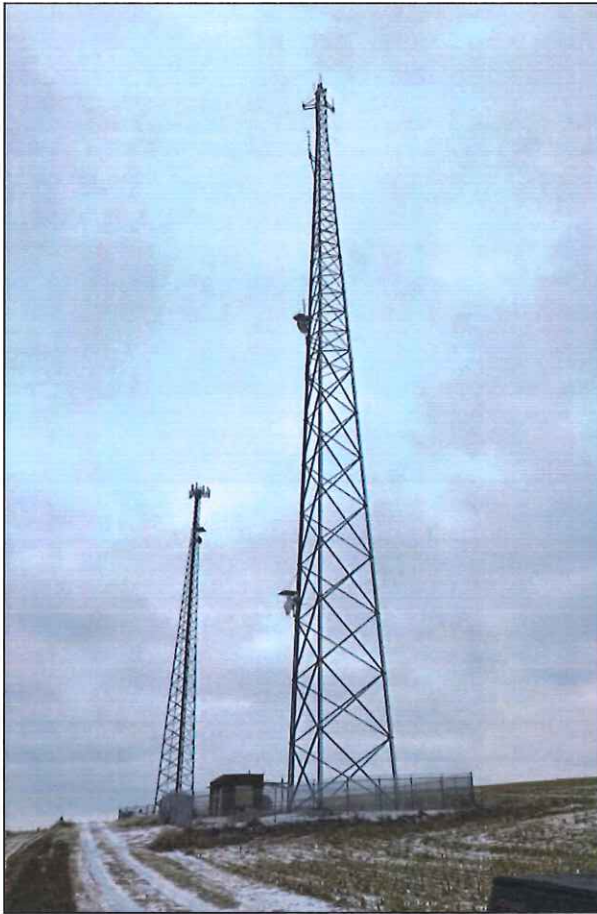
Dodge County Nebraska Radio System Photos

North Bend Tower Site Structure, Shelter, Generator and Propane Tank



Dodge County Nebraska Radio System Photos

Dodge/Snyder and Uehling Tower Site Structures

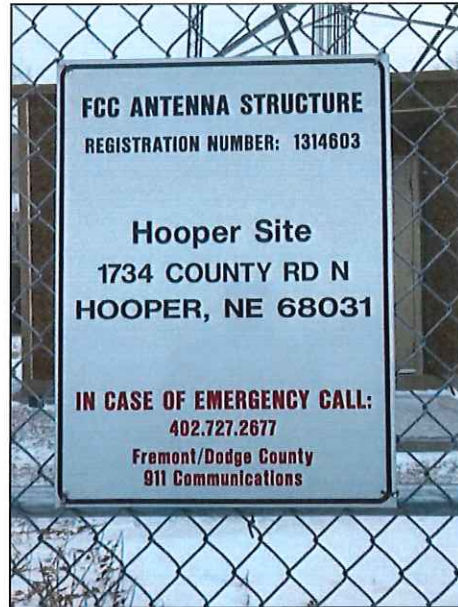


Uehling Site Compound



Dodge County Nebraska Radio System Photos

Hooper Tower Site Structure and Details



THERMOSOND BUILDINGS
 58140 CR 3 South Elkhart, IN. 46517
 Phone (574) 295-1214

DATA PLATE

SERIAL #:	1803-152-1	MANUFACTURED DATE:	5/13/20
BUILDING SIZE:	11'8" x 2'6"	DATE OF ALTERATION:	
NUMBER OF MODULES:	1	DECAL / IN SIGNA #:	
PLAN APPROVAL #:		MFG. LICENSE #:	
MODEL/DRAWING #:	TBB 1138	AGENCY PLAN #:	
STD. PLAN APPROVAL #:		EMPTY BUILDING WEIGHT:	77,000 Lbs

OWNER: Motorola
 LOCATION: Dodge County, NE

OCCUPANCY GROUP:	S2	CONSTRUCTION TYPE:	VB
FLOOR LIVE LOAD:	300 PSF	ROOF LIVE LOAD:	150 psf
FLOOR DEAD LOAD:	58 PSF	ROOF DEAD LOAD:	75 psf
MAXIMUM FLOOR LOAD:	320 PSF	WIND SPEED:	162 mph (3 sec. Gust)
MAX. SNOW LOAD:	150 PSF	WIND SPEED CAT.:	D
SEISMIC DESIGN CAT.:	D		

ELECTRICAL SERVICE: 120/240 AMP: 200 PHASE: Single
 TEST VOLTAGE / TIME: 1080v/1 sec

HVAC MAKE: Baird MODEL: W42AC A/C: 41,800 BTU HEATKW: 5

INSULATION R / U value: R 11.4 WALLS R-18 ROOF N/A FLOOR
 PERMISSIBLE GAS / TYPE:

APPLICABLE CODES:
 2015 International Building Code w/ State Amendments
 2015 International Mechanical Code w/ State Amendments
 2015 International Energy Conservation Code w/ State Amendments
 2017 National Electrical Code

FIRE RATING EXTERIOR WALLS: N/A
 SPRINKLER SYSTEM REQUIRED: YES NO
 SPRINKLER SYSTEM PROVIDED: YES NO

SPECIAL CONDITIONS AND/OR LIMITATIONS

