

ENGINEERING EXHIBIT

Digital Low Power Television Station Application for Minor Modification of Construction Permit prepared for

Gray Television Licensee, LLC
K29OE-D Racine, MN
Facility ID 186458
Ch. 29 1 kW Directional

Gray Television Licensee, LLC (“Gray”) is the licensee of digital Low Power Television station K29OE-D, Channel 29, Facility ID 186458, Racine MN. K29OE-D is licensed to operate at 1.55 kW effective radiated power (“ERP”) with a directional antenna (file# 0000179250, granted April 13, 2022). A Construction Permit (file# 0000197968) authorizes relocation of K29OE-D and use of an alternate directional antenna at 15 kW ERP and increased height. *Gray* herein seeks a minor modification of the CP to utilize the licensed directional antenna as relocated to the same site authorized by the CP at reduced ERP.

The proposed facility will employ an antenna to be side-mounted on an existing tower structure having an overall height above ground of 45.7 meters. The structure does not require an FCC Antenna Structure Registration number since its overall height is less than 61 meters above ground and the structure passes the FCC’s “TOWAIR” slope test program. The proposed location, 20.2 km (12.6 miles) from the licensed site, is at the studio location for K29OE-D and *Gray*’s full power television station KTTC (Facility ID 35678, Rochester, MN). No change to the overall structure height is proposed.

The proposed antenna (the same as currently licensed) is a Kathrein model K723147 (single panel) having horizontal polarization. The proposed ERP is 1 kW using a “full service” out of channel emission mask. A plot of the directional antenna’s azimuthal pattern is supplied in Figure 1. Figure 2 depicts the coverage contour of the proposed facility as well as that of the licensed facility, demonstrating compliance with §73.3572 for a minor change.

After obtaining a license to cover the proposed facility, *Gray* will submit another minor modification application for authority to raise the K29OE-D ERP to 15 kW utilizing a different directional antenna having a wider azimuthal pattern with no further change of site location. Those will be the same technical parameters that are authorized by the current CP (file# 0000179250). Meanwhile, the 1 kW ERP facility proposed herein can be constructed in a short timeframe by utilizing certain existing equipment from the licensed operation.

Interference study per OET Bulletin 69¹ shows that the proposal complies with the FCC's interference protection requirements toward all digital television, television translator, LPTV, and Class A stations. The results, summarized in Table 1, show that any new interference does not exceed the FCC's interference limits (0.5 percent to full power and Class A stations, and 2.0 percent to secondary stations) to any facility.

Human Exposure to Radiofrequency Electromagnetic Field (Environmental)

The proposed facility was evaluated for human exposure to RF energy using the procedures outlined in the FCC's OET Bulletin Number 65. Based on OET-65 equation (10) and 20 percent antenna relative field in downward elevations (pattern data shows 20 percent or less relative field at angles 30 to 90 degrees below the antenna), the calculated power density attributable to the proposed facility at locations near the transmitter site at a height of two meters above ground level is $0.9 \mu\text{W}/\text{cm}^2$, which is 0.2 percent of the general population / uncontrolled maximum permissible exposure limit. This is well below the five percent threshold limit described in §1.1307(b) regarding sites with multiple emitters, categorically excluding the applicant from responsibility for taking any corrective action in the areas where the proposal's contribution is less than five percent.

The general public will not be exposed to RF levels attributable to the proposal in excess of the FCC's guidelines. RF exposure warning signs will be posted. With respect to worker safety, the applicant will coordinate exposure procedures with all pertinent stations and will reduce power

¹FCC Office of Engineering and Technology Bulletin number 69, *Longley-Rice Methodology for Evaluating TV Coverage and Interference*, February 6, 2004 ("OET-69"). This analysis employed the FCC's current "TVStudy" software with the default application processing template settings, 1 km cell size, and 1 km terrain increment. Comparisons of various results of this computer program (run on a Mac processor) to the FCC's implementation of TVStudy show excellent correlation.

or cease operation as necessary to protect persons having access to the site, tower, or antenna from RF electromagnetic field exposure in excess of FCC guidelines. This exhibit is limited to the evaluation of exposure to RF electromagnetic field. No increase in structure height is proposed.

List of Attachments

Figure 1	Antenna Azimuthal Pattern
Figure 2	Coverage Contour Comparison
Table 1	TVStudy Analysis of Proposal
Form 2100	Saved Version of Engineering Sections of FCC Form at Time of Upload

Chesapeake RF Consultants, LLC

Joseph M. Davis, P.E.	April 17, 2023	
207 Old Dominion Road	Yorktown, VA 23692	703-650-9600

**Azimuth Pattern - Relative Field
(True North)**

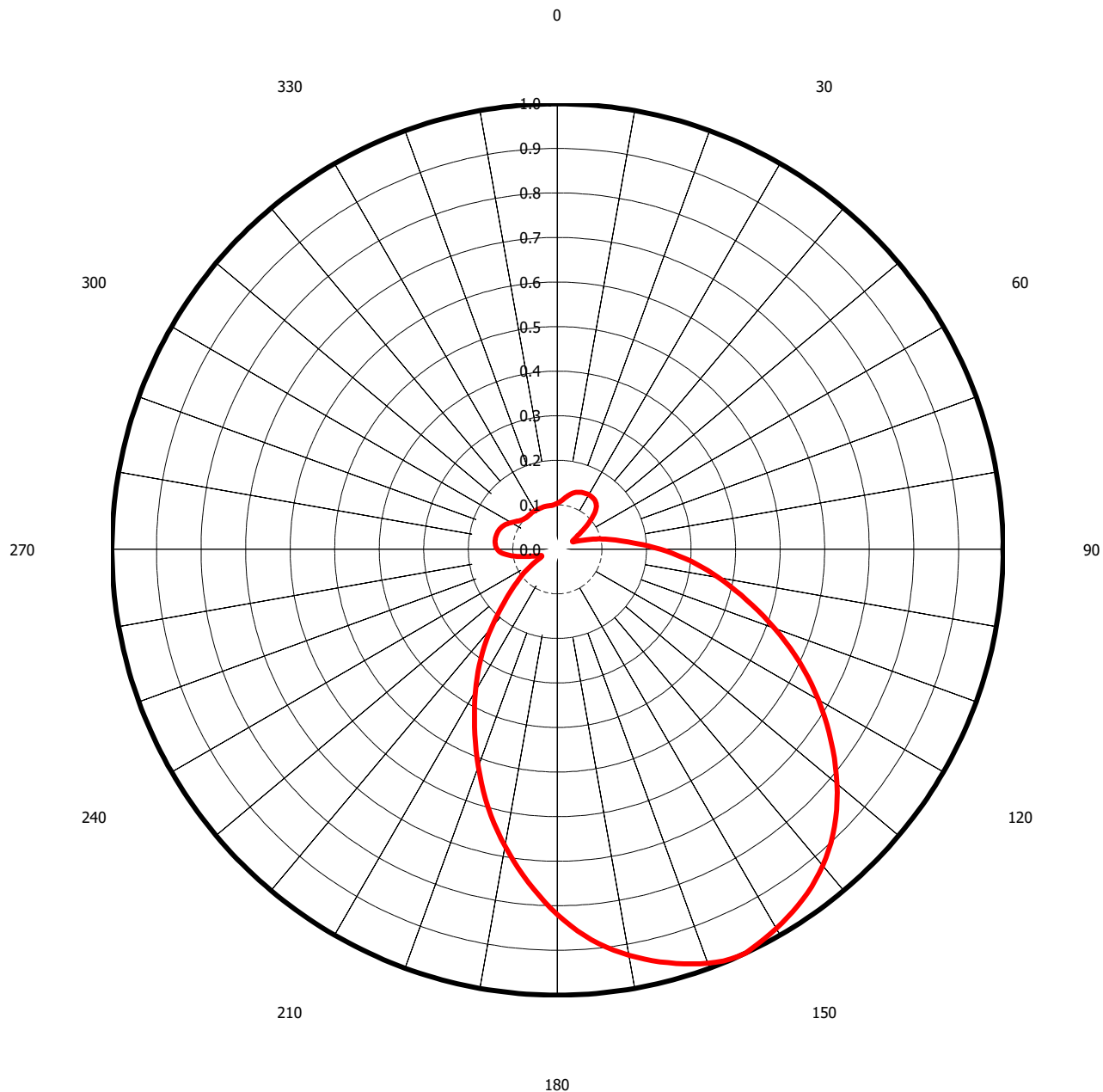


Figure 1
Antenna Azimuthal Pattern
K29OE-D Racine, MN
Facility ID 186458
Ch. 29 1 kW Directional

prepared for
Gray Television Licensee, LLC

April, 2023



Chesapeake RF Consultants, LLC
Radiofrequency Consulting Engineers
Digital Television and Radio

Figure 2
Coverage Contour Comparison
K290E-D Racine, MN
Facility ID 186458
Ch. 29 1 kW Directional

prepared for
Gray Television Licensee, LLC

April, 2023

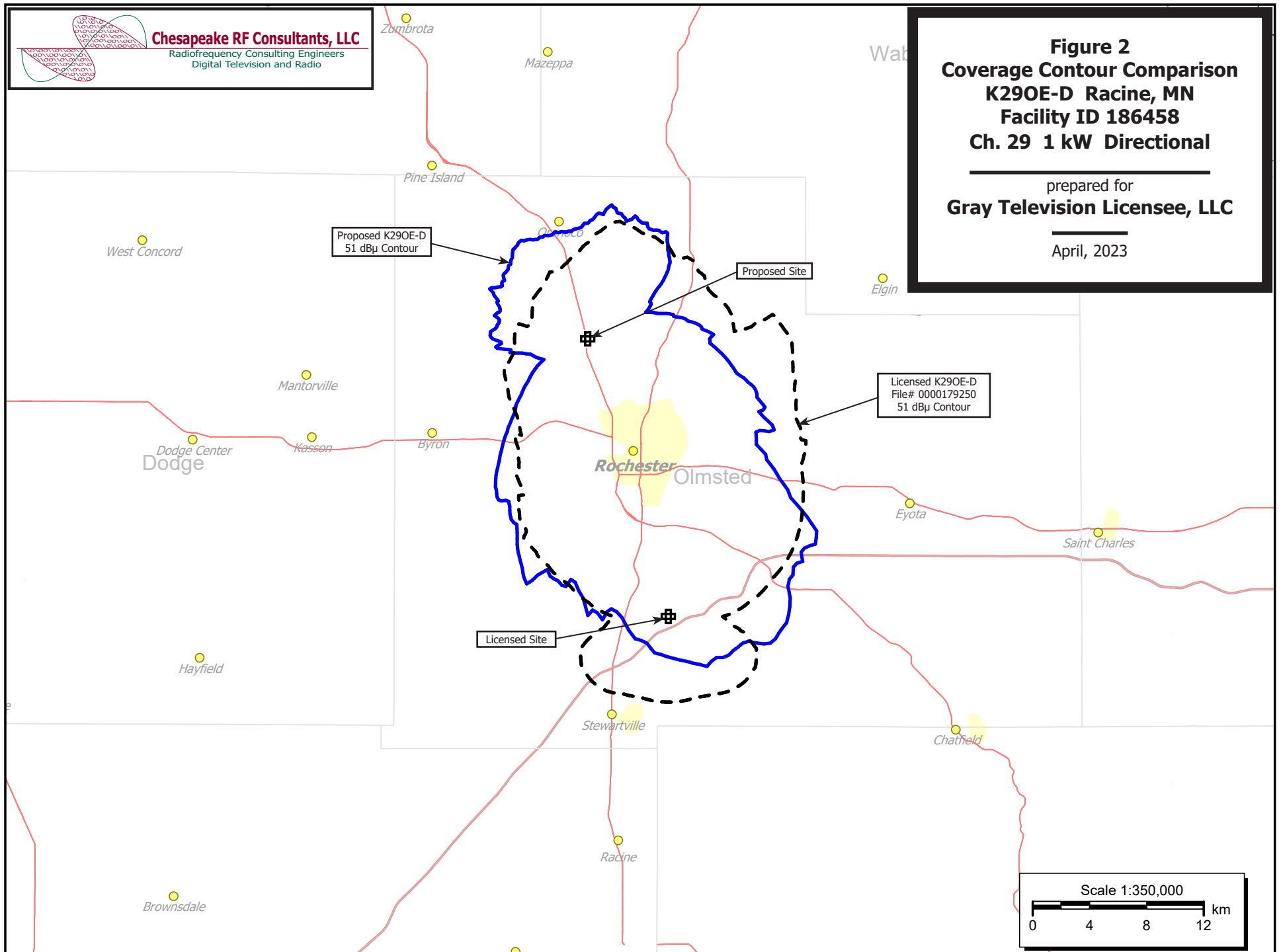


Table 1 K290E-D TVStudy Analysis of Proposal (page 1 of 3)



tvstudy v2.2.5 (4uoc83)
Database: localhost, Study: K290E-D Studio_1kW, Model: Longley-Rice
Start: 2023.04.17 14:44:43

Study created: 2023.04.17 14:44:43

Study build station data: LMS TV 2023-04-17

Proposal: K290E-D D29 LD APP RACINE, MN
File number: K290E-D Studio_1kW
Facility ID: 186458
Station data: User record
Record ID: 4951
Country: U.S.

Build options:
Protect pre-transition records not on baseline channel

Search options:
Baseline record excluded if station has CP

Stations potentially affected by proposal:

IX	Call	Chan	Svc	Status	City, State	File Number	Distance
No	K28PQ-D	D28	LD	LIC	SAINT CLOUD, MN	BLANK0000089168	171.9 km
No	K28OH-D	D28	LD	LIC	ST. JAMES, MN	BLANK0000064440	166.5
No	WXOW	D28	DT	LIC	LA CROSSE, WI	BLANK0000058613	96.7
No	KGAN	D29	DT	LIC	CEDAR RAPIDS, IA	BLCDT20140416AAI	204.3
No	DDK30NF-D	D29	LD	APP	KEOKUK, IA	BLANK0000072001	421.2
No	KBWF-LD	D29	LD	LIC	SIOUX CITY, IA	BLANK0000063408	364.2
No	WAUR-LD	D29	LD	LIC	AURORA, IL	BLANK0000107754	418.7
No	WMAQ-TV	D29	DT	LIC	CHICAGO, IL	BLANK0000053194	466.3
No	K29NY-D	D29	LD	LIC	ALEXANDRA, MN	BLANK0000195944	308.3
No	K29NY-D	D29	LD	APP	ALEXANDRA, MN	BLANK0000212504	308.3
No	K29IF-D	D29	LD	LIC	FROST, MN	BLDTL20080505ABD	127.0
No	K29EB-D	D29-	LD	LIC	GRAND RAPIDS, MN	BLANK0000016819	367.4
No	K29EB-D	N29-	TX	LIC	GRAND RAPIDS, MN	BLTT20021011AAW	367.4
No	K29LV-D	D29	LD	LIC	JACKSON, MN	BLANK0000064447	206.3
Yes	WFTC	D29	DT	LIC	MINNEAPOLIS, MN	BLCDT20100809CJF	117.9
No	K48GQ-D	D29	LD	LIC	REDWOOD FALLS, MN	BLANK0000063427	201.9
No	K29IE-D	D29	LD	LIC	ST. JAMES, MN	BLDTT20090817ACY	166.8
No	KXVO	D29	DT	LIC	OMAHA, NE	BLANK0000189938	453.0
No	W29ET-D	D29	LD	LIC	COLOMA, WI	BLANK0000060433	235.8
No	WDJT-TV	D29	DT	LIC	MILWAUKEE, WI	BLANK0000086892	384.3
No	WPVS-LD	N29z	TX	LIC	MILWAUKEE, WI	BLTTL20080221AAP	372.2
No	KSTC-TV	D30	DT	LIC	MINNEAPOLIS, MN	BLANK0000202445	118.8
No	K30QY-D	D30	LD	LIC	OAKLAND, MN	BLANK0000194532	89.0
No	K30QY-D	D30	LD	CP	OAKLAND, MN	BLANK0000195575	113.2
No	K30RA-D	D30	LD	LIC	RACINE, MN	BLANK0000178831	20.2
No	K30RA-D	D30	LD	CP	RACINE, MN	BLANK0000197967	0.0
No	K30FN-D	D30	LD	LIC	ST. JAMES, MN	BLANK0000124535	166.5
No	WEAU	D30	LD	LIC	EAU CLAIRE, WI	BLANK0000124038	96.5

No non-directional AM stations found within 0.8 km

No directional AM stations found within 3.2 km

Record parameters as studied:

Channel: D29
Mask: Full Service
Latitude: 44 5 32.00 N (NAD83)
Longitude: 92 30 34.00 W
Height AMSL: 383.7 m
HAAT: 0.0 m
Peak ERP: 1.00 kW
Antenna: KAT-1x K723147 (ID 1008960) 155.0 deg
Elev Pattn: Generic

50.2 dBu contour:
Azimuth ERP HAAT Distance
0.0 deg 0.011 kW 66.5 m 8.5 km
45.0 0.014 56.8 8.4

Table 1 K29OE-D TVStudy Analysis of Proposal
(page 2 of 3)



90.0	0.055	33.3	8.9
135.0	0.774	53.1	22.1
180.0	0.664	48.3	20.3
225.0	0.029	33.2	7.6
270.0	0.017	36.5	7.0
315.0	0.010	62.1	8.0

Database HAAT does not agree with computed HAAT

Database HAAT: 0 m Computed HAAT: 49 m

Distance to Canadian border: 445.2 km

Distance to Mexican border: 1774.4 km

Conditions at FCC monitoring station: Allegan MI

Bearing: 105.1 degrees Distance: 554.7 km

Proposal is not within the West Virginia quiet zone area

Conditions at Table Mountain receiving zone:

Bearing: 251.7 degrees Distance: 1134.5 km

Study cell size: 1.00 km

Profile point spacing: 1.00 km

Maximum new IX to full-service and Class A: 0.50%

Maximum new IX to LPTV: 2.00%

Interference to BLCDT20100809CJF LIC scenario 1

Desired:	Call WFTC	Chan D29	Svc DT	Status LIC	City, State MINNEAPOLIS, MN	File Number BLCDT20100809CJF	Distance		
Undesireds:	K29OE-D	D29	LD	APP	RACINE, MN	K29OE-D Studio_1kW	117.9 km		
	KGAN	D29	DT	LIC	CEDAR RAPIDS, IA	BLCDT20140416AAI	321.3		
	KSTC-TV	D30	DT	LIC	MINNEAPOLIS, MN	BLANK0000202445	1.3		
Service area		Terrain-limited			IX-free, before		IX-free, after	Percent New IX	
36050.2	3,786,936	35475.6	3,771,055		35103.5	3,755,740	34984.9	3,754,108	0.34 0.04
Undesired				Total IX		Unique IX, before		Unique IX, after	
K29OE-D	D29	LD	APP	166.9		3,354		118.6	1,632
KGAN	D29	DT	LIC	152.0		5,363		102.7	3,645
KSTC-TV	D30	DT	LIC	222.1		9,967		219.1	9,933

Interference to proposal scenario 1

5.58% interference received

	Call	Chan	Svc	Status	City, State	File Number	Distance
Desired:	K29OE-D	D29	LD	APP	RACINE, MN	K29OE-D Studio_1kW	
Undesireds:	KGAN	D29	DT	LIC	CEDAR RAPIDS, IA	BLCDT20140416AAI	204.3 km
	K29NY-D	D29	LD	LIC	ALEXANDRA, MN	BLANK0000195944	308.3
	WFTC	D29	DT	LIC	MINNEAPOLIS, MN	BLCDT20100809CJF	117.9
	K30QY-D	D30	LD	LIC	OAKLAND, MN	BLANK0000194532	89.0
	K30RA-D	D30	LD	LIC	RACINE, MN	BLANK0000178831	20.2
Service area		Terrain-limited		IX-free		Percent IX	
507.6	119,990	505.6	119,969	411.6	113,276	18.58	5.58
Undesired				Total IX	Unique IX	Prcnt Unique IX	
KGAN D29 DT LIC				4.0	59	0.00	0.00
WFTC D29 DT LIC				87.9	4,780	14.19	3.43
K30RA-D D30 LD LIC				18.2	2,514	1.20	1.59

Interference to proposal scenario 2

9.11% interference received

Table 1 K29OE-D TV Study Analysis of Proposal
(page 3 of 3)



	Call	Chan	Svc	Status	City, State	File Number	Distance
Desired:	K29OE-D	D29	LD	APP	RACINE, MN	K29OE-D Studio_1kW	
Undesireds:	KGAN	D29	DT	LIC	CEDAR RAPIDS, IA	BLCDT20140416AAI	204.3 km
	K29NY-D	D29	LD	LIC	ALEXANDRA, MN	BLANK0000195944	308.3
	WFTC	D29	DT	LIC	MINNEAPOLIS, MN	BLCDT20100809CJF	117.9
	K30QY-D	D30	LD	LIC	OAKLAND, MN	BLANK0000194532	89.0
	K30RA-D	D30	LD	CP	RACINE, MN	BLANK0000197967	0.0
	Service area	Terrain-limited		IX-free		Percent IX	
	507.6	119,990	505.6	119,969	388.5	109,034	23.16 9.11
Undesired				Total IX	Unique IX	Prct Unique IX	
KGAN D29 DT LIC				4.0 59	0.0	0	0.00 0.00
WFTC D29 DT LIC				87.9 4,780	80.8	3,591	15.99 2.99
K30RA-D D30 LD CP				32.3 7,285	29.2	6,155	5.78 5.13

**Channel and
Facility
Information**

Section	Question	Response
Facility ID	186458	
State	Minnesota	
City	RACINE	
LPD Channel	29	

Antenna Location
Data

Section	Question	Response
Antenna Structure Registration	Do you have an FCC Antenna Structure Registration (ASR) Number?	No
	ASR Number	
Coordinates (NAD83)	Latitude	44° 05' 32.0" N+
	Longitude	092° 30' 34.0" W-
	Structure Type	LTOWER-Lattice Tower
	Overall Structure Height	47.5 meters
	Support Structure Height	42.1 meters
	Ground Elevation (AMSL)	342.6 meters
Antenna Data	Height of Radiation Center Above Ground Level	41.1 meters
	Height of Radiation Center Above Mean Sea Level	383.7 meters
	Effective Radiated Power	1 kW

Antenna
Technical Data

Section	Question	Response
Antenna Type	Antenna Type	Directional Custom
	Do you have an Antenna ID?	Yes
	Antenna ID	1008960
Antenna Manufacturer and Model	Manufacturer:	KAT
	Model	1x K723147
	Rotation	155 degrees
	Electrical Beam Tilt	Not Applicable
	Mechanical Beam Tilt	Not Applicable
	toward azimuth	
	Polarization	Horizontal
Elevation Radiation Pattern	Does the proposed antenna propose elevation radiation patterns that vary with azimuth for reasons other than the use of mechanical beam tilt?	No
	Uploaded file for elevation antenna (or radiation) pattern data	
	Out-of-Channel Emission Mask:	Full Service

Directional Antenna Relative Field Values (Pre-rotated Pattern)

Degree	Value	Degree	Value	Degree	Value	Degree	Value
0	1.000	90	0.04	180	0.10	270	0.04
10	0.96	100	0.06	190	0.10	280	0.09
20	0.88	110	0.12	200	0.10	290	0.17
30	0.75	120	0.14	210	0.11	300	0.30
40	0.60	130	0.14	220	0.13	310	0.44
50	0.44	140	0.13	230	0.14	320	0.60
60	0.30	150	0.11	240	0.14	330	0.75
70	0.17	160	0.10	250	0.12	340	0.88
80	0.09	170	0.10	260	0.06	350	0.96

Additional Azimuths

Degree	V _A
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