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**Engineering Statement
Digital Replacement Translator Application for KOPB-TV
Channel 48 at Portland, Oregon
January 2012**

This Engineering Statement has been prepared on behalf of Oregon Public Broadcasting, licensee of non-commercial television station KOPB-TV at Portland, Oregon. This material has been prepared in connection with an application for a digital replacement translator to ensure that KOPB-TV digital service is provided to viewers in portions of Portland, Oregon whose reception is affected by terrain shadowing and receiver-induced intermodulation products.

Portions of southwest Portland are situated on the opposite side of a ridge which lies on the path from the main KOPB-TV transmitter site. This ridge has always presented challenges to TV and FM reception in this area (which includes the Macadam area where OPB's studios are located), and OPB's experience is that over-the-air reception of KOPB-TV in this area of Portland has become less reliable since the analog shut-off. The addition of a digital replacement translator will allow OPB to provide a reliable digital signal to this area.

Interference from FM Stations

This particular portion of Portland is also located close to nearly every full-power FM station licensed to the Portland market, which has resulted in confirmed cases of intermodulation interference to reception of KOPB-TV on high-band VHF Channel 10. In the article "Testing for DTV Interference" published in TV Technology on June 22, 2009 (available online at www.tvtechnology.com/article/82716), Charles W. Rhodes described the mechanisms by which high-power FM signals can produce second harmonic and A+B mix products in DTV receivers which fall within high-band VHF channels. The A+B mix products are particularly problematic because they manifest 6 dB stronger than either of the second harmonics.

In the Portland market where KOPB-TV is located there are fifteen high-power FM stations which produce either second harmonic or A+B mix products in the receiver which fall within the 192-198 MHz spectrum of Channel 10. Those stations, many of which operate with a full 100 kW ERP, are:

Callsign	Frequency	Community of License	ERP
KBOO	90.7 MHz	Portland	26.5 kW
KOPB-FM	91.5 MHz	Portland	73 kW
KGON	92.3 MHz	Portland	100 kW
KPDQ-FM	93.9 MHz	Portland	52 kW
KBFF	95.5 MHz	Portland	100 kW
KYCH-FM	97.1 MHz	Portland	100 kW
KUPL-FM	98.7 MHz	Portland	37 kW
KWJJ-FM	99.5 MHz	Portland	52 kW
KKRZ	100.3 MHz	Portland	100 kW
KXL-FM	101.1 MHz	Portland	100 kW
KINK	101.9 MHz	Portland	100 kW
KKCW	103.3 MHz	Beaverton	100 kW
KRSK	105.1 MHz	Molalla	22.5 kW
KFBW	105.9 MHz	Vancouver	22.5 kW
KLTH	106.7 MHz	Lake Oswego	100 kW

Of these stations, there are two which produce second harmonics within the Channel 10 spectrum, namely KYCH-FM 97.1 MHz (second harmonic 194.2 MHz) and KUPL-FM 98.7 MHz (second harmonic 197.4 MHz). More significantly, among all fifteen FM stations in this list there are 30 separate frequency combinations which have potential to produce A+B mix products in the receiver within the Channel 10 spectrum.

Mr. Rhodes happens to live near Portland, and as described in the article has performed tests of ten NTIA-approved downconverters at his home 14 miles from the FM towers. Those tests confirmed that the total received power of the FM signals was -26 dBm, *some 10 dB stronger* than any DTV signal at that location.

As noted in Mr. Rhodes' article, interference from FM stations to high-band VHF can be eliminated by utilizing either an FM trap or a 75 ohm high pass filter (which attenuates FM and low-band VHF signals, but passes high-band VHF and UHF signals) at the input to affected DTV receivers. Indeed, OPB engineers have first-hand field experience with the use of these techniques. In numerous cases, the application of either an FM trap or high pass filter has resulted in a marked improvement in reception of KOPB-TV on affected receivers. The additional filtering has often made the difference between truly robust reception and marginal or no reception of KOPB-TV.

This first-hand experience demonstrates that not only is the FM interference mechanism described above a theoretical possibility, but it is also a real-world fact affecting reception of KOPB-TV. Nevertheless the use of filtering techniques, while a solution in individual cases, is not a universal solution owing to the impracticality of providing every affected receiver with an appropriate filter. Many viewers experiencing reception problems will not know where to turn for help, and many will simply assume that nothing can be done.

I. Allocation Study

Study has been made of all cochannel and adjacent-channel facilities in the vicinity of the proposed operation, including a detailed Longley-Rice interference study to demonstrate that the proposed operation will not cause interference to any facilities with which contour overlap exists. This study was performed using the SunDTV program from V-Soft Communications and a 1 km grid spacing. The SunDTV program identically duplicates the FCC's OET-69 processing program.

The results of this study indicate that the proposed facility is predicted to cause zero additional interference to any of the listed stations. Based on the foregoing allocation and interference study, it is believed that the proposed facility can operate without risk of interference to other stations.

Summary Study

Percent allowed new interference: 0.500
Percent allowed new interference to non Class A LPTV: 2.000
Census data selected 2000
Data Base Selected
./data_files/pt_tvdb.sff
TV INTERFERENCE and SPACING ANALYSIS PROGRAM

Date: 01-23-2012 Time: 15:47:25

Record Selected for Analysis

PORT USERRECORD-01 PORTLAND OR US
Channel 48 ERP 1. kW HAAT 264. m RCAMSL 00357 m STRINGENT MASK
Latitude 045-29-25 Longitude 0122-41-45
Status APP Zone 2 Border Site number: 01
Dir Antenna Make usr Model USRPAT01 Beam tilt N Ref Azimuth 0.
Last update Cutoff date Docket
Comments
Applicant

Cell Size for Service Analysis 1.0 km/side

Distance Increments for Longley-Rice Analysis 1.00 km

Not full service station
Service Class = LD
Maximum height/power limits not checked

Site number	1			
Azimuth	ERP	HAAT	51.0 dBu F(50,90)	
(Deg)	(kW)	(m)	(km)	
0.0	1.000	293.8	40.6	
45.0	1.000	295.9	40.4	
90.0	1.000	272.1	39.4	
135.0	1.000	297.6	40.5	
180.0	1.000	247.6	38.2	
225.0	1.000	270.8	39.3	
270.0	1.000	281.5	39.8	
315.0	1.000	143.1	32.2	

Contour Overlap to Proposed Station
Station
KUNP-LP 47 PORTLAND OR BLTTL20060809ABC

Station inside contour of Digital LPTV station
PORT 48 PORTLAND OR USERRECORD01

Contour Overlap Evaluation to Proposed Station Complete

NO LANDMOBILE SPACING VIOLATIONS FOUND

Checks to Site Number 01

Proposed facility OK to FCC Monitoring Stations

Proposed facility OK toward West Virginia quiet zone

Proposed facility OK toward Table Mountain

Proposed facility is within the Canadian coordination distance
Distance to border = 310.2km

Proposed facility is beyond the Mexican coordination distance

Proposed station is OK toward AM broadcast stations

Start of Interference Analysis

Channel	Call	City/State	ARN
48	PORT	PORTLAND OR	USERRECORD01

Stations Potentially Affected by Proposed Station

Chan	Call	City/State	Dist(km)	Status	Application	Ref. No.
34	K34KE	HOOD RIVER OR	91.3	LIC	BLTT	-20100323AAM
34	K34HK	LONGVIEW WA	79.3	LIC	BLTTL	-20080509AAL
40	K40EG	TILLAMOOK OR	88.1	LIC	BLTT	-19960130JA
45	K45CV	CORVALLIS OR	111.5	LIC	BLTT	-19930604IG
47	K47AV	COTTAGE GROVE OR	192.3	CP	BDFCDTT	-20081003AEI
47	K47AV	COTTAGE GROVE OR	192.4	LIC	BLTT	-19860113IE
47	KUNP-LP	PORTLAND OR	5.0	LIC	BLTTL	-20060809ABC
47	KUNP-LP	PORTLAND OR	5.0	CP	BDFCDTL	-20111208ABV
47	K47LM-D	PRINEVILLE, ETC. OR	180.1	LIC	BLDTT	-20100511ACM
47	K47CD	ROCKAWAY OR	100.7	LIC	BLTT	-20030610AAF
47	K47CD	ROCKAWAY BEACH OR	100.7	CP	BDFCDTT	-20100429ABA
47	KCST-LP	HOQUIAM WA	203.3	LIC	BLTTL	-20090330AIY
47	NEW	YAKIMA WA	203.9	APP	BNPDTL	-20090825AMW
48	K48DC	BAKER CITY, ETC. OR	398.3	LIC	BLTT	-20081202AGT
48	K48GO-D	CAVE JUNCTION OR	367.4	LIC	BLDTL	-20110128ACT
48	K48MP-D	CORVALLIS OR	111.4	LIC	BLDTT	-20111031ADB
48	K48KC-D	COTTAGE GROVE OR	192.3	LIC	BLDTT	-20090330AAO
48	K48GC	FLORENCE OR	202.3	CP	BDFCDTL	-20090818AAC
48	K48GC	FLORENCE OR	202.3	LIC	BLTTA	-20020701AAI
48	K48DZ-D	HERMISTON OR	269.3	LIC	BLDTL	-20110817AAL
48	K48HV-D	KLAMATH FALLS OR	386.5	LIC	BLDTL	-20100928AAC
48	KFBI-LD	MEDFORD OR	354.8	LIC	BLDTL	-20091016ABK
48	K48MA-D	RAINIER OR	75.7	LIC	BLDTT	-20110825AAY
48	NEW	ROSEBURG OR	260.1	APP	BNPDTL	-20091014AFE
48	K48BL	TERREBONNE-BEND, ETC OR	173.1	LIC	BLTTA	-20010711ABF
48	KING-TV	SEATTLE WA	239.5	CP	BPCDT	-20080617AED
48	KING-TV	SEATTLE WA	239.5	LIC	BLCDDT	-19981026KE
48	NEW	YAKIMA WA	208.6	APP	BNPDTL	-20090825BIN
49	K49KT-D	BEND OR	197.5	LIC	BLDTL	-20101004AAQ
49	KAMK-LP	EUGENE OR	168.6	CP	BDISDTL	-20110817ADL
49	KWVT-LD	SALEM OR	5.7	LIC	BLDTL	-20110208ADU
49	NEW	CENTERVILLE WA	140.3	APP	BNPDTL	-20100513ADZ
49	K49IX-D	PUYALLUP WA	190.0	LIC	BLDTT	-20090610ACB
49	K49GF	YAKIMA, ETC. WA	205.6	LIC	BLTTL	-20040616AAK
50	K50CE	HOOD RIVER OR	91.3	LIC	BLTT	-20100322ADH
50	K50GG	SALEM OR	66.1	LIC	BLTTL	-20020916ABF
51	K51FK	NEHALEM, ROCKAWAY OR	100.4	LIC	BLTTL	-19990528JF
51	KOXO-CA	NEWBERG OR	5.3	LIC	BLTTA	-20070831ADA
51	KHPN-LD	WARRENTON OR	108.8	CP	BPTTL	-20090427ACZ
52	K52CH	MAUPIN OR	132.7	LIC	BLTT	-19980427JD
56	K56CD	MAUPIN OR	132.7	LIC	BLTT	-19980427JB

%%%

Study of this proposal found the following interference problem(s):

NONE.

II. RF Exposure Study

OET Bulletin 65 Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields (Edition 97-01) states in part that:

When performing an evaluation for compliance with the FCC's RF guidelines all significant contributors to the ambient RF environment should be considered. . . For purposes of such consideration, significance can be taken to mean any transmitter producing more than 5% of the applicable exposure limit (in terms of power density or the square of the electric or magnetic field strength) at accessible locations.

As will be demonstrated below, the proposed operation will produce less than 5% of the applicable exposure limit for both controlled and uncontrolled environments. Thus, the proposed facility is categorically excluded from the requirement of further study. Therefore, pursuant to §1.1307(b)(3) of the Commission's Rules no calculations are required for the other FM and TV facilities in the vicinity, and precise calculations are made only with regard to the levels from this proposal.

The power density calculations shown below were made using the techniques outlined in OET Bulletin No. 65. "Ground level" calculations in this report have been made at a reference height of 2 meters above ground to provide a worst-case estimate of exposure for persons standing on the ground in the vicinity of the tower. The equation shown below was used to calculate the ground level power density figures from each antenna.

$$S(\mu W / cm^2) = \frac{33.40981 \times AdjERP(Watts)}{D^2}$$

Where: *AdjERP(Watts)* is the maximum lobe effective radiated power times the element pattern factor times the array pattern factor.

D is the distance in meters from the center of radiation to the calculation point.

Power density levels produced by the proposed facility were calculated for an elevation of 2 meters above ground (41 meters below the antenna radiation center). The worst case power density levels occur at depression angles between 45 and 90 degrees below the horizontal. The calculations in this report assume a worst-case relative field value of 0.244 at these angles, based on the manufacturer's vertical plane pattern for the horizontally-polarized Scala SL8 antenna proposed

in this application. This relative field value yields a worst-case adjusted average effective radiated power of 59.5 watts at depression angles between 45 and 90 degrees below the horizontal. Assuming this power and the shortest distance between the antenna radiation center and 2 meters above ground level (i.e. straight down), the highest calculated power density from the proposed antenna alone occurs at the base of the antenna support structure. At this point the power density is calculated to be $1.2 \mu\text{W}/\text{cm}^2$, which is <1% of $449 \mu\text{W}/\text{cm}^2$ (the FCC maximum for uncontrolled environments at the Channel 48 frequency).

These calculations show that the worst-case maximum calculated power density produced at two meters above ground level by the proposed operation alone is less than 5% of the applicable FCC exposure limit at all locations between 1 and 1000 meters from the base of the antenna support structure. Section 1.1307(b)(3) of the Commission's Rules excludes applications for new facilities or modifications to existing facilities from the requirement of preparing an environmental assessment when the calculated emissions from the applicants proposed facility are predicted to be less than 5% of the applicable FCC exposure limit. Therefore, the proposed facility is in compliance with Section 1.1301 et seq and no further analysis of RF exposure at this site is required in this application.

Pursuant to OET Bulletin No. 65, all station personnel and contractors are required to follow appropriate safety procedures before any work is commenced on the antenna tower, including reduction in power or discontinuance of operation before any maintenance work is undertaken. The permittee/licensee in coordination with other users of the site must reduce power or cease operation as necessary to protect persons having access to the site, tower or antenna from radiofrequency radiation in excess of FCC guidelines.

January 25, 2012

Erik C. Swanson, P.E.