BC Centre for Disease Control
An agency of the Provincial Health Services Authority

Measurement of Radiofrequency (RF) Emissions from BC Hydro's Itron Smart Meters

Date of test: January 10, 2012

1. Radiofrequency exposure metric measured:

RF **Peak Power Density S** in **$\mu W/cm^2$** from BC Hydro's Itron Smart Meters

2. Testing Set-Up

2.1. Smart Meters Tested

- Brand name: Itron Smart Meters
- Frequency: Within **902 MHz - 928 MHz**
- Nominal Power: **32dBm (1 Watt)**; Used during the tests: **250 mWatt**.
- Where tested: BC Hydro test facility, Surrey, BC

2.2. RF Survey Meter used: Narda Broadband NBM-520 with Probe EC5091

*2.3. Characteristics of the **NBM-520 Meter** and the **EC 5091 Probe*** (Ref. Narda flyer)

2.3.1. **NBM-520 meter**

- Frequency Range: 300 MHz to 50 GHz
- Isotropic Response (response is independent of probe orientation)
- Display Range: 0.0001% to 9999% of standard
- Calibration: Last calibration on July 26, 2011 (considered valid until July 22, 2013)

2.3.2. **EC 5091 Probe**, E field, shaped SC 6 Canada

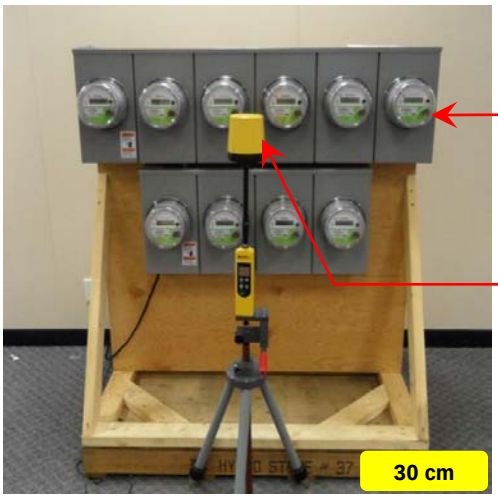
- Measurement range: **0.5% to 600% of Safety Code 6 Limits for RF/Microwave workers**.

2.4. Tripod (survey meter support)

A non-conducting plastic tripod was used to hold the survey meter & probe assembly vertically above the ground.

Figure 1 below shows the testing set-up used to measure the peak RF power density from a bank of 10 of BC Hydro's Itron Smart Meters.

Figure 1. Smart meter measurement set-up



Probe at a distance of 30 cm from the smart meter bank

Probe at 1 meter from the smart meter bank

Probe at 3 meters from the smart meter bank

3. Testing Procedure

3.1. RF emission mode

- Smart meters are designed to emit pulses that last approximately 100 to 150 milliseconds (0.1 to 0.15 seconds) at irregular intervals.
- In a cluster of smart meters, the meters do not emit simultaneously but are programmed to communicate with a single controller in a random sequence. This mode of operation eliminates the potential for exposure to more than one signal at the same time (**Ref.1**).
- In this trial, smart meters were scheduled to emit brief pulses every 5 minutes (5 minute interval interrogation).
- The continuous monitoring of RF levels was maintained for a time period of 10 minutes at each position of the probe to ensure that the highest possible RF exposure level was detected and recorded.

3.2. The RF Measurements

At 30 cm from the smart meters and beyond, RF measurements are made in the far field region where plane wave conditions apply. Hence, the selected RF exposure metric is the power density (in units of W/m^2).

Electric field strength **E** (V/m) at each position can also be determined from power density ***S*** (W/m^2) readings using the following formula (plane wave conditions):

$$E = \sqrt{377\,S}$$

Where the value **377** represents the characteristic impedance of free space in units of Ohms (Ω).

The peak power density readings were taken at 3 different distances from the RF sources: 0.3 m, 1 m, and 3 m.

The peak readings were recorded using the "peak hold" option of the survey meter.

3.3. RF Exposure Situations

The first series of tests were carried out with one operating smart meter and the second series with a bank of 10 operating smart meters.

4. Testing Results

The instantaneous **Peak Power Density** recorded from BC Hydro smart meter emissions during the tests are shown in **Table 1** below.

Table 1 – Instantaneous Peak Power Density S (μW/cm^2) from BC Hydro Smart Meters

Distance RF source – RF Probe	Peak Power Density S* 1 operating smart meter (μW/cm^2)	Peak Power Density S* Bank of 10 smart meters (μW/cm^2)
30 cm	3.204	4.035
1 meter	2.016	2.610
3 meter	1.170	1.779

Note: These readings incorporate the existing background generated by uncontrolled external RF sources.

5. Remarks

5.1. Radiofrequency Background:

- During the test, RF sources within the testing facility, namely cell phones carried by testers and other smart meters in the facility were turned off to minimize the internal background.
- The RF background was monitored at each position (30 cm, 1 meter, 3 meters) over30 minutes while the smart meters were idle.
- The RF background level due to uncontrolled external RF sources (power lines, external wireless systems,…) varied from less than 01 μW/cm^2 to occasional peaks at 2 to 3 μW/cm^2.

5.2. Instantaneous peak power density readings:

- RF signals were taken over a period of 10 minutes. The instantaneous peak power density reading at each position (30 cm, 1 meter, 3 meters) was saved using the "peak hold" option of the meter.
- The recorded levels correspond to the highest outdoor exposure levels that would be expected to be generated during smart meter pulses.

5.3. Comparison of smart meter exposure to other household RF devices:

To put RF exposure to smart meters in context, levels generated by other RF household devices under similar exposure conditions are compared to those for smart meters.

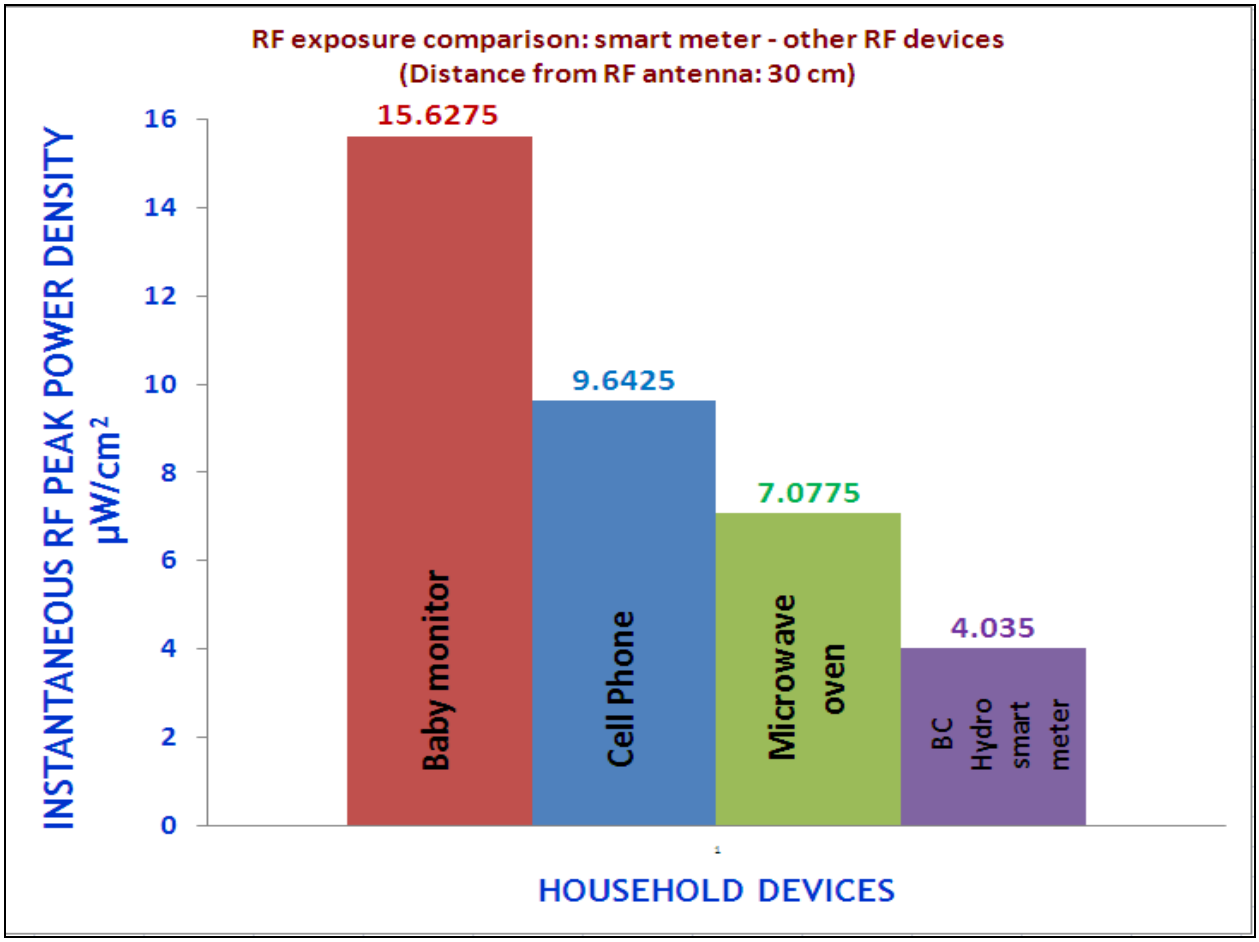
Typical values of RF emissions from mobile phones, microwave ovens, baby monitors, and cordless phones at a distance of 30 cm are listed below in **Table 2** (Source: **Ref. 2**)

Table 2 – Radiofrequency emissions from some household devices

DEVICE	Instantaneous Peak Power Density at 30 cm (Source: Ref. 2) In units of μW/cm^2
RF Baby Monitor	15.6275
Cell Phone	9.6425
Microwave Oven	7.0775

Figure 2 shows the instantaneous power density levels for cell phones, microwave ovens, baby monitors, and BC Hydro smart meters (outdoor).

Figure 2 – Comparison of RF smart meter exposure to other RF devices



(Source: Ref. 2)

As shown in **Figure 2**, BC Hydro smart meter RF emissions outside homes are lower than the RF exposure associated with some household devices, e.g. baby monitors, cell phones, and microwave ovens.

5.4. *Duty cycle of BC Hydro smart meters and time-averaged power density*

Since smart meters release brief radiofrequency pulses at irregular intervals, to better understand the effective exposure of persons near smart meters, the **duty cycle** (**fraction of time a smart meter is transmitting for a given period**) of the meters should be taken into account.

BC Hydro smart meters have a duty cycle of 0.07% corresponding to a cumulative emission duration of 1 minute per day on the average (**Ref.3**).

Table 3 gives the values of the **time-averaged power density S** at 30 cm, 1meter, and 3 meters for a duty cycle of 0.07%.

The ratios of the **S** values to Health Canada Safety Code 6 (**SC.6**) Limit for the public are shown **in brackets**.

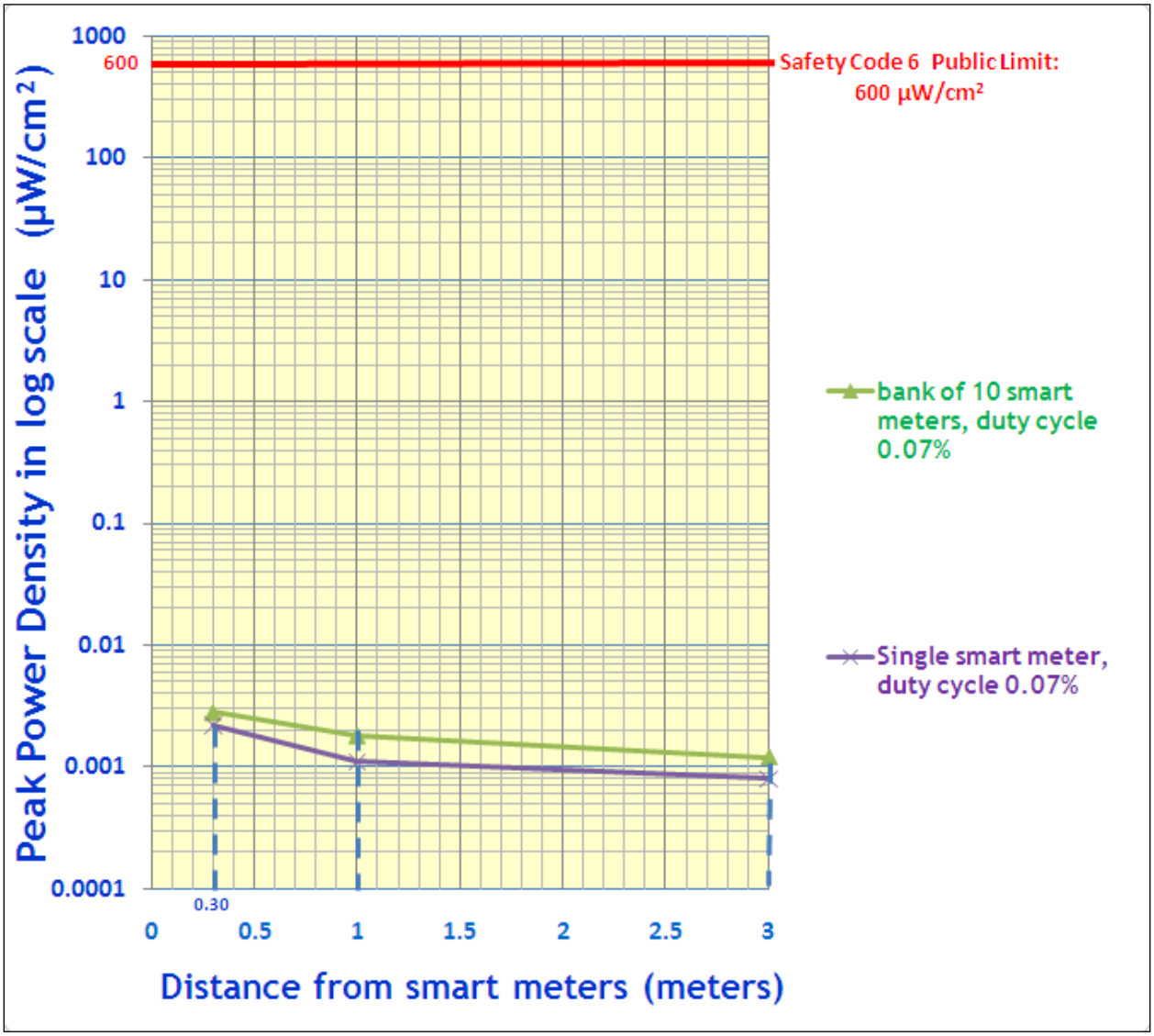
Table 3 – Comparison of smart meter emissions to Health Canada Safety Code 6 Limits for public environment

Distance from smart meter	Time-averaged Power Density S 1 operating smart meter ($\mu W/cm^2$)	Time-averaged Power Density S 10 operating smart meter ($\mu W/cm^2$)
30 cm	0.0022 (0.00037 % of SC 6 Limit)	0.0028 (0.00047 % of SC 6 Limit)
1 meter	0.0011 (0.00018 % of SC 6 Limit)	0.0018 (0.00030 % of SC 6 Limit)
3 meters	0.0008 (0.00013 % of SC 6 Limit)	0.0012 (0.00021 % of SC 6 Limit)

Figure 3 below shows the levels of smart meter emissions in comparison to Health Canada's Safety Code 6 Limit of 600 $\mu W/cm^2$ of continuous exposure for general public areas.

As illustrated in **Figure 3**, the time-averaged RF exposure levels from smart meters is low (Less than 0.001 % of Health Canada's Safety Code 6 limit), even at a short distance from the RF antenna.

Figure 3. Comparison of Smart Meter Emissions to HC safety Code 6 Limits



The RF power density results obtained during this test are comparable to values reported by investigators referenced below (**Ref 1 thru 6**).

6. References

Ref. 1 - A Discussion of Smart Meters and RF Exposure Issues - An EEI-AEIC-UTC White Paper – A Joint Project of the EEI and AEIC Meter Committees - March 2011 Published by: Edison Electric Institute; 701 Pennsylvania Avenue NW, Washington, DC 20004-2696;

http://www.aeic.org/meter_service/smartmetersandrf031511.pdf

Ref. 2 - AMI Meter Electromagnetic Field Survey Final Report Prepared For Department of Primary Industries - Document Number: M110736 – Prepared by: EMC Technologies Pty Ltd 176 Harrick Road Keilor Park, Victoria 3042 (Australia), 20 October 2011.

http://www.dpi.vic.gov.au/smart-meters/publications/reports-and-consultations/ami-meter-em-field-survey-repor

Ref. 3 - Planetworks Consulting – Safety Code 6 Report –Single Smart Meter and a bank of 10 smart meter (October 2011).

http://www.bchydro.com/etc/medialib/internet/documents/smi/SMI_MeterBank.Par.0001.File.SMI-MeterBank-2011-Oct-11.pdf

Ref. 4 An Investigation of Radiofrequency Fields Associated with the Itron Smart Meter, EPRI, Palo Alto, CA: 2010. 1021126

http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=405

Ref. 5 Federal Communications Commission /USA - ACS Report: 11-0093.W06

http://www.fcc.gov/search/results/smart%20meters

Ref. 6 - Richard A. Tell, RICHARD TELL ASSOCIATES, INC. An Analysis of Radiofrequency Fields Associated with Operation of the Hydro One Smart Meter System – Revised October 13, 2010 - Prepared for Hydro One Networks Inc. 483 Bay Street, North Tower, Toronto, Ontario M5G 2P5

http://www.hydroone.com/MyHome/MyAccount/MyMeter/Documents/Smart_Meters_Report_on_RFE.pdf