Preliminary Comments on the *WaterSense®* *Draft Specification for Soil Moisture-Based Irrigation Control Technologies*

January 23, 2020

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The comments provided below are replicated in their entirety as submitted by each stakeholder. The only changes made were of a typographical nature or for clarity, as indicated by items in brackets. Any parenthetical items, emphasis through capitalization, or grammar that is inconsistent with WaterSense style were provided by the commenters.

Commenter: Brian Koblenz
Affiliation: Irricloud
Comment Date: November 25, 2019

Email Text:

I have both read your specification and participated in your webinar.

Most of my response is targeted to make sure that this process does not inhibit or reduce innovative ideas that may improve water savings now and in the future. My concern is that approving a specification like this IMPLIES that SMS [soil moisture sensor] systems that do not meet this specification are likely inferior in terms of water savings and, that should not be the implication.

FWIW [for what it's worth], I believe my company's products can meet all of your specifications, however the lack of definition of "Irrigation Event" and what it means to stop an "Irrigation Event" gives me some concern. (More on this later.)

You state systems that enable and disable irrigation events are "in-scope" yet you exclude from your scope "On-demand SMS" which are precisely those systems that enable and disable irrigation based on SMS data.

What I believe you are doing in actuality is ONLY including those systems that "disable" pre-defined irrigation events and the absence of "disabling" the event allows the event to move forward. In other words, the base controller "clock" enables the event and the sensor can "disable" the event. In this scenario, SMS are given high thresholds above which they must "disable" irrigation events. (I suspect most of the add-on SMS systems rely on this scenario but they will struggle with the requirement to "notify" the base controller that the SMS is not operating properly but I will leave it to those vendors to make their case.)

One could imagine a different (better?) system where a clock has an "irrigation event" program with a set of zones to run but no specified start time. Then the SMS could interact with the clock to "enable" that program that would then run to completion. In this scenario, the SMS are given a low threshold below which an irrigation event must be "enabled". There are many things to recommend this style and it can work in the context of "restricted watering days", but that restricted day framework may itself not lead to the most efficient watering scenarios and may change over time.

One could also imagine yet another system where the "irrigation event" program is based on a combination of clock information and SMS data where both starting and stopping (enabling/disabling) the irrigation event is controlled by the SMS.

All of the above scenarios are practical, useful, and efficient; supporting one to the exclusion of the others is inappropriate.

What is an "irrigation event"? Most irrigation controllers today work with the notion of a program and even within that term, different companies do things differently. A program might:

a) run 1 zone for some time

b) run multiple zones concurrently for some time

c) run a set of zones in sequence where each zone has a run time

d) might mix b) and c)

e) might "water and soak" any of a), b), c), d) so that the watering repeats some number of times (usually within a day) at some interval

f) let your imagination roam

My point is that I think you want to be tolerant of many different ways of skinning the cat and your specification is insufficiently tolerant. In any case, I believe it is necessary to clearly define irrigation event.

I don't want to set your process back too far, but maybe there is a way to be both simpler and more tolerant.

You already have a test methodology for WBIC [weather-based irrigation controllers]. How about creating your engineered boxes with a pre-defined moisture content and place them in your test area where they are exposed to the weather and can control an irrigation valve. Place the SMS in the box, connect it to the base controller which can enable the valve and log the amount of watering that occurs. (Ensure the base controller does not have access to the weather data or program it to be at some very different location.) Keeping with the WBIC model, if, after a month (and assuming at least 4 days of .1 inches of rain etc), the amount of watering is "good", then we have a WaterSense approved system. You can still do the freeze test or any other stress you want to create on the SMS but you are not limiting the way the base controller and SMS interact.

I am sure the above could have been written more eloquently and I am happy to answer any questions or discuss and clarify via email or phone.

-brian
brian.koblenz@irricloud.com

Commenter: Peter Lackner
Affiliation: Toro Irrigation Division
Comment Date: December 13, 2019

Email Text:

We would like to request that a fourth moisture level, 100% (field capacity), be added to the test protocol, at least for testing the Toro® Precision™ Soil Sensor, model PSS-KIT. Per the instruction manual, this is required for the sensor's calibration procedure, as well as for it to change states from allowing irrigation to blocking it while in operation.

Given that a) the testing facility will already have all required materials on-hand to make this accommodation (water, soil, salt solution, and the tools required to calibrate to any given percentage of moisture depletion), b) the test is only conducted once for any given model of sensor, c) the manufacturer is paying for the test, and d) the dual-threshold "checkbook" method of irrigating, which the Precision Soil Sensor uses, is an accepted practice per the IA's [Irrigation Association's] handbook (see *Irrigation 6th Edition*, Ch. 13 "Irrigation Scheduling"), we feel this is a reasonable request.

In other words, the sensor does not operate incorrectly or inaccurately, it simply operates differently from the other manufacturers that have been tested. As such, creating the test such that it is designed to fail any existing product that already operates in this manner might be considered unfair "restraint of trade" or undue burden on the manufacturer to change its product.

Regards,

Peter Lackner
Product Marketing Manager
Toro Irrigation Division

Commenter: Bernard Cardenas-Lailhacar
Affiliation: University of Florida
Comment Date: December 20, 2019

Email Text:

Hi All,

From the Public Meeting Summary comments, seems that some stakeholders are really confused with the term "irrigation event" (there are two comments/questions on page 3 and two comments on page 4 regarding this concept). Sometimes seem that they are referring to only one zone running and sometimes to all the zones that could potentially run. I suggest changing the language to "irrigation cycle", and define this as "all the irrigation zones that are programed to run sequentially after the first zone starts".

This definition encompass[es] the "on-demand" SMSs models that could start an irrigation cycle at any time (not necessarily after a scheduled start time).

Regards,

Bernard Cardenas-Lailhacar | Research Associate |
Agricultural & Biological Engineering Dept. | University of Florida |
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Commenter: Celine Benoit
Affiliation: Metropolitan North Georgia Water Planning District
Comment Date: January 7, 2020

Email Text:

Hello,

Please find attached the Metropolitan North Georgia Water Planning District's comments for the WaterSense Draft Specifications for Soil Moisture-Based Irrigation Control Technologies.

Feel free to reach out with any questions or comments.

Thank you for your consideration.

Best,

Celine Benoit
Water Efficiency Planner & GIS Analyst
Metropolitan North Georgia Water Planning District

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Email Attachment

See page 8.

Metropolitan North Georgia Water Planning District
International Tower | 229 Peachtree St., NE | Suite 100 | Atlanta, GA 30303

WaterSense Draft Specification for Soil Moisture-Based Irrigation Control Technologies: Comments

The Metropolitan North Georgia Water Planning District (The District) is committed to continuing to support water efficiency not only on a regional scale within the Metro Atlanta area, but nationwide. Our planning efforts and the implementation of water-saving technology throughout our region has demonstrated positive impacts for our communities. We continue to promote the use of WaterSense products in our planning efforts and are pleased to see the inclusion of irrigation products such as soil moisture-based controllers.

Please find below our comments regards the WaterSense Draft Specification for Soil Moisture-Based Irrigation Control Technologies:

Under 3.0 Supplemental Capability Requirements

3.1 Is there a time frame established for how long content should be preserved within the product giving a loss of power?

3.3 Are there further specification as to the equipment surrounding the notification system to indicate when the system is not receiving sensor mechanism input? Does this include notification via an app or on the physical system itself?

3.4 We support the requirement of ensuring the products capability of functioning with a rainfall device, given that our Georgia Code (12-5-6) mandates irrigation systems installed after 2005 using public water sources, be equipped with a rain sensor shut-off switch.

3.5.2 and 3.5.3 Requiring day interval schedule is also supported by the District. Our current Drought Response requires adopting an interval irrigation scheduling during times of drought, with complete cessation at times of high drought response.

We look forward to the finalization of these requirements as they develop, and are glad to contribute in further discussions. Thank you for considering our comments.

Thank you,

Celine Benoit
Water Efficiency Planner & GIS Analyst
Metropolitan North Georgia Water Planning District

Commenter: Bob Beers
Affiliation: HydroPoint
Comment Date: January 15, 2020

Email Text:

Good afternoon,

I hope you all had a great holiday season and new years [sic].

We attended the EPA session at the IA Show in [Las] Vegas regarding the moisture sensor testing process and specification terms. You all have done a great job with everything...we were very impressed!

One question we had as we left is related to verbiage around how a moisture sensor is "connected to" or "communicates with" a smart irrigation controller. It sounded as though the specification would require a moisture sensor to be directly wired to a smart irrigation controller for it to qualify. With our Baseline Irrigation products we can support a moisture sensor that is wired to a gateway device (we call it a SubStation) which wirelessly networks back to the smart irrigation controller. So, the moisture sensor still delivers all of the real-time moisture data back to the controller which can act on the moisture data with no measurable difference in reaction time versus a wired device.

We are hoping for some clarification around that scenario. It's the same moisture sensor product and the same smart controller product...we just add in a wireless gateway so we can manage a moisture sensor anywhere on the site.

Thanks!

Bob Beers
Product Manager, Irrigation Technology
o 208-639-8738 **m** 208-703-7141

HydroPoint 360º Smart Water Management
hydropoint.com | baselinesystems.com

Commenter: Sean Steffensen
Affiliation: California Energy Commission
Comment Date: January 21, 2020

Email Text:

The California Energy Commission provides comments in the enclosed letter.

Thanks,
SEAN STEFFENSEN, P.E. | MECHANICAL ENGINEER
CALIFORNIA ENERGY COMMISSION | EFFICIENCY DIVISION
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Email Attachment

See pages 11 through 15.

January 21, 2020

Ms. Stephanie Tanner
U.S. Environmental Protection Agency
Office of Water
WaterSense Program
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Dear Ms. Tanner:

The California Energy Commission (CEC) appreciates the opportunity to provide comments on the U.S. EPA's (EPA) proposed specification for Soil Moisture-Based Irrigation Control Technologies (SMBICT). The CEC is the primary energy policy and planning agency of the State of California. One of the chief mandates of the CEC is to reduce the wasteful, uneconomic, inefficient, and unnecessary consumption of energy and water in the state by prescribing standards for minimum levels of operating efficiency for appliances that consume a significant amount of energy or water on a statewide basis. We recognize the importance of working closely with the EPA to lead efficiency efforts that will incentivize energy and water efficient technologies that will reduce the wasteful consumption of energy and water.

The CEC appreciates the EPA's efforts to establish a new voluntary WaterSense specification for SMBICT, especially as the state recovers from severe drought conditions and continues to focus on ways to conserve its limited water supply. The CEC is pleased that the EPA's specification proposes to address inefficient irrigation scheduling – applying water when not needed. The SMBICT will measure soil moisture content and prevent the wasteful application of water. The specification has the potential to encourage consumers to choose products that will automate irrigation and save what the EPA estimates to be hundreds of billions of gallons of water across the country.

The CEC supports the EPA's proposed modifications to the American Society of Agricultural and Biological Engineers (ASABE) X633 Testing Protocol for Landscape Soil Moisture-Based Control Technologies to reduce the test time while maintaining the repeatability and reliability of the test procedure.

Specifically, the CEC supports the EPA's proposal to modify the test procedure:

- Soil moisture testing only in moderately coarse media and saline water,
- Freeze testing only in moderately coarse media and saline water at 40 percent water depletion,
- Clarification to connect add-on and plug-in devices to a base controller during testing as specified by the manufacturer.

The CEC encourages careful review of the calculation methods and performance levels selected by the EPA. The CEC recommends some modifications to ensure repeatability and clarity. The CEC provides this information and recommended changes to the specification language in the appendix to this letter.

The CEC appreciates the opportunity to comment on this draft specification. If there are any questions about the attached comments, please contact Sean Steffensen at (916) 651-2908 or at Sean.Steffensen@energy.ca.gov.

Sincerely,

DAVID HOCHSCHILD
Chair

Appendix

Topic 1: Clarify the calculation of relative average deviation (RAD) as shown on slide 35 of webinar presentation and section 2.2.1.2 of the draft specification.

The draft specification says that the RAD will be averaged across all water depletion levels. The WaterSense Draft Specification for Soil Moisture-Based Irrigation Control Technologies (November 20, 2019) webinar slide 35 shows that the RAD should be calculated at each water depletion level (20 percent, 40 percent, and 60 percent). The webinar and the draft specification seem to be inconsistent.

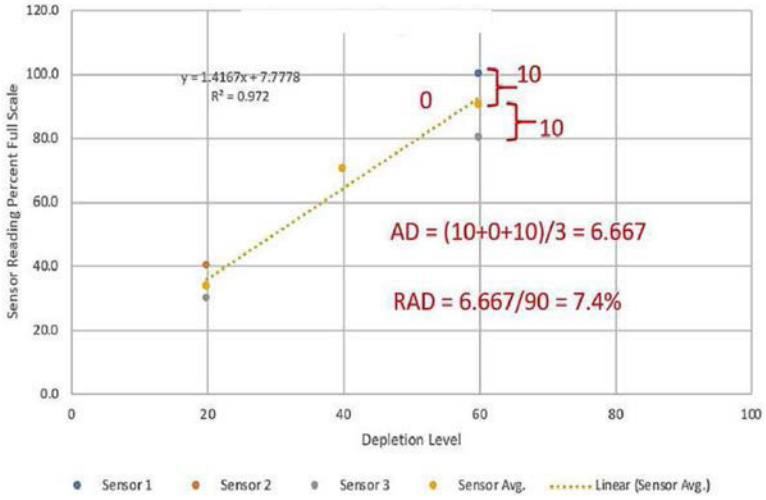
The calculation of the average RAD across all water depletion levels could be made clearer by adding Equation (3) to the specification.

The draft specification must also define the units of the performance criteria. The webinar suggests the units are "sensor reading percent full scale."

Equation (3): $RAD_{avg}=(RAD_{20}+RAD_{40}+RAD_{60})/3$

Where RAD_{20} is the relative avg deviation at 20 percent water depletion
RAD_{40} is the relative avg deviation at 40 percent water depletion
RAD_{60} is the relative avg deviation at 60 percent water depletion

Figure: Plot Showing Calculation of Relative Average Deviation



Source: U.S. EPA WaterSense Webinar, November 20, 2019, Slide 35

Section 2.2.1.2 is included below for reference.

> "2.2.1.2 The relative average deviation (RAD) of the readings at which the replicate SMSs enable and disable irrigation, calculated in accordance with Equations 1 and 2 below, when averaged across all water depletion level readings, shall be less than or equal to 10 percent."

Equation (1) $$Relative\ Avg\ Deviation = \frac{Avg\ Deviation}{\bar{x}}$$

Where: $\bar{x}$ is the mean

Equation (2) $$Avg\ Deviation = \frac{\sum_{i=1}^{n}|\bar{x}-x_i|}{n}$$

Where: $\bar{x}$ is the mean

x_i *is the observation*

n is the number of observations

Topic 2: Clarify Equation 2 in section 2.2.1.2 to show that the calculation is at a single water depletion level.

The test procedure requires three observations per each water depletion level. Therefore "n" in equation 2 will always be three. Equation 2 could be made clearer by replacing n with three in Equation 2.

Clarity also could be added by rewriting Equation 2 as a simple sum as shown below.

Suggested Equation (2) Average Deviation = $[(\bar{x}-x_1)+(\bar{x}-x_2)+(\bar{x}-x_3)]/3$

Where: $\bar{x}$ is $(x_1+x_2+x_3)/3$
x_1 is the first observation
x_2 is the second observation
x_3 is the third observation

Topic 3: The sensor readings and calculation methods in section 2.2.1.3 need to be identified.

The draft specification provides this instruction to find the slope as a verification of the device performance. The draft does not identify the readings or describe how the three readings at each of the three water depletion levels are used to calculate the slope.

> Section 2.2.1.3 "The absolute value of the slope of the line generated by plotting irrigation enable readings for all three replicates across all three depletion levels and the absolute value of the slope of the line generated by plotting irrigation disable readings for all three replicates across all three depletion levels shall both be greater than zero when rounded to two significant digits (i.e., ≥ 0.01)."

The EPA must identify the irrigation enable and irrigation disable readings to remove ambiguity. Are the readings a sensor value presented as a percentage of full scale? Is the reading a resistance, a current or voltage? What units are used to record the reading? If the reading varies among the soil moisture sensing technologies, then the specification must define the differences.

The calculation result is sensitive to the units of the readings' measurement. The performance criteria should be expressed in the desired units. If the readings are in ohms then the criteria would be expressed as >0.01 ohms per percent water depletion.

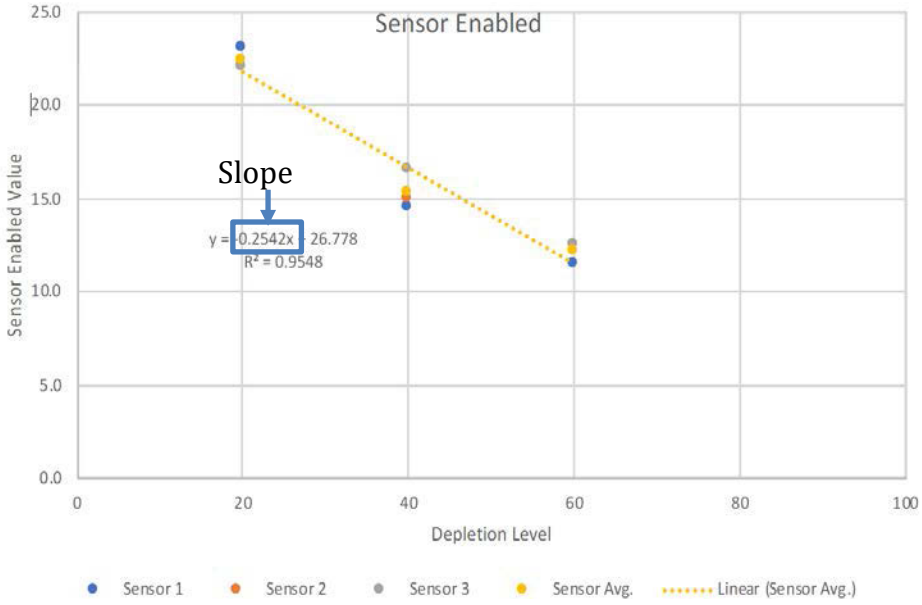
If units of measure vary among the soil moisture sensing technologies, then the specification must define the units of the performance criteria for each technology.

The draft specification must define the vertical axis as the sensor reading and the horizontal axis as the water depletion level so the slope can be calculated consistently.

The draft specification must define how the depletion level percentage is represented when the calculation is performed. For example would “20” or “0.2” be used to represent 20 percent when the slope is calculated?

The draft specification does not provide a calculation method for the slope of the line. Slide 37 of the webinar presentation shows a Microsoft Excel plot where the slope is observed as the coefficient of the “x” value of the linear least squares fit of the data. The draft specification must identify the linear least squares fit as the calculation method to ensure consistency.

Figure: Plot Showing Slope of Sensor Readings



Source: U.S. EPA WaterSense Webinar, November 20, 2019, Slide 37