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1	GE	Various	The proposed testing protocol is too short.		Reject	In Phase 1 testing the sensor will be subjected to a comprehensive drying regime with stratifications for evaluating sensor response to varied soil textures, temperatures (including freezing conditions) and irrigation salinity levels. It will also be evaluated for response over multiple wet/dry cycling. The duration of the tests will vary as needed to accomplish the development of the calibration curves. Phase 2 involves evaluation of the controller as a means to mediate and schedule irrigation using data gathered by the sensor. As such it will be subject to the same test duration as used for climatologically based controls (i.e. 30 days).
2	TE	4.6	Suggest adding “by the force of gravity” to the definition of field capacity.		Reject	A more enlarged definition of field capacity is of marginal value. The concept is used as a convenience in describing the range of moisture contents encountered during an irrigation cycle. The critical value is the moisture content designed for on the dry end of the moisture retention curve. This value indicates indirectly the maximum stress level that can be permitted if adequate growth is to be maintained. Because of the dynamics of how moisture moves in the root zone, this value can only be determined by field experiments.
3	TE	5.2 Phase 2	Instead of specifying a particular controller for use in Phase 2, suggest a definition of the “feature set” required which could be offered by a number of controllers.		Reject	The protocol must be structured to test a range of sensor operating characteristics and controller features. The “or equal” argument will have to be made by the sensor manufacturer to the SWAT committee.
4	ED	Various	Change the word “calibration” to “testing response” wherever it occurs in the text.	Use “testing response” instead of “calibration.”	Accept	
5	GE	Sect. 1 and 2 Phase 2	Change the terminology to eliminate reference to CIMIS.	Remove all reference to CIMIS and replace with “a mutually agreed upon weather data source.”	Accept	
6	GE	Sect. 5.2 Phase 2	Change the wording of section 5.2 to substitute “feature set” for “make and model.”		Reject	The performance summary will identify the controller actually used in the test. The manufacturer will have to make the “or equal” argument to the SWAT committee.
7	GE	Sect 1 Phase 1 & Phase2	Editorial comments should be removed from the protocol bodies and moved to a forward or appendix.	Restructure the introductory sections of the protocol to more closely parallel international standards.	Accept	Moved editorial comments to a “Forward” section.
8	GE	Phase 2	Phase 2 needs to be changed to evaluate the performance of the sensor integrated with the controller.		Reject	Phase 2 is an attempt to meet the objective of evaluating a complete system (sensor and controller). Phase 2 uses a virtual yard and the quantifiable variables to test the controller’s abilities. The sensor’s performance qualities are

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8						quantified in the real world testing in Phase 1. A real world Phase 2 test would be prohibitively expensive.
9	GE	Phase 1	Overall, this protocol works fairly well. The amount of time to execute the protocol is the main concern.		Reject	In Phase 1 testing the sensor will be subjected to a comprehensive drying regime with stratifications for evaluating sensor response to varied soil textures, temperatures (including freezing conditions) and irrigation salinity levels. It will also be evaluated for response over multiple wet/dry cycling. The duration of the tests will vary as needed to accomplish the development of the calibration curves. Phase 2 involves evaluation of the controller as a means to mediate and schedule irrigation using data gathered by the sensor. As such it will be subject to the same test duration as used for climatologically based controls (i.e. 30 days).
10	GE	1.0 Intro. Phase 2	The specifics of how to design and implement the "data conversion device" must be specified in the protocol.		Reject	The testing agency's controller will maintain a moisture balance calculation. Using the results from Phase 1, this controller will convert this moisture balance reading into the equivalent soil moisture sensor reading. The manufacturer's "data conversion device" will convert this signal into a value readable by the sensor's controller. The sensor's controller will make a runtime decision consistent with the water management strategy designed into the control. The testing agency controller will update the moisture balance and the process begins iteration. The data conversion device must be designed to supply an output signal unique to the individual sensors.
11	GE	1.0 Intro Phase 2	Remove the general discussion in 1.0 Introduction from the body of the protocol.	Move the general discussion information from 1.0 Introduction and put it into a "Forward" section. Rename 1.0 to Scope.	Accept	-
12	GE	2.0 Scope Phase 2	What is meant by the sentence "The operational concepts also assume that threshold adjustments can be made manually in response to seasonal changes in on-site conditions."?		N/A – Reader Q.	The purpose of the Phase 1 testing was to determine the testing response to a number of root zone conditions. If, for example, the quality of the water changes dramatically during growing season the change in threshold setting is required to reflect an actual change in the threshold response curve. The requirement of "operation without human intervention" assumes there is no significant change in site conditions. With climate-based controllers, a dramatic change in water quality could require the use of a [leaching] factor.
13	GE	1.0 Intro. Phase 2	The best irrigation for plant health is to irrigate as infrequently as possible while maintaining the soil moisture within the		Reject	Another definition of "best" is to start with a well-watered root zone and replace the water withdrawn every one to three days depending on the original storage. This tends to

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13			limits required by the plant material to be healthy.			limit root zone stress to some nominal value. As the commenter notes, ideal frequency depends in part on plant growth form that in turn helps mediate RZWD and ultimately RZWWS. For this reason, Phase 2 will evaluate performance for different growth forms in a range of virtualized environments as per Table 1-A.
14	GE	2.0 Scope Phase 2	The concept of consumptive use is not a valid measure of the sensor's performance.		Reject	The protocol uses consumptive use (irrigation and rainfall) in the maintenance of the moisture balance. This moisture balance reflects the result of the sensor's reaction to the previous day's ending moisture balance. Say, for example, that the sensor "authorizes" a ten-minute irrigation. The testing agency controller updates the moisture balance and communicates the results back to the soil moisture sensor. In this way the results of the soil moisture sensor's decisions are quantified in the Performance Report.
15	GE	2.0 Scope Phase 2	The protocol should comment on the essentially static laboratory conditions provided in the testing protocol and the exclusion of other real world considerations such as compaction, roots, and soil fauna.	Add a fifth paragraph to section 2.0 Scope. "The protocol determines the testing response of the sensors under essentially static laboratory conditions. The impact of such real world conditions as compaction, roots, and soil fauna have not been addressed.	Accept	Language will be added to reflect the limitations in these variable site characteristics.
16	GE	Phase 1 and Phase 2	Document needs to be proof read to eliminate incomplete and awkward sentences.		Accept	The drafts are still fluid at this point, but the Working Groups will make every effort to assure complete, clear final protocols.
17	GE	4.0 Definitions Phase 1 and Phase 2	Suggest using definitions against standard and accepted terminology. (For example, when defining field capacity and permanent wilting point.)	The definitions of field capacity and permanent wilting point have been expanded.	Accept	The definitions will be altered to reflect standardized industry specific definitions.
18	ED	1.0 Intro. 2nd Para Phase 2	Define "their"	Change "their" to "the sensor."	Accept	The paragraph will be rewritten to improve clarity and sentence flow.
19	TE	5.2 Sampling Phase 2	"I recommend that a standard time clock (controller) be used for all testing."		Reject	This is a testing protocol for a commercial assembly including the sensor, controller and any other features that the manufacturer wants to include. The results then will be applicable to only that assembly which in the opinion of the manufacturer is what is needed to meet the objective of saving irrigation water. The protocol is not meant primarily as a tool for advancing the science of system control using soil moisture sensors.

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20	TE	5.0 Funct. Tests Phase 2	Questions related to the development of the "black box" interface between the testing agency controller and the manufacturer's controller: 1.) When will the black box interface be specified? 2.) Will there be a deadline to have it working and verified? 3.) What parameters are going to be included in the interface? a. Moisture level? b. Temperature? c. Salinity? d. Soil Type? e. 95% confidence level of noise? f. Sensor repeatability? g. Rainfall? h. ETo – with KC simulation? i. Exposure? j. Scope?	-	N/A – Reader Q.	1) After completion of Phase 1 sensor testing. 2) Before the beginning of Phase 2 3) The testing agency controller will provide a minute- by-minute update of the sensor measurement in percentage. The sensor measurement will be based on the moisture balance and the testing response curve determined in Phase 1. The interface will convert the sensor measurement to a signal that the manufacturer's controller can read. This simulates the situation where the sensor is connected directly to the manufacturer's controller. This is equivalent to the MBO value on the moisture balance calculation. The manufacturing control interprets this value on the built-in water management strategy. The reading could either leave the valve closed or trigger an irrigation event. Parameters a, b, c, d, g, h, i and j are used in developing the testing agency controller program. Parameters e and f could be involved in the operation of the manufacturer's controller program in setting of default values for example.
21	TE	5.0 Funct. Tests Phase 2	Reference #37 parameters listing. Need to clarify how these parameters will be provided to the interface.	-	Accept	Language will be developed to address this.
22	TE	5.0 Funct. Tests Phase 2	Will the interface be tested for accuracy?	Consider adding a laboratory test that monitors the manufacturer's controller response to a sensor placed in the soil containment box and run through a drying cycle and compares it to the controller's reaction when the feed is through the interface.	N/A – Reader Q.	This is under discussion.
23 (1)	TE	5.0 Funct. Tests Phase 2	How is the question of sensor signal noise, variability, and repeatability to be dealt with?	Since this question is fundamental to the concept of soil moisture-based controllers, it should be investigated by a separate protocol. We suggest studying the performance of specific controller-sensor combinations when the sensor is put through a number of wet-dry cycles.	N/A – Reader Q.	This is under discussion.
24	TE	5.0 Funct. Tests Phase 2	Since the test protocol shows six zones, are six interfaces required?	-	N/A – Reader Q.	Yes. There will be six sensor reading input feeds. It may be possible to use a single interface with an indexing feature at manufacturer's option.
25	TE	5.0 Funct. Tests	If a manufacturer stipulates that only one sensor can run all zones, will he choose	-	N/A – Reader	Yes.

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25		Phase 2	the zone and supply only one interface?		Q.	
26	GE	Phase 2	Is the soil moisture balance calculation the only calculation that provides the basis for the adequacy and efficiency calculation?	-	N/A – Reader Q.	The adequacy calculation is based exclusively on the soil moisture balance calculation. The efficiency calculation includes the moisture balance calculation (overfilling the root zone) and a runtime penalty for applying water too fast or a cycling penalty for not allowing enough soak time.
27 (1)	GE	Phase 2	Is there an alternative test if for some reason the interfacing module is not available?	-	N/A – Reader Q.	No alternative is visualized at this time.
28 (1)	GE	Phase 2	Is the interface design viewed as intellectual property or can it be shared with other manufacturers?		N/A – Reader Q.	To avoid any chance of potentially inadvertently compromising manufacturers' proprietary controller designs the corresponding interface designs will not be shared with other manufacturers.
29 (1)	GE	Phase 2	Because of the inherent scientific complexity of this evaluation, we recommend that it be reviewed by an international panel of experts for comment and possible development of a more realistic solution.	-	Reject	The SWAT protocol review process permits comment and input by *any* interested party. Both the U.S. Environmental Protection Agency and the IA recognize the importance of having an industry-driven process for development of the testing protocols and call for involvement from all interested stakeholders.
30	TE	2.0 Scope Phase 2	The protocol does not need to state how a manufacturer should implement the control functions or require a specific means.	Move the last paragraph of the Scope to a "Forward" section and note it as one possibility.	Accept	Agreed.
31	ED	2.0 Scope Phase 2	What does the term readable "signal" mean in the last sentence?	Add "electronically" readable to the text.	Accept	It means an electronically readable signal.
32	TE	5.5 Test D Phase 2	A test specifying a minimum of 2.5 in. of ETo is too short	-	Reject	In Phase 1 testing the sensor will be subjected to a comprehensive drying regime with stratifications for evaluating sensor response to varied soil textures, temperatures (including freezing conditions) and irrigation salinity levels. It will also be evaluated for response over multiple wet/dry cycling. The duration of the tests will vary as needed to accomplish the development of the calibration curves. Phase 2 involves evaluation of the controller as a means to mediate and schedule irrigation using data gathered by the sensor. As such it will be subject to the same test duration as used for climatologically based controls (i.e. 30 days).
33	TE	Table 1 Phase 2	A sprinkler with an application rate of 1.6 in./hr. may only operate about 1 ½ hr in 30 days. This is not realistic.		Reject	In practice a requirement of 2.50 in. ETo is met by a number of irrigation cycles ranging from 5 to 20 minutes depending on soil type, scope, vegetation, water management objectives, sprinkler application rate, etc.
34	TE	5.5	The test duration should include at least		Reject	In Phase 1 testing the sensor will be subjected to a

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34			12 to 25 in. of ETo in order to allow for overall accuracies supportable by individual measurements.			comprehensive drying regime with stratifications for evaluating sensor response to varied soil textures, temperatures (including freezing conditions) and irrigation salinity levels. It will also be evaluated for response over multiple wet/dry cycling. The duration of the tests will vary as needed to accomplish the development of the calibration curves. Phase 2 involves evaluation of the controller as a means to mediate and schedule irrigation using data gathered by the sensor. As such it will be subject to the same test duration as used for climatologically based controls (i.e. 30 days).
35	GE	Phase 2	The length of the test should be determined by how long it takes to accomplish the needed resolution, say +/- 2.5% accuracy, in the range of moisture control needs themselves.		Reject	In Phase 1 testing the sensor will be subjected to a comprehensive drying regime with stratifications for evaluating sensor response to varied soil textures, temperatures (including freezing conditions) and irrigation salinity levels. It will also be evaluated for response over multiple wet/dry cycling. The duration of the tests will vary as needed to accomplish the development of the calibration curves. Phase 2 involves evaluation of the controller as a means to mediate and schedule irrigation using data gathered by the sensor. As such it will be subject to the same test duration as used for climatologically based controls (i.e. 30 days).