

How to Complete the Ultraviolet Light Disinfection Worksheet of the SWMOR-Alt

General Information about the Spreadsheets

The Surface Water Monthly Operating Report for Alternative Technologies (SWMOR-Alt) is for public water systems that produce drinking water from surface water or groundwater under the direct influence of surface water using alternate technologies. The EPA's Long Term 2 Enhanced Surface Water Treatment Rule (LT2) defines the alternate technologies that can receive credit for removal or inactivation of pathogens.

As you work with the SWMOR-Alt spreadsheets, you will find many features that make it easier for you to use. The following general information will help you use the spreadsheets.

An Excel spreadsheet is also called a workbook which is made up of separate worksheets. After you open the workbook, you will find a series of tabs at the bottom of the screen. Each of these tabs identifies one of the worksheets in the workbook. When you click on one of these tabs, the tab will change from gray to white and the program will take you to the worksheet for the pages shown on the tab.

Because the SWMOR-Alt is an electronic file, we have been able to place many instructions and comments directly in the two spreadsheets. Those electronic comments will help you immediately while you are completing the form.

“We” and “You” in This Guide

“We” as used in this guide refers to the Texas Commission on Environmental Quality—specifically, the TCEQ's Water Supply Division.

In this guide, “you” means the person who must sign the SWMOR or SWMOR2 each month. Under the rules, this person must be the certified surface water treatment plant operator who is responsible for the daily supervision of the plant.

1. ULTRAVIOLET LIGHT MONTHLY OPERATING REPORT WORKSHEETS

The SWMOR-Alt spreadsheet contains four separate UVMOR worksheets. These worksheets include the **UV-Sensor Data** worksheet, the **UV-ISA** worksheet, the **UV-CDA** worksheet, and the **UV-UVT Analyzer** worksheet. The SWMOR-Alt spreadsheet automatically determines which, if any, of these worksheets need to be displayed based on the information you supplied when you customized the SWMOR-Alt for your plant. If your MOR requires all, or any, of these sheets, they will appear as separate tabs at the bottom of the SWMOR-Alt spreadsheet, as shown in **Figure 1.1**.

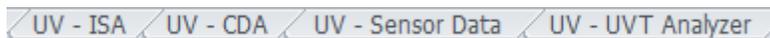


Figure 1.1. Tabs at the bottom of the SWMOR-Alt indicating the UV worksheets

For example, none of the four worksheets will be visible if you indicated that your plant does not have any UV reactors or does not want to claim disinfection credit for its UV reactors. On the other hand, if you indicated you want to claim credit for disinfection achieved in reactors that use the calculated dose approach of UV disinfection, the SWMOR-Alt will display the **UV-CDA**, **UV-Sensor Data**, and the **UV-UVT Analyzer** worksheets but the **UV-ISA** worksheet will remain hidden.

If your plant uses UV reactors and wants to claim disinfection credit for the reactors but the appropriate UV worksheet tabs are not visible, you will need to close the file, reopen it, and re-customize your spreadsheet. See Chapter 2 for more information about customizing the SWMOR-Alt for your particular plant.

At the top of the each of the UVMOR worksheets, there is a block of information that describes your system, plant, and reporting period. The spreadsheet copies this information from the data you entered on the **P.2-Turbidity Data** worksheet, and the data cannot be re-entered or edited on any of the four UV worksheets.

2. UV-SENSOR DATA WORKSHEET

The **UV-Sensor Data** worksheet of SWMOR-Alt is where you report the calibration results of the UV sensors being used at your plant. The TCEQ requires monthly calibration of your UV sensors. From the calibration information, this worksheet calculates the sensor correction factor (sensor CF) values that are used by the **UV-ISA** and **UV-CDA** worksheets (see Chapter 3 and Chapter 4 for details).

To get to the **UV-Sensor Data** worksheet, click on the **UV-Sensor Data** tab at the bottom of the SWMOR-Alt spreadsheet, as shown in **Figure 2.1**.



Figure 2.1. Tab at the bottom of the SWMOR-Alt indicating the UV Sensor Data Worksheet

The **UV-Sensor Data** worksheet normally contains two sections corresponding to both approaches to the monitoring and operation of UV reactors: the intensity setpoint approach (ISA) and the calculated dose approach (CDA). However, if your plant only uses one of these types, the SWMOR will only display the section of the worksheet that applies to your type of reactors. If two sections are shown, the upper section, which is located on rows 1 through 72, contains the sensor calibration data for the sensors in your ISA reactors.

The lower section, which is located on rows 73 through 144, contains the same information for the sensors in your CDA reactors. **Figure 2.2** shows the headings for both sections.

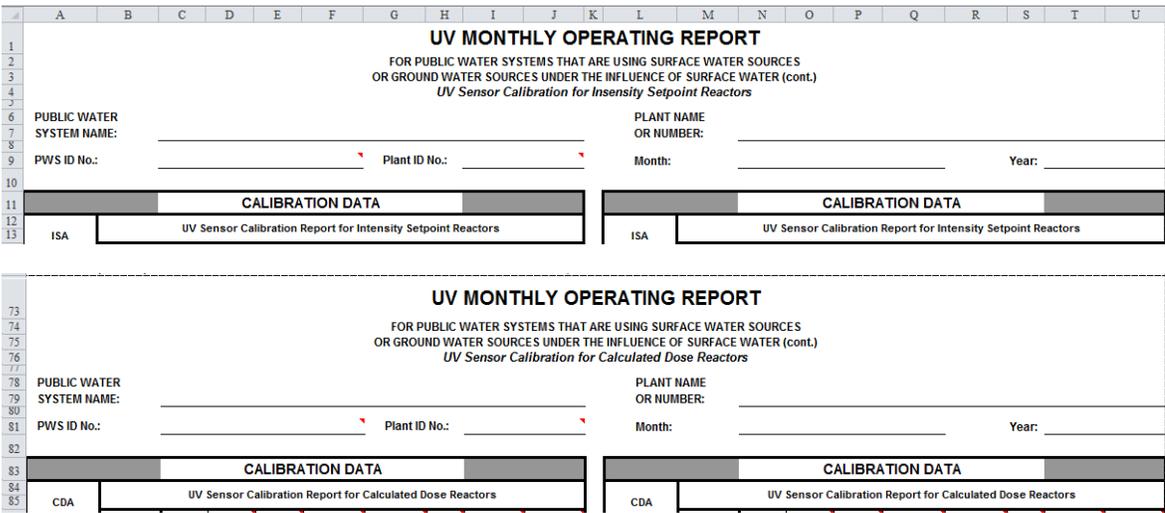


Figure 2.2. UV Sensor Calibration Section Headings (Top for ISA reactors and bottom for CDA reactors)

Each of the two sections contains the block of information that describes your system, plant, and reporting period. The spreadsheet copies this information from the data you entered on the **P.2-Turbidity Data** worksheet, and the data cannot be re-entered anywhere on the **UV-Sensor Data** worksheet.

2.1 UV SENSOR CALIBRATION DATA TABLES

You must use a reference sensor to calibrate each duty sensor in all of your UV reactors at least once each month and record the calibration results in the appropriate **Calibration Data** table for each reactor. A duty sensor is an on-line UV sensor installed in the UV reactor to monitor UV intensity during normal operation.

Figure 2.3 shows the fields where you will enter calibration data for the first ISA reactor (UVIS No. 1). The corresponding table for CDA reactors (not shown) is essentially identical except that the units for the sensor readings are different.

CALIBRATION DATA									
ISA Reactor Number	UV Sensor Calibration Report for Intensity Setpoint Reactors								
	Calibration Date and Data	Duty Sensor	Duty Sensor Serial #	Ref Sensor Serial #	Duty Sensor Reading (mW/cm ²)	Ref Sensor Reading (mW/cm ²)	Cal Ratio	Duty Sensor Replaced?	Calculated Sensor CF
UVIS No. 1	Previous Month's Sensor CF	1							
		2							
		3							
		4							
	Calibration Date	5							
		6							
		7							
	New Sensor CF	8							
		9							
		10							

Figure 2.3. UV sensor Calibration Data table

The SWMOR-Alt uses the information you supplied when you customized the SWMOR-Alt for your plant and automatically configures the calibration data tables. The spreadsheet will shade and lock data entry cells for reactors or sensors that do not exist. The spreadsheet allows for up to 20 reactors of each type (ISA and CDA) and up to ten duty sensors per reactor.

If your spreadsheet does not allow you to enter calibration results for one of your sensors or reactors because that area is shaded, you will need to close the file,

reopen it, and re-customize your spreadsheet. See Chapter 2 for more information about customizing the SWMOR-Alt for your particular plant.

Calibration Date and Data

Previous Month's Sensor Calibration Factor

At the beginning of each month, you must record each reactor's sensor calibration factor (CF) from the previous month. This value is used in the calculations in the other UV worksheets for all days up to the date of recalibration for this month. The value you enter in this month's **Previous Month's Sensor CF** cell must match the value you reported for the reactor's **New Sensor CF** in the previous month's SWMOR. You may not leave this cell blank.

Calibration Date

Enter the date in the current month that you verified the performance of all the duty sensors in the UV reactor. You may not leave the cell blank and you must test all the sensors in a given reactor on the same day. You must enter at least the month and day in any way that EXCEL accepts (e.g., 6/18 or 06-18); you may also include the year but EXCEL will automatically add it if you don't.

If you tested the sensors in a given reactor more than once during the current month, enter the date of the test that produced the highest calibration ratio.

New Sensor CF (Calibration Factor)

The SWMOR uses the calibration data you report for the duty and reference sensor readings (see below) to calculate a new calibration factor (CF) for each UV reactor. The resulting new sensor calibration factor is based on the highest CF for any sensor in the reactor. This CF value is used to evaluate the reactor's performance starting on the date that the sensors were calibrated. Therefore, it is important that you calibrate all of the sensors within a given reactor on the same date. Prior to this date, the previous month's sensor calibration factor is used.

UV Sensor Calibration Report

Duty and Reference Sensor Serial Numbers

Enter the serial number of each duty sensor in the appropriate **Duty Sensor Serial #** cell and enter the serial number of the reference sensor that was used to calibrate the duty sensor in the corresponding **Ref Sensor Serial #** cell. Although you do not have to enter the entire serial number, you must enter enough information to identify the specific duty sensor being tested and the specific reference sensor used to calibrate them. You may not leave these cells blank.

Duty and Reference Sensor Readings

Measure the UV intensity with the reference sensor and duty sensor. Record the measured results in the appropriate **Ref Sensor Reading** and **Duty Sensor Reading** cells. For ISA reactors, record these values in milliwatts per square

centimeter (mW/cm^2). For CDA reactors, the calculated dose approach should result in a calculated value of millijoules/ cm^2 (mJ/cm^2) on your instrument's output. You may not leave either of these cells blank.

The most important thing is that the values in the cells for the duty and reference sensor reading were obtained identically and reported in the same units. If your instrument shows the values in other units than indicated here and on the worksheet, contact TCEQ for guidance; it is likely that whichever units are reported are acceptable as long as they are the same for the duty and reference sensors.

Calibration Ratio

The SWMOR-Alt automatically calculates the new calibration ratio for each sensor and enters the result in the appropriate **Cal Ratio** column. These values are obtained by dividing the applicable **Duty Sensor Reading** by the corresponding **Ref Sensor Reading**.

Duty UV Sensor Replaced?

For each calibrated duty sensor, use the drop-down list in the appropriate **Duty UV Sensor Replaced?** cell to select a response. You may not leave this cell blank.

The options available in the drop-down list depend on the sensor's calculated calibration ratio shown in the adjacent **Cal Ratio** cell. TCEQ requires that the sensor's calibration ratio be 1.20 or less.

If the sensor's calibration ratio is greater than 1.20, you must select if the duty sensor was replaced with a new sensor that has a calibration ratio which is not greater than 1.20. You may not replace the duty sensor unless the replacement sensor has a calibration ratio that is 1.20 or lower. Select if you did not replace the duty sensor.

If the replacement sensor's new calibration ratio value is greater than 1.20, you must select .

Calculated Sensor CF

The SWMOR-Alt automatically calculates the sensor correction factor (CF) for each sensor based on the data contained in its corresponding **Cal Ratio** and **Duty UV Sensor Replaced?** cells.

If the sensor's calibration ratio was 1.20 or lower, the SWMOR-Alt will enter a calibration ratio of because the sensor meets minimum performance requirements for a properly calibrated sensor.

If the sensor's calibration ratio was greater than 1.20 and you replaced the inaccurate sensor with a properly calibrated one, the SWMOR-Alt will automatically

enter **Replaced** in the **Calculated Sensor CF** cell and will exclude the sensor when calculating the **New Sensor CF** for the reactor.

If the old sensor's calibration ratio was greater than 1.20 and you replaced it with another improperly calibrated one, the SWMOR-Alt automatically subtracts 0.2 from the value shown in the corresponding **Cal Ratio** cell and enters the result in the **Calculated Sensor CF** cell.

3. UV INTENSITY SETPOINT APPROACH (UV-ISA) WORKSHEET

The UV Intensity Setpoint Approach (**UV-ISA**) worksheet of the SWMOR-Alt summarizes the performance of the UV reactors in your plant that employ the intensity setpoint approach as their UV reactor dose-monitoring strategy.

To get the **UV-ISA** worksheet, click on the **UV-ISA** tab at the bottom of the SWMOR-Alt spreadsheet, as shown in **Figure 3.1**.



Figure 3.1. Tab at Bottom of the SWMOR-Alt Indicating the UV-ISA Worksheet

At the top of the **UV-ISA** worksheet, there is a block of information that describes your system, plant, and reporting period as shown in Figure 3.2. The spreadsheet copies this information from the data you entered on the **P.2-Turbidity Data** worksheet, and the data cannot be re-entered or edited on the **UV-ISA** worksheet.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
1	UV MONTHLY OPERATING REPORT																			
2	FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES																			
3	OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER																			
4	<i>UV Intensity Setpoint Approach Reactors</i>																			
5																				
6	PUBLIC WATER SYSTEM NAME: _____										PLANT NAME OR NUMBER: _____									
7																				
8																				
9	PWS ID No.: _____					Plant ID No.: _____					Month: _____					Year: _____				
10																				

Figure 3.2. Heading of the UV-ISA Worksheet

You must enter daily information in the **UV-ISA** worksheet. Only fill out the portions of this worksheet that are relevant to your plant. At the end of the month, a performance summary will be generated to the lower right of the daily performance data entry area. The spreadsheet calculates the performance summary from the data you recorded during the month.

The performance data entry area is arranged such that every five UV reactors are grouped into a data entry sub-area for the entire month. The number of sub areas depends on the total number of UV reactors in your plant; the sub areas are located beneath one another. The number of UV reactors shown on the **UV-ISA** worksheet is automatically generated from the number you entered during customization of

the SWMOR-Alt. Refer to Chapter 2 for more details on customizing the SWMOR-Alt to your plant.

3.1 VALIDATED OPERATIONAL CONDITIONS FOR UV-ISA

Figure 3.3 shows the portion of the worksheet where validated operational conditions required by the intensity setpoint approach are shown for the first five UV-ISA reactors. The validated parameters include the **Max. Validated Flow Rate (MGD)** and the **Intensity Setpoint (mW/cm²)**. A cell for these parameters for each reactor will be generated automatically; cells that are unnecessary for your plant will be shaded and locked. If your plant has more than five UV-ISA reactors, similar cells are located lower in the worksheet. The right hand portion of the figure shows a cell (blank in the figure, just below the **Crypto Log Inactivation** title) for the required *Cryptosporidium* log inactivation to be achieved in the UV reactors. The information for all of these cells is transferred automatically to the **UV-ISA** worksheet based on the information you supplied when you customized the SWMOR-Alt for your plant. It is not possible to edit these data on the **UV-ISA** worksheet.

VALIDATED OPERATIONAL CONDITIONS						
VALIDATED PARAMETERS						PERFORMANCE REQUIREMENTS
Parameters	Reactor Number					Crypto Log Inactivation
	UVIS1	UVIS2	UVIS3	UVIS4	UVIS5	
Max. Validated Flow Rate (MGD)						
Intensity Setpoint (mW/cm ²)						

Figure 3.3. Validated operational conditions for UVIS Reactors No. 1 to No.5 by UV Intensity Setpoint Approach

3.2 DAILY PERFORMANCE DATA FOR INDIVIDUAL UV REACTOR BY INTENSITY SETPOINT APPROACH

As shown in Figure 3.4, the **Performance Data/Operational Data** table requires daily information input for each UV reactor. The required information is the total daily water production, maximum flow rate, minimum UV intensity of the water treated, total off-specification (off-spec) water production, and off-spec operation hours.

PERFORMANCE DATA								
OPERATIONAL DATA								
Date	Reactor	Total Product. (MG)	Max. Flow Rate (MGD)	Min. Intensity (mW/cm ²)	Sensor CF	Adjusted Min. Intensity (mW/cm ²)	Total Off-Spec Product. (MG)	Consec. Off-Spec Hours (hr)
1	1							
	2							
	3							
	4							
	5							
2	1							
	2							
	3							
	4							
	5							

Figure 3.4. Performance Data/Operational Data for UV Reactors No. 1-5 using the Intensity Setpoint Approach

Total Production (MG)

For each day that the UV reactor is used for treatment, record the total amount of water treated by each UV reactor in the appropriate **Total Product.** cell. Record this value in units of million gallons (MG).

If a reactor was off line all day, enter **<X>** in this cell. If a reactor treated water on a specific day but you failed to record how much, enter **<ND>** in this cell.

Maximum Flow Rate (MGD)

You are required to monitor the flow rate continuously when the reactor is treating water; if you collected all of this required data, enter the maximum (or peak) flow rate through each reactor in the appropriate **Max Flow Rate** cell. Record this value in million gallons per day (MGD). The maximum flow rate (in MGD) cannot be less than the total production (in MG) and will generally be greater; the two values will only be the same if the reactor operated at a constant flow rate for the entire 24 hour period. For example, if you ran the plant for 12 hours at 1 MGD, and 12 hours at 2 MGD, your total production would be 1.5 MG, and 1.5 is less than 2.

If a reactor was off line all day, enter **<X>** in this cell.

If a reactor treated water on a specific day but you failed to collect any flow rate data during the day, enter **<ND>**.

If a reactor treated water and you collected some, but not all, of the required flow rate data, and all of the data that you do have is less than the maximum validated flow rate, enter <MD>.

If a reactor treated water and you collected some, but not all, of the required flow rate data, and some of the data you do have is greater than the maximum validated flow rate, enter that peak flow in the appropriate **Max Flow Rate** cell.

Minimum Intensity (mW/cm²)

Each day, enter the minimum UV intensity of the water that was treated by each reactor in the appropriate **Min Intensity** cell. Record this value in milliwatts per square centimeter (mW/cm²).

If a reactor was off line all day, enter <X> in this cell. If a reactor treated water on a specific day, but you failed to collect any UV intensity data during the day, enter <ND>. If you collected some, but not all of the required UV intensity data, enter <MD>.

Sensor CF

The SWMOR-Alt automatically generates the sensor correction factor (**Sensor CF**) based on the data entered on the **UV–Sensor Data** worksheet. Prior to the calibration date, the value is calculated using the previous month's CF. On and after the calibration date, the value is calculated from the new CF.

If the cell reads <Sensor MD>, then more information is required to calculate the CF for a particular sensor. This data needs to be entered in the **UV–Sensor Data** worksheet.

Adjusted Minimum Intensity (mW/cm²)

The SWMOR-Alt automatically calculates the **Adjusted Min Intensity** based on the data contained in the corresponding cells for **Min Intensity** and **Sensor CF**.

The **Adjusted Min Intensity** values are valid only when the reactor is operating within its validated operating conditions (see Section 3.1). If the reactor operated outside its validated conditions at any point during the day, its **Adjusted Min Intensity** value will be followed by an asterisk (*).

Total Off-spec Production (MG)

Each day, record the amount of water that was produced by each reactor during periods when the reactor was operating off-spec in the appropriate **Total Off-spec Product** cell. Record this value in units of MG. The reactor is regarded as off-spec when:

- the **Max Flow Rate** is higher than the **Max Validated Flow Rate** of the reactor, or
- the **Adjusted Min Intensity** is below the **Intensity Setpoint** for the reactor.

The amount of off-spec water produced by a reactor must not exceed the total amount of water it produced during the day.

If a reactor was off line all day, enter **<X>** in the appropriate cell.

If the reactor was continuously operated within its validated range and the **Adjusted Min Intensity** was not less than the **Intensity Setpoint**, the SWMOR-Alt will not allow you to enter a non-zero value. In such a case, either leave the applicable cell blank or enter **<0>** which will be automatically converted to **<0.000>**.

Consecutive Off-spec Hours (hr)

Each day, record the longest consecutive period of time, rounded to the nearest ¼ hour, when the reactor was operating off-spec in the appropriate **Consec. Off-spec Hours** cell. Record this value in hours (hr). Refer to the **Total Off-spec Product** section above for specifics of when the reactor is regarded as off-spec.

3.3 MONTHLY SUMMARY FOR ALL UV REACTORS

Below the daily performance data for the first five reactors, the monthly summary table is displayed as shown in **Figure 3.5**. This table is located to the lower right of the data performance table where you entered all of the daily data explained above—that is, in the rectangular space created by cells AD62 to AL67. Values for the total production, total off-spec production and total percent off-spec are automatically calculated in the appropriate cells. As indicated in the table, this summary is for all UV reactors, including both ISA and CDA reactors if you have both types at your plant.

MONTHLY SUMMARY FOR ALL UV REACTORS	Total Production (MG)	Total Off-spec Production (MG)	Total % Off-spec
	1.00	0.00	0.00
Treated water pumpage and total UV production differ in more than 15% on the following month and days:			

Figure 3.5. Monthly Summary for All UV Reactors in the UV-ISA Worksheet.

Total Production (MG)

The SWMOR automatically calculates the **Total Production** by summing the daily total production data contained in the **UV-ISA** and **UV-CDA** worksheets. This value is updated daily as that day's data is added into the appropriate cells, but only the value at the end of the month is important.

Total Off-spec Production (MG)

The SWMOR-Alt automatically calculates the **Total Off-spec Production** by summing the daily **Total Off-spec Product** data contained in the **UV-ISA** and **UV-CDA** worksheets. This value is updated daily as that day's data is added into the appropriate cells, but only the value at the end of the month is important.

Total % Off-spec

The SWMOR-Alt automatically calculates the **Total % Off-spec** by dividing the **Total Off-spec Production** by the **Total Production**.

The **Total % Off-spec** values will only be valid if the **Total Production** and **Total Off-spec Production** values are valid.

Treated (or Raw) water pumpage and total UV production differ by more than 15% on these days

The SWMOR-Alt automatically calculates the two values under the **Monthly Summary for All UV Reactors**.

The first blank indicates whether the water is raw or treated according to the location of your UV reactors

The second blank indicates all the dates when the percent of off-spec production was greater than 15%.

The calculated values are valid as long as all the daily data cells are filled in.

4. UV CALCULATED DOSE APPROACH (UV-CDA) WORKSHEET

The UV calculated dose approach (**UV – CDA**) worksheet of SWMOR-Alt summarizes the performance of the UV reactors in your plant that employ the UV calculated dose approach as their UV reactor dose-monitoring strategy.

To get the **UV-CDA** worksheet, select the **UV-CDA** tab at the bottom of the SWMOR-Alt spreadsheet, as shown in **Figure 4.1**.



Figure 4.1. Tab at the bottom of the SWMOR-Alt indicating the UV-CDA worksheet

At the top of the **UV-CDA** worksheet, there is a block of information that describes your system, plant, and reporting period as shown in Figure 4.2. The spreadsheet copies this information from the data you entered on the **P.2-Turbidity Data** worksheet, and the data cannot be re-entered or edited on the **UV-ISA** worksheet.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	
1	UV MONTHLY OPERATING REPORT																					
2	FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES																					
3	OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER																					
4	<i>UV Calculated Dose Approach Reactors</i>																					
5																						
6	PUBLIC WATER																					
7	SYSTEM NAME:	_____										PLANT NAME	_____									
8												OR NUMBER:	_____									
9	PWS ID No.:	_____	Plant ID No.:	_____	Month:	_____	Year:	_____														
10																						

Figure 4.2. Heading of the UV-CDA Worksheet.

You must enter daily information on the **UV-CDA** worksheet. Fill out only the portions of this worksheet that are relevant to your plant. At the end of the month, a performance summary will be generated to the right of the daily performance data entry area. The performance summary is calculated from the data you recorded during the month.

4.1 VALIDATED OPERATIONAL CONDITIONS FOR UV-CDA

Figure 4.3 shows the portion of the worksheet where validated operational conditions required by the calculated dose approach are shown for the first five UV-

CDA reactors. The validated parameters include the **Max Validated Flow Rate (MGD)** and the **Min Validated UVT (%)**. A cell for these parameters for each reactor will be generated automatically; cells that are unnecessary for your plant will be shaded and locked. If your plant has more than five UV-CDA reactors, similar cells are located lower in the worksheet. The right hand portion of the figure shows two cells for the required *Cryptosporidium* log inactivation and the required UV dose to be achieved in the UV reactors. The information for all of the cells in this figure is transferred automatically to the **UV-CDA** worksheet based on the information you supplied when you customized the SWMOR-Alt for your plant. It is not possible to edit these data on the **UV-CDA** worksheet.

VALIDATED OPERATIONAL CONDITIONS							
VALIDATED PARAMETERS					PERFORMANCE REQUIREMENTS		
Parameters	Reactor Number					Crypto Log Inactivation	Required UV Dose (mJ/cm ²)
	UVCD1	UVCD2	UVCD3	UVCD4	UVCD5		
Max Validated Flow Rate (MGD)							
Min Validated UVT (%)							

Figure 4.3. Validated Operational Conditions for UVCD No.1 to 5 by Calculated Dose Approach

4.2 DAILY PERFORMANCE DATA FOR INDIVIDUAL UV REACTORS BY CALCULATED DOSE APPROACH

As shown in **Figure 4.4**, the **Performance Data/Operational Data** table requires daily information for each UV reactor. The required information is the total daily water production, the maximum flow rate, the minimum UV transmittance of the water treated, the minimum UV dose, total off-spec water production, and the off-spec operation hours.

PERFORMANCE DATA									
Date	Reactor	OPERATIONAL DATA							
		Total Product. (MG)	Max. Flow Rate (MGD)	Min UV Trans. (%)	Minimum Meas'd UV Dose (mJ/cm ²)	Sensor CF	Adjusted Minimum UV Dose (mJ/cm ²)	Total Off-Spec Product. (MG)	Consec. Off-Spec Hours (hr)
1	1								
	2								
	3								
	4								
	5								

Figure 4.4. Performance Data/Operational Data for UV Reactors No. 1-5 Using the Calculated Dose Approach

Total Production (MG)

For each day that the UV reactor is used for treatment, record the total amount of water treated by each UV reactor in the appropriate **Total Product** (total production) cell. Record this value in units MG.

If a reactor was off line all day, enter **<X>** in this cell. If a reactor treated water on a specific day but you failed to record how much, enter **<ND>** in this cell.

Maximum Flow Rate (MGD)

You must monitor the flow rate continuously when the reactor is treating water; if you collected all of this required data, enter the maximum (peak) flow rate through each reactor in the appropriate **Max Flow Rate** cell. Record this value in MGD. The maximum flow rate (in MGD) cannot be less than the total production (in MG) and will generally be greater; the two values will only be the same if the reactor operated at a constant flow rate for the entire 24 hour period.

If a reactor was off line all day, enter **<X>** in this cell.

If a reactor treated water on a specific day but you failed to collect any flow rate data during the day, enter **<ND>**.

If a reactor treated water and you collected some, but not all, of the required flow rate data, and all of the data that you do have is less than the maximum validated flow rate, enter **<MD>**.

If a reactor treated water and you collected some, but not all, of the required flow rate data, and some of the data you do have is greater than the maximum validated flow rate, enter that peak flow in the appropriate **Max Flow Rate** cell.

Minimum UV Transmittance (%)

Each day, enter the minimum UV Transmittance (UVT) of the water that was treated by each reactor in the appropriate **Min UV Trans** cell. Record this value as a percentage (%).

If a reactor was off line all day, enter **<X>** in this column. If a reactor treated water on a specific day, but you failed to collect any UVT data during the day, enter **<ND>**. If you collected some, but not all of the required UVT data, enter **<MD>**.

Minimum Measured UV Dose (mJ/cm²)

Each day, record the minimum measured UV dose that each reactor achieved while it was operating in the appropriate **Minimum Meas'd UV Dose** cell. Record this value in millijoules per square centimeter (mJ/cm²).

If a reactor was off line all day, enter **<X>** in this cell.

If a reactor treated water on a specific day but you failed to collect any UV intensity data, enter <ND>.

If you collected some, but not all the required UV dose data, enter <MD>.

A UV reactor monitored by the calculated dose approach will receive reduced inactivation credit during periods when the actual UV dose was below the required UV dose.

Sensor CF CALC

The SWMOR-Alt automatically generates the sensor correction factor (**Sensor CF**) based on the data entered on the **UV–Sensor Data** worksheet. Prior to the calibration date, the value is calculated using the previous month’s CF. On and after the calibration date, the value is calculated from the new CF.

If the cell reads <Sensor MD>, then more information is required to calculate the CF for a particular sensor. This data needs to be entered in the **UV–Sensor Data** worksheet.

Adjusted Minimum UV Dose (mJ/cm²) CALC

The SWMOR-Alt automatically calculates the **Adjusted Minimum UV Dose** based on the data contained in the corresponding cells for **Minimum Measured UV Dose** and **Sensor CF**.

The **Adjusted Minimum UV Dose** values are valid only when the reactor is operating within its validated operating conditions (see Section 4.1). If the reactor was operated outside its validated conditions at any point during the day, its **Adjusted Minimum UV Dose** value will be followed by an asterisk (*).

Total Off-spec Production (MG)

Each day, record the amount of water that was produced by each reactor during periods when the reactor was operating off-spec in the appropriate **Total Off-spec Product** cell. Record this value in units of MG. The reactor is regarded as off-spec when:

- the **Max Flow Rate** is higher than the **Max Validated Flow Rate** of the reactor, or
- the **Min UVT** of the water is lower than the **Min Validated UVT** of the reactor, or
- the **Adjusted Minimum UV Dose** is below the **Required UV Dose**.

The amount of off-spec water produced by a reactor cannot exceed the total amount of water it produced during the day.

If a reactor was off line all day, enter <X> in the appropriate cell.

If the reactor was continuously operated within its validated range and the **Adjusted Minimum UV Dose** was not less than the **Required UV Dose**, the SWMOR-Alt will not allow you to enter a non-zero value. In this scenario, leave the applicable cell blank or enter <0> which will be automatically converted to <0.000>.

Consecutive Off-spec Hours (hr)

Each day, record the longest consecutive period of time, rounded to the nearest $\frac{1}{4}$ hour, when the reactor was operating off-spec in the appropriate **Consec. Off-spec Hours** cell. Record this value in hours (hr). The conditions under which the reactor is regarded as operating off-spec are indicated in the section above on **Total Off-spec Production**.

If a reactor was off line all day, enter <X> in the appropriate cell.

If the reactor was continuously operated within its validated range and the **Adjusted Minimum UV Dose** was not less than the **Required UV Dose**, the SWMOR-Alt will not allow you to enter a non-zero value. In this scenario, leave the applicable cell blank or enter a value of <0.00>.

4.3 UV TREATMENT SUMMARY AND CREDITS

After you finish entering daily data for the entire month, the SWMOR-Alt automatically summarizes the daily inactivation credits achieved by the UV reactors and the performance of UV treatment for this month.

Daily Minimum Inactivation Summary Data

Figure 4.5 is a partial view (showing the first 16 days of the month) of the summary of minimum inactivation credits achieved by the UV reactors for each day.

DAILY MINIMUM INACTIVATION											
Reactor Range	SUMMARY DATA					Reactor Range	SUMMARY DATA				
	Date	Min Dose (mJ/cm ²)	Inactivation Credit Achieved				Date	Min Dose (mJ/cm ²)	Min Inactivation		
			Giardia Log	Virus Log	Crypto Log				Giardia Log	Virus Log	Crypto Log
1 to 3	1					1 to 3	9				
	2						10				
	3						11				
	4						12				
	5						13				
	6						14				
	7						15				
	8						16				

Figure 4.5. Daily Minimum Inactivation summary for UV calculated dose approach

Reactor Range

The summary table is for the entire set of UV CDA reactors at your plant. The SWMOR-Alt automatically indicates the entire range of reactors in this cell. The example in Figure 4.5 is for a plant with three CDA reactors.

Minimum Dose (mJ/cm²)

For each day, the SWMOR-Alt automatically searches for the minimum adjusted UV dose applied in all your UV reactors based on the daily information you entered in the performance data area and then enters this value in the **Min Dose** cell.

Inactivation Credit Achieved

The inactivation credits summarized here include credits for *Giardia* inactivation (**Giardia Log**), viral inactivation (**Virus Log**) and *Cryptosporidium* inactivation (**Crypto Log**).

Giardia Log

Virus Log

Crypto Log

The SWMOR-Alt spreadsheet uses a series of mathematical equations to determine the levels of *Giardia*, viral, and *Cryptosporidium* inactivation achieved in each of the UV reactors for each day. The spreadsheet then searches for the minimum

inactivation level among all the UV reactors and automatically enters the minimum value in the **Giardia Log**, **Virus Log** and **Crypto Log** columns, respectively.

4.4 MONTHLY SUMMARY FOR ALL UV REACTORS

The SWMOR-Alt automatically determines if your UV treatment met the performance criteria for the *Crypto* inactivation credit. The information is summarized just below the **Daily Minimum Inactivation** block (see **Figure 4.6**) in the rectangular space created by cells AS27 to BD29. Values for the total production, total off-spec production and total percent off-spec water are automatically calculated and shown in the appropriate cells. As indicated in the table, this summary is for all UV reactors, including both ISA and CDA reactors if you have both types at your plant.

Total volume of water treated by all UV reactors:	_____ MG	Treated water pumpage and total UV production differ by more than 15% on these days (month):	
Total volume of off-spec water produced by all reactors:	_____ MG		
Percentage of off-spec water:	_____ %		

Figure 4.6. Monthly summary for all UV reactors in the UV-CDA worksheet.

Total volume of water treated by UV reactors **CALC**

The SWMOR-Alt automatically calculates the total volume of water that was treated by your UV reactors by summing the daily total production data contained in the **UV-ISA** and **UV-CDA** worksheets for the entire month.

Total volume of off-spec water produced **CALC**

The SWMOR-Alt automatically calculates the total volume of water that was produced when the UV reactors were operating off-spec for the entire month by summing the daily **Total Off-spec Product** data contained in the **UV-ISA** and **UV-CDA** worksheets .

Percentage of off-spec water **CALC**

The SWMOR-Alt automatically calculates the percentage of off-spec water produced for the entire month and enters this value in the corresponding cell.

Treated (or Raw) water pumpage and total UV production differ by more than 15% on these days **CALC**

The SWMOR-Alt automatically calculates the two blanks under the Monthly Summary for All UV Reactors.

The first blank indicates whether the water is raw or treated according to the location of UV process.

The second blank indicates all the dates when the percent of off-spec production was greater than 15%.

Note that the two blanks are valid only when not every daily data cell is empty.

5. UV TRANSMITTANCE ANALYZER (UV-UVT ANALYZER) WORKSHEET

The UV transmittance analyzer (**UV-UVT Analyzer**) worksheet of SWMOR-Alt is where you report the calibration results of the UVT analyzers. You are only required to monitor the UVT analyzer calibration if you use the UV calculated dose approach. To get to the **UV- UVT Analyzer** worksheet, click on the UV-UVT Analyzer tab at the bottom of the SWMOR-Alt spreadsheet, as shown in **Figure 5.1**.



Figure 5.1. Tab at the bottom of the SWMOR-Alt indicating the UV-UVT Analyzer worksheet

As at the top of all of the worksheets, there is a block of information that describes your system, plant, and reporting period, as shown in **Figure 5.2**. The spreadsheet copies this information from the data you entered on the **P.2-Turbidity Data** worksheet, and the data cannot be re-entered or edited on the **UV-UVT Analyzer** worksheet.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	
1	UV MONTHLY OPERATING REPORT																			
2	FOR PUBLIC WATER SYSTEMS THAT ARE USING SURFACE WATER SOURCES																			
3	OR GROUND WATER SOURCES UNDER THE INFLUENCE OF SURFACE WATER (cont.)																			
4	<i>UVT Analyzer Calibration</i>																			
5																				
6	PUBLIC WATER SYSTEM NAME: _____									PLANT NAME OR NUMBER: _____										
7																				
8																				
9	PWS ID No.: _____					Plant ID No.: _____					Month: _____					Year: _____				
10																				

Figure 5.2. Heading of the SWMOR-Alt worksheet for UVT Analyzer Calibration

The TCEQ requires that on-line UVT analyzers be evaluated at least weekly by comparing the on-line UVT measurements to UVT measurements made with a bench-top spectrophotometer. **Figure 5.3** shows the area for UVT analyzer No.1 as an example of the type of calibration data that you need to supply.

CALIBRATION DATA								
UVT Analyzer Number	Benchtop UVT Analyzer Serial Number:							
	Week	Calibration Date	On-line UVT Analyzer Serial #	On-line Reading (% UVT)	Grab Sample Reading (% UVT)	Difference (% UVT)	Recalibration Performed? (if Diff > 2%)	Other Action Taken
UVT No. 1	1							
	2							
	3							
	4							
	5							

Figure 5.3. UVT analyzer Calibration Data for UVT No.1

Benchtop UVT Analyzer Serial Number:

You are required to have a benchtop UV analyzer to calibrate the on-line analyzers at least once per week. Enter the serial number of your laboratory benchtop UV instrument in the cell to the right of this heading. Although you do not have to enter the entire serial number, you must enter enough information to identify the specific benchtop analyzer used. Unless you have a new instrument that was put in service within the last month, this number should be the same as entered in the previous month.

Calibration Date

You are required to calibrate each UVT on-line analyzer at least once per week. Each time you perform a calibration, enter the date that you performed it in the **Calibration Date** cell. You must enter at least the month and day in any way that Excel accepts (for example, 6/18 or 06-18); you may also include the year but Excel will automatically add the current year if you don't.

On-line UVT Analyzer Serial #

Record the UVT analyzer serial number in the appropriate **UVT Analyzer Serial #** cell. Again, you do not have to enter the entire serial number, but you must enter enough information to identify the specific on-line analyzer being calibrated.

On-line Reading (% UVT)

Record the percent transmittance reading of the on-line UVT analyzer in the appropriate **On-line Reading** cell.

Grab Sample Reading (% UVT)

Collect a grab sample from a location close to the on-line UVT analyzer sampling point measure it on your calibrated bench-top spectrophotometer, and record the percent UV transmittance of the grab sample in the appropriate **Grab Sample Reading** cell. The bench-top spectrophotometer must be set at a wavelength of 254 nm, and a 1-cm cell must be used for the analysis.

Difference (% UVT)

The SWMOR-Alt spreadsheet automatically calculates the difference between the percent transmittance reading from the on-line UVT analyzer and the reading from the calibrated spectrophotometer and enters the difference (as a positive number) in the appropriate **Difference** cell.

Recalibration Performed? (Diff > 2% UVT)

For each UVT analyzer, use the drop-down list in the **Recalibration Performed? (Diff > 2% UVT)** cell to select one of the following three cases:

- Select if the value contained in the corresponding **Difference** cell is greater than 2.00% and the on-line UVT analyzer has been recalibrated.
- Select if the value contained in the corresponding **Difference** cell is greater than 2.00% but the on-line UVT analyzer has not been recalibrated. In this case, you must enter information in the next column, under **Other Action Taken**.
- If the value contained in the **Difference** column is less than or equal to 2.00%, you are only permitted to select .

Other Action Taken

Select in the **Other Action Taken** cells when the corresponding **Recalibration Performed** cell is either “NA” or “YES.”

When the corresponding **Recalibration Performed** cell is “NO”, you must use the drop-down list in the **Other Action Taken** cell to choose one of the following three cases:

- Select when you take manual UVT measurements with a calibrated bench-top spectrophotometer every 4 hours and enter the UVT into the UV reactor’s program logic controller.
- Select when you enter the design UVT value into the program logic controller (PLC) and verify daily that the design UVT does not exceed the actual UVT with a grab sample.

- Select [None] when neither of the above two options are taken.

If you select [None], your UV facility is off-spec until one of the first two options is followed or until the UVT analyzer meets the calibration criterion.