Preliminary Rules: Process Control Event – 2011

The process control event for the 2011 Operations Challenge will be very similar to the 2010 event. The test content and layout will be essentially unchanged. The scoring system from last year will be used. There will be a mandatory process question.

Overview

The event consists of answering a number of multiple choice questions, some short math questions with multiple choice answers, and up to five operational type scenarios that have four to six questions each that may require considerable calculations. The event is timed, with a maximum of 25 minutes allowed for completion. The team can split up the test any way it chooses during the test. If a team completes the test before the end of the event, their actual time is recorded. The event should be viewed as an opportunity for a team to demonstrate their accumulated knowledge of wastewater treatment and skill in plant process control.

This year the test will include a mandatory problem set. The topic of the mandatory set will be announced by summer.

Event Philosophy

The purpose of the process control event is to distinguish the relative process control skills of the teams competing so that points can be awarded proportionately. In an ideal world this would consist of each team standing before a panel of judges and reciting all their wastewater knowledge and answering questions from the judges. In the context of the Operations Challenge, this is not practical, so a timed written test is used.

Unlike most test situations, the expectation is not that all teams will complete all the questions. The goal is not to see who can answer all questions with the fewest mistakes. Instead, teams are given the opportunity to provide as many correct answers as they can in the allowed time. The test is designed to be long enough so that teams do not run out of questions to answer.

The types and difficulty level for questions are roughly matched to the points awarded for getting the correct answer. Solving the process scenario questions are worth more than the quick multiple choice questions. It is up to each team to develop a strategy to figure out which questions to answer in the time allotted to achieve the highest final score.

Mandatory Problem

The test will include a set of problems that must be answered. If no work is shown for a question, the score is -60, regardless of answer circled. If there is at least an attempt to work out the answer, zero points will be awarded, regardless of the answer circled. If substantial work is shown, partial credit as described below is possible for 60 points. Correct answers will receive 60 or 120 points if work is shown. Incorrect (or no answer circled) answers may receive partial credit for work shown.

Process Scenario Categories

The scenario problems will include the following processes:

- Activated sludge
- Chemically enchanced precipitation
- Lift stations
- Piping diagrams
- Energy and sustainability

Grading

The tests will be graded as follows:

- multiple choice questions as: correct answer, incorrect answer, or no answer
- short math multiple choice questions as: correct, incorrect, or no answer as well as whether work is shown on test paper
- operational scenarios as: correct, incorrect, or no answer as well as whether work is shown on test paper.

Scoring

Scoring in the Process Control event consists of two components: time and correctness. The raw time is the actual time that a team requires to complete the test and return it to the Judge at their table. The time allotted for the test is 25 minutes. All teams that have not finished the test before time runs out will receive a raw time of 25 minutes (1500 seconds). Raw time will be used to determine a time bonus, which is added to the correctness component of the score to calculate the final score.

If a team's raw time is greater than 20 minutes, they receive a time penalty equal to one half of the difference between their raw time and 20 minutes. As an example, if a team has a raw time of 23 minutes and 45 seconds, their time penalty is (1425 seconds – 1200 seconds)/2 = 112.5 seconds. Since this is a penalty, 112.5 will be subtracted from their score.

If a team's raw time is between 15 and 20 minutes, they receive time bonus points equal to one half of the difference between their raw time and 20 minutes. As an example, if a team has a raw time of 16 minutes and 10 seconds, their time bonus is (1200 seconds – 970 seconds)/2 = 115 seconds. Since this is a bonus, 115 will be added to their score.

There is no additional time bonus for finishing earlier than 15 minutes. If a team finishes earlier than 15 minutes their time bonus will be based on a time of 15 minutes.

The correctness component of the score is based on the total of points awarded for correct answers and work shown. In the multiple choice and extended multiple choice sections, points are awarded only for correct answers, there are no penalties.

Points				
Test section	**Correct answer[1]**	**No answer**	**Incorrect answer**	**Correct answer AND showing work**
Multiple choice	10	0	0	N/A
Extended multiple	25	0	0	N/A

choice				
Short math multiple choice	0	25*	25*	50/25*
Operational scenarios	0[1]	60*	60*	120/60*
Mandatory questions	-60/0[1]	-60/0	-60/0/60*	120/60*

[1]For any math questions, there are no points for a correct answer if no work is shown.
*Partial credit for showing work as described below

To receive any points on a math question, at least some relevant work must be shown. Simply circling an answer and not showing any work will result in zero points, regardless of whether the circled answer is correct or not.

Partial credit is possible, even if an incorrect or no answer is circled.

If a Judge determines that a team member is not attempting to help with parts of the test, a 500 point penalty will be assessed for each non-participating team member.

A team's final score will be the sum of the time bonus (or penalty) and the points awarded for correct answers. The highest score will win the event.

Partial Credit and Showing Work

For any math section question, the team must write out the numbers used and show them in an equation form.

Example:

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16 mg/l x 8.34 x 2.4 MGD = 320 lbs
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Simply putting down numbers does not count. The equation used must also be relevant to the question. i.e. there will not be credit for writing down the lbs formula when the question is about detention time.

For the math and operational scenario questions, if the grader feels that the work shown demonstrates correct and significant, but incomplete, progress towards the answer the work shown may receive the partial credit listed in the Points table. If the work shown uses a conceptually incorrect approach partial credit might not be awarded.

Note that in the Operational Scenarios, sometimes answers that are text rather than numbers may still require work to be shown. For example, if the correct answer for a problem is "the hydraulic loading rate is too high" then the work shown **must** include a calculation of the hydraulic loading rate.

The test grader can only use what the test taker writes down to determine how the test taker is

attempting to solve the problem. Therefore it is the responsibility of the test taker to clearly show how he or she arrived at an answer. The grader cannot infer missing steps in solving the problem.

Scope

The questions will cover the following areas of wastewater treatment as well as general topics such as: pumping, maintenance, laboratory, safety, flow measurement, and metering:

Process Areas	**Example Systems**
Preliminary Treatment	Screening Grit Removal Flow Equalization
Odor Control	Wet Chemical Scrubbing Chemical Addition Biofilters
Primary Treatment	Primary Sedimentation Flow Equalization Clarification
Secondary Treatment Suspended Media	Activated Sludge Biological Nutrient Removal Clarification Sequencing Batch Reactors
Secondary Treatment Fixed Media	Trickling Filtration Biological Nutrient Removal
Advanced Treatment	Filtration Biological Nutrient Removal
Thickening	Gravity Belt Thickener Dissolved Air Flotation Gravity Thickening
Solids Stabilization Methods	Anaerobic Digestion Aerobic Digestion
Dewatering	Belt Filter Press Drying Beds Centrifuge Dewatering
Disinfection	Chlorination \ Dechlorination Ultraviolet Disinfection
Management and Support	Process Instrumentation Treatment Plant Security

Resources

The following references will be used in creating and grading the test questions:

- Water Environment Federation Manual of Practice 11
- The monthly *Water Environment & Technology Operations Forum* WEF Skills Builder quiz: http://www.wef.org/ConferencesTraining/SkillsBuilder/
- The WEF/ABC study guide
- California State University Sacramento Operations of WWTPs volumes 1 & 2 and Advanced Waste Treatment
- Collections Systems questions will be based on the Sacramento Manual, Operations and

Maintenance of Wastewater Collections Systems.

- Manual on the Causes and Control of Activated Sludge Bulking and Foaming, Jenkins, Richards & Daigger

Questions on Operations Central Certification Quiz on the WEF website are recommended as resource study materials.

Additional general study material includes:

- EPA design manuals, which can be obtained at http://www.epa.gov/ttbnrmrl. Select *Browse* to see the full list of available documents. Only some are applicable to wastewater.
- Wastewater Engineering Treatment Disposal, and Reuse, Metcalf and Eddy, McGraw-Hill
- Note that these sources will NOT be used in creating or grading tests. They are listed for those interested in additional sources of wastewater knowledge.

Test Details

The same test is used for both Division 1 and Division 2.

The multiple choice test will consist of 42 questions with four possible answers each, fifteen multiple choice questions requiring a small amount of math, and 20 questions where each answer is chosen from a list of 20 possible answers (extended multiple choice).

Four or five process scenarios with four to six questions each are in the test. Teams may answer as many parts of any scenario that they desire.

Formula sheets, reference books or any other material are not permitted.

Team members may talk among themselves but may not be disruptive. Teamwork in solving problems is encouraged. Also consider that other teams may overhear your discussions.

General Details

What will be supplied at the event: Answer sheet forms and scratch paper for calculations. We will also try to have a pencil sharpener available prior to the event but this is not guaranteed. Competitors must supply their own No. 2 lead pencils and calculators (calculators cannot have programming or printout capability)

All four team members must be present before the start of the event.

If a team is disqualified from the event they will receive a score based on the maximum time and every question left blank and no work shown.

The test will have equivalent metric units of measure supplied in addition to the standard U.S. units. (**Teams must request a metric version by June 1, 2011**)

Notes

The exact number of questions may change slightly between now and the event. The points may also be adjusted to ensure test balance.

The Judges will not have reference books available at the event; plan on bringing your own copies as needed. (No reference material can be used during the test)

Process Control Event committee members will be available to discuss scoring of test questions the morning after the event.