Module 11:
Maintenance
Answer Key

What are some factors that impact the availability of equipment? (What causes "downtime"?)

Ans: Many possible answers are available. Generally, the answers will fall into these categories:

- Human Error
- Acts of God or Nature
- Product Defects
- Planned Service Work

What are some factors that help to ensure high availability of equipment (minimal "downtime")?

Ans: Many possible answers are available. Generally the answers will fall into these categories:

- Continuous Monitoring and Assessment of Equipment
- "Real Time" Knowledge of Equipment Condition
- Analysis of Other Information, such as Equipment History, Operational Protocols, and Manufacturer's Data

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What safety hazards can you identify in the photograph?

Ans: No shaft guard on pump; leaking oil or water on the floor; limited clearance in the area; limited lighting in the area (the flash photography brings out some details that would be missed in a low-lighting area).

UNIT REVIEW:

1. List the five goals of a wastewater treatment plant's maintenance program.

Ans: Fixed asset management; maintenance of design intent; efficiency of operation; safety and environmental protection; and system reliability

2. Explain why the banker or municipal residents are concerned about plant maintenance.

Ans: (possible answer) He/She/They want to protect their investment.

3. How does regular maintenance impact the availability of personnel?

Ans: Management knows how many people to assign to various tasks; keeping crises to a minimum, through regular maintenance, means that staffing is not "hit or miss" but is planned and organized.

4. Give three examples of the ways in which plant maintenance directly impacts the quality of the treatment process.

Ans: Possible answers include valves, meters that read quality standards, equipment that responds to the metered data, etc.

5. What could happen if a pump were allowed to operate with excessively worn wear rings?

Ans: Possible answers include lower pump efficiency; higher power consumption; need for more capacity placed online; increased burden on electrical system.

What maintenance tasks might a plant operator in a small facility complete?

Ans: Various answers are possible. The overall theme is that operators in a small facility will probably complete many types of maintenance on a routine basis.

What maintenance tasks might a plant operator in a large facility complete?

Ans: Various answers are possible. The overall theme is that operators in a large facility will probably have a maintenance staff that does most of the maintenance tasks. However, the operator will make some minor adjustments, monitor equipment, and so forth.

Why does it make sense to involve operators in the maintenance plan of any facility?

Ans: The operators, of course, are involved in the everyday functioning of equipment and systems. They know the equipment well and know how it should perform. They can quickly notice any changes in performance. Also, it makes sense to think that operators know what works in the "real world" environment, as opposed to what works on the design table. Their input is valuable to the maintenance plan.

What are some examples of PM that are performed at the facility in which you work? How often are the tasks performed?

Ans: Various answers are possible; answers vary according to the size and type of facility. Some examples include: adjusting packing gland on a pump seal; checking and recording pressure gauge readings for pumps, exercising valves as part of a semi-annual valve program.

What consequences could you imagine if the PM work was neglected for a long time?

Ans: Various answers are possible, including equipment failure, higher costs, lower available labor pool, operation-wide failures, etc.

What are some examples of corrective maintenance that are performed at the facility in which you work?

Ans: Various answers are possible. Some include: adjustment of pump/motor alignment after excessive vibration was observed; lubrication of a roller bearing on a conveyor after noise was detected; replacement of an air filter after excessive differential pressure across the filter was observed.

How do you identify the items in need of corrective maintenance?

Ans: Various answers are possible. Some include: visual inspection; noise patterns; vibration analyses.

What are some examples of breakdown maintenance that are performed at the facility in which you work?

Ans: Various answers are possible. Some answers include: replacement of a motor after it overheated and failed; rebuilding a clarifier gear case after oil leaked and gears were damaged from lack of lubrication.

Thinking about the examples you have heard in class, what other types of maintenance, if any, could have prevented the breakdown maintenance?

Ans: Various answers are possible, according to the answers given to the previous question. In most cases, regular preventive maintenance and timely corrective maintenance will prevent the need for breakdown maintenance.

List some maintenance activities that occur at your plant during these time frames:

NOTE: Various answers are possible in all categories.

- *Daily*

Ans: Pump operation (noise, vibrations, smell); tank levels; and aeration patterns on tank.

- *Weekly*

Ans: Meter readings; check maintenance reports to tweak equipment or order chemicals.

- *Monthly*

Ans: Check hours of operation (unit may need periodic servicing); check for animals such as groundhogs; check embankments of ponds; clean the sampler; check filters on aeration blowers.

- *Quarterly*

Ans: Change out or rotate equipment; generate extra testing as needed; perform required testing from Permit or Regulatory Agency; check, clean, or change HVAC filters; check, clean, or change process filters.

- *Annually*

Ans: Check and service all equipment on its year anniversary; check large gear cases on clarifier drives, bar screens, mixer motors, and comminutors; inspect vehicles.

- *Seasonally*

Ans: Exterior building inspection (cracks, remove wind screens, etc.); change oil viscosity for aeration mixer motors; roof inspection; check and make adjustments for changes in seasonal discharge requirements.

How does your facility plan for the unplanned? What resources are available to deal with emergencies?

Ans: Various answers are possible. Participants may state that their facility has spare parts on hand, duplicates equipment, or has redundant operations.

Looking at the picture shown below, how many types of identification systems can you find?

Ans: Various answers are possible. Be sure the participants see, at a minimum, the following tags: function (in blue duct tape); manufacturer's number (black plastic tag); facility's pump number (written on the equipment in black Magic Marker); components (blue duct tape).

What are the possible consequences of this kind of labeling?

Ans: Various answers are possible. Make sure participants note, at a minimum: safety issues; confusion when identification is required.

In the following activity, you will create three types of tagging systems. Using the equipment listed below, create a Number Code, Alpha-numeric Code, and Smart Number Code for each of the products.

Number Code:

Ans: Various answers possible. The earliest purchases should have the lowest number. An example:

Bar Screen (Brunning facility)	2355
Bar Screen (Main Street facility)	2356 (this was bought the same day as the other bar screen; therefore, it is probably tagged with the next available number)
Sump Pump	3888 (this was purchased two years after bar screens)
Aeration Blower	5203 (this was purchased the year after the pump)

Alpha-numeric Code:

Ans: Various answers are possible. The earliest purchases will have a lower number, according to the type of equipment. An example:

Bar Screen (Brunning facility)	BS2355 (BS stands for bar screen in this example)
Bar Screen (Main Street facility)	BS2356 (this was bought the same day as the other bar screen; therefore, it is probably tagged with the next available number)
Sump Pump	SP4200
Aeration Blower	AB5203

Smart Number Code:

Bar Screen (Brunning facility)	BS032355 (BS stands for bar screen in this example; 03 is the facility; and 2355 is the identification number)
Bar Screen (Main Street facility)	BS042356 (BS stands for bar screen; 04 is the facility;

	and 2356 is the identification number, indicating it was the purchase made directly after the previous bar screen purchase, therefore, it is probably tagged with the next available number)
Sump Pump	SP024200 (SP stands for sump pump; 02 indicates the Lee Highway facility; 4200 is the identification number for this piece of equipment)
Aeration Blower	AB045203 (AB is Aeration Blower; note that the next two digits, 04, are the same as the bar screen in the Main Street facility; the 04 indicates the location of the equipment)

Which impeller type in the centrifugal pump would you use for primary clarifier sludge? Why?

Ans: The appropriate choice would be an open type because it would tend not to clog.

Which impeller type in the centrifugal pump would you use for a utility water pump? Why?

Ans: The appropriate choice would be a closed impeller because there should be no solids in the treated water that could clog it. Using the closed impeller would yield a more efficient pump system.

What are the "first line of defense" tactics that you can use to detect trouble by using only your own senses? Think of all the systems in your plant.

Ans: Various answers are possible, including: smelling hot wires; seeing leaking valves; hearing excessive vibration noises.

What was being scanned?

Ans: The scan shows a 440 volt distribution panel secondary mixer fuse block.

What is the problem? How does it show on the scan?

Ans: C Phase line side of the breaker is overheated. (Point out the "hot spot" indicated by color change.)

What is the ambient temperature? What is the temperature of the overheated area?

Ans: Ambient temperature is 70º F; the overheated area reads 99.2º F.

Participants should refer to Figure I3 of the workbook.

What is being scanned here? What is the problem, and what solutions are suggested?

Ans: Main drive cabinet main breaker is overheated. The suggested solution is to disassemble, clean, and retighten bad connection.

Remember that these analysis companies simply report their findings and recommendations. They do not fix the problem. It is up to the customer to decide what to do with the findings they receive.

Participants should refer to Figure I4 of the workbook.

What do we see here? What is the temperature difference? Can you point out the "hot spot?"

Ans: The scan shows a main buss duct. Ambient temperature is 74.2 F and hot spot shows 110.5 F.

What are some factors that impact the schedule of dewatering tanks?

Ans: Various answers are possible; make sure participants list, at a minimum, the following answers:

- During summer months, the flow into most WWTPs is lower. This may provide some flexibility in removing tanks from service.
- However, discharge limits in the NPDES permit may become more stringent in the summer. This may create some concern about when tanks can be removed from service without fear of permit violations.
- If a major storm is expected (such as a hurricane), you may need to put a tank back into service with only partially completed repairs. For example, painting may not have been finished on all submerged parts, but the storm is expected to arrive within the next 24 hours. Here it is important to document the service completed and then finish it as soon as possible after the crisis situation.
