



NDCEE

National Defense Center for Energy and Environment



DoD Executive Agent

Office of the
Assistant Secretary
of the Army
Installations, Energy and
Environment

Energy/Water Nexus Security Perspective

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The NDCEE is operated by:  *Concurrent Technologies Corporation*

Technology Transition – Supporting DoD Readiness, Sustainability, and the Warfighter

Agenda

- Introduction to the Energy/Water Nexus
- Examples
- Case Studies
- Conclusions

Introduction to the Energy/Water Nexus

- The Energy/Water Nexus occurs where both energy and water are needed to operate a system effectively.
- Facility security and personnel safety can be compromised when either energy or water are unavailable.
 - For example . . .

Example 1. Water and Wastewater Treatment

- Energy is necessary for both water and wastewater treatment.
- Without energy, potable water may not be available and wastewater may not be treated prior to discharge.
- As a result, most drinking water and wastewater treatment plants are equipped with emergency generators, which require fuel.



Example 2. Water and Wastewater Distribution

- Energy is necessary for both water and wastewater distribution.
 - Drinking water treatment plants have pumps for distribution, causing the system to remain pressurized.
 - Wastewater distribution systems sometimes have sewage lift stations equipped with pumps to lift sewage to gravity-fed lines.
 - These pumps require backup power sources (e.g., generators and fuel) during power outages.



Drinking water system distribution pumps



Sewage lift station and emergency generator

Example 2. Water and Wastewater Distribution

- Due to elevation differences at some installations, booster pumps are required to maintain water pressure.
- For example, water booster pumps are needed for all buildings over four stories.
- Pumps rely on both water and energy to function properly.
- Without both water and energy, sufficient water would not be available at some locations.



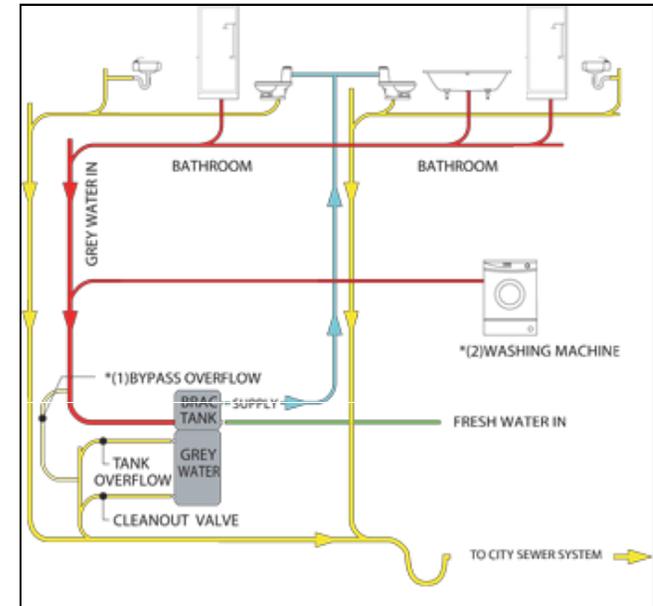
For example, water booster pumps at Yankee Stadium



Low water pressure

Example 3. Alternate Water Sources

- Alternate or back-up water sources also require energy for treatment and distribution. Examples include:
 - Desalination systems
 - Reverse osmosis water purification systems or units (ROWPUs)
 - Groundwater wells
 - Grey water systems (for wastewater only)



Grey Water System Diagram



Desalination System

Example 4. Fire Suppression

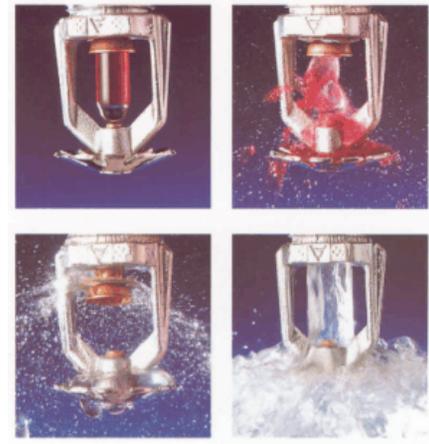
- Sufficient water pressure from water pumps is needed for fire hydrants to provide adequate fire suppression.
- In addition, fire pumps are often necessary for building fire sprinkler systems.
- Pumps rely on both water and energy to function properly.
- Without both water and energy, a fire cannot be extinguished quickly.



Fire hydrant testing



Fire pumps for fire sprinkler system



Fire sprinkler head activation

Example 4. Fire Suppression

- Aircraft Hangars are equipped with fire suppression systems that use foam to extinguish fires.
- They rely on high-pressure pumps to inject water into the systems for foam release.
- Without both water and energy, a fire cannot be extinguished quickly.
- Due to the presence of fuels, hangar fires can be very dangerous.



Aqueous film forming foam (AFFF) system test



High Expansion Foam (HEF) system test

Example 5. Actuated Water Valves

- Actuated water valves rely on a source of power for operation.
- They can be activated and operated as needed or automatically.
- Actuated water valves can be found on critical infrastructure such as fire systems, backup water sources, etc.
- Without energy, water would not be available for these applications.

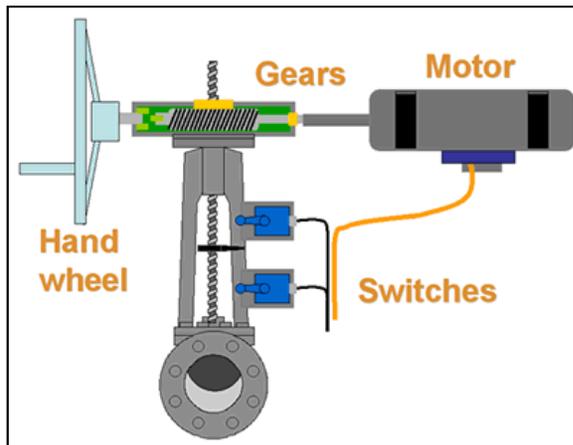


Diagram of an electric actuated valve.



Operation of an electric actuated valve by computer.

Example 6. Chiller Systems, Cooling Towers, and Boilers

- Building chiller systems, cooling towers, and boilers require energy and make-up water.
- Without both energy and water, these systems cannot operate.
- Refrigeration and/or steam sterilization are particularly critical to hospitals and laboratories.
- Climate control is particularly critical to buildings housing electronics, including computer equipment.



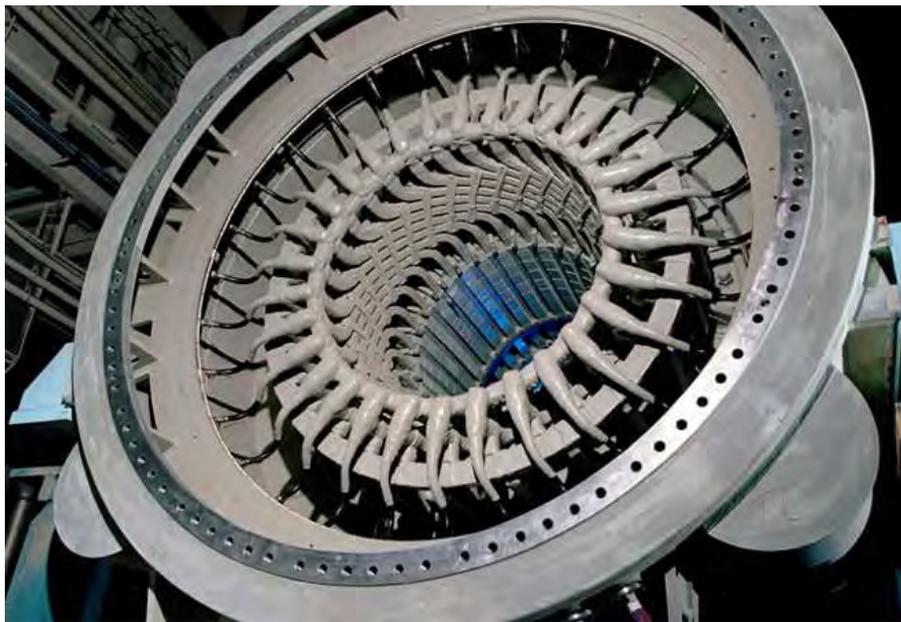
Basic diagram of an air conditioning system



Chiller make-up water supply

Example 7. Water-Cooled Generators

- Large emergency generators are often water-cooled and therefore require water to operate and generate electricity.
- Without water, energy cannot be generated.



Internal view of a water-cooled generator

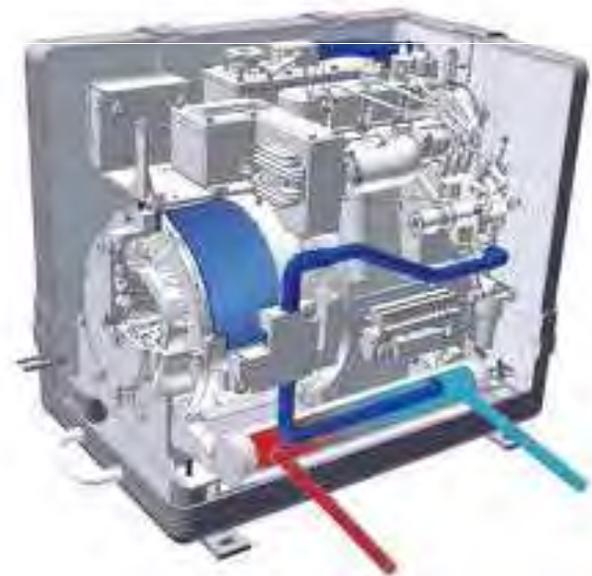


Diagram of a water-cooled generator

Example 8. Utility Privatization

- On-post drinking water and wastewater treatment plants and distribution systems can be privatized.
- Under utility privatization, installations:
 - Experience a decrease in water security due to a loss of authority to make system changes/repairs.
 - Must rely on outside parties for contingency operations if power is unavailable.
- Contingencies rely on diesel fuel to operate emergency generators.
- If generators cannot operate during a power outage, then:
 - Potable water supply may be disrupted.
 - Untreated wastewater may flow into rivers from treatment plants.
 - Sewage overflows from manholes may result.



Raw sewage flowing into the Hudson River due to a fire at a WWTP

Case Studies

- Case Study 1
 - WW system is privatized at an installation.
 - Tornadoes caused a week-long power outage in region.
 - Contractor had only small reserves of diesel fuel, not enough to power generators during entire outage.
 - Contractor did not have back-up fuel supply & was not on installation “refuel list.”
 - Contractor had to drive several hours across state lines to obtain additional diesel fuel.
- Case Study 2
 - Back-up generator to hospital requires water for cooling.
 - Water source for coolers and back-up generators is groundwater wells that requires power for pumping.
 - No back-up power for the well pumps.

Conclusions

- Installations rely on *both* water and energy to operate essential systems.
- Often cannot perform critical emergency functions without both.
- Therefore, the Energy/Water Nexus is important to consider when:
 - Planning for contingency and/or emergency operations.
 - Planning and implementing Net Zero Water Projects.
 - Planning and implementing Net Zero Energy Projects.

