Industrial Water Use and Reuse Workshop

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Grand Hyatt, San Antonio, Texas

Notes from Implementation Session

Loraine Huchler, Chair

Panelists

Role	Name
Facilitator	Loraine Huchler President MarTech Systems, Inc. huchler@martechsystems.com
Regulatory	Tara Lanier Marathon Petroleum tllanier@marathonpetroleum.com
Recycled Water Supplier	Joe Walters Manager of Business Development and Regulatory Affairs West Basin Municipal Water District joew@westbasin.org
Plant – Project Engineer or Utilities Engineer (also functions as the Capital Project Committee Member)	Don Akers Technologist Marathon Petroleum dhakers@marathonpetroleum.com
Consultant (Water Treatment Supplier in "real life")	Sid Dunn Baker Petrolite sidney.dunn@bakerpetrolite.com
Consultant	Jerry Levine Principal Water & Power Consult jerry08536@gmail.com
Equipment Supplier	Al Pristera VP Project Development, Water & Waste Solutions Ecolab Al.pristera@ecolab.com
Water Treatment Supplier	Tim Eggert Senior Technical Consultant, Regional Engineering, Water & Process Technologies GE POWER & Water Timothy.Eggert@ge.com
Water Treatment Supplier	Michael Goldblatt Applications Project Manager Ashland Chemical Company MGoldblatt@ashland.com

Two scenarios

- **Recycled Water at the Inlet to the Plant**
  - Title 22 water is recycled water that conforms to the water quality specification in CA statute "Title 22"
  - There are other sources of municipal or private recycled water, especially in areas of water scarcity such as the Middle East or Caribbean Islands
  - This scenario also applies to situations where the influent water to a plant has a significant and long-term or permanent change in the concentration of contaminants.

- **Internal Reuse**
  - Individual streams are recycled within the boundary limits of a plant
  - This is the more common scenario due to the absence of municipal or private recycled water suppliers in the U.S.

Roles

Panelist preparation: *think about your role and responsibilities as a member of a water reuse team. Think about your experiences in these projects and perhaps comment on a key insight or approach that you could offer as advice on tackling projects like these.*

- **Regulatory (Joe Walters, Tara Lanier):** Role is to ensure conformance of operations to Federal and State regulations regarding air and water discharges and be proactive about possible changes in permit requirements.

- **Project Engineer (Don Akers)**: Role is to
  - gather cost data to justify any capital expenditures
  - assess operating expenditures
  - meet the ROI hurdle
  - assemble the proper support team
    - finance
    - maintenance
    - operations (production)
    - engineering
    - environmental
    - sustainability
    - water treatment supplier (advisor)
    - corporate water treatment staff (if available)
  - consider additional stakeholders
    - Finance
    - Maintenance
    - Sustainability
    - Public
    - Public Relations
    - Identify the decision-maker
    - Company shareholders
    - Regulatory agencies
    - Health & safety

    - Water purveyor
    - Academicians, graduate students, undergraduates
    - Local politicians
    - Legislators
    - Environmental advocacy groups
    - Legal
    - "Mother Nature" – e. g. Climate
  - ensure that the project follow their corporate practices for project management, methods to analyze return on investment, criteria of success
  - identify and manage the project tasks, scope and budget
  - create a Request for Proposal (RFP) for Engineering Firm
  - establish negotiable items for design phase
  - participate in the acceptance phase during commissioning

- **Consultant (Jerry Levine, Sid Dunn)**: A consultant's role varies:
  - advisor: technology, applications, chemistry requirements, equipment selection
  - conduct feasibility study
  - ensuring proper integration with existing infrastructure,
  - ensuring operability
  - determining operator training requirements
  - assessing risks for the proposed system configurations
  - establishing best practices
  - contingency planning
  - assess impact on the wastewater treatment plant and discharge permit
  - liaise with regulatory agencies
  - validate costs and return on investment
  - substituting for in-house staff

- **Equipment supplier (Al Pristera, Tim Eggert)**: Role is to
  - identify the options for technology and
  - provide cost estimates and
  - delivery schedules for capital equipment.
  - pilot testing to confirm design and performance

- **Water Treatment supplier (Tim Eggert, Mikel Goldblatt, Sid Dunn)**: Role is to
  - assess impacts from the influent to discharge
  - identify chemical treatment programs to control deposition, corrosion and microbiological growth with water that has new or higher concentrations of contaminants
  - product trials are often required to ensure a good fit

Role Play

- **Justification of a project** (Joe Walters, Tara Lanier, Don Akers, Tim Eggert)
  Panelist preparation: *your manager has just told you that the plant is going to embark on a water reuse project, and indicated that your first responsibility is to identify a justification in preparation to sell the project to the project budget review committee. Explain how various drivers might be compelling (or not). You might want to draw on past experience (e. g. the multi-year drought in southeast Texas two years ago) or describe specific corporate cultures or industry trends.*

  - Economics
    - Lower cost water is available (e. g. Title 22)
    - Change (usually increase) in chemical treatment and operating costs
    - Change in risks (that always translate into costs – due to mitigation of consequence – either after they happen or avoidance measures)
    - Synergy with plant expansions that require additional influent or wastewater treatment assets
  - "Acts of God"
    - Local drought conditions cause poor water quality and a <u>temporary</u> reduction in withdrawal quantities.
  - Corporate Policy
    - Corporate mandate to reduce water usage within plant
  - Regulatory
    - Changes in regulatory issues: withdrawal volumes, discharge volumes, discharge contaminant concentrations
  - What do you do about intangible drivers
    - Sustainability
    - "good corporate citizen"
    - public-private pilot projects

- **Project Definition** (Don Akers, Tim Eggert, Jerry Levine, Sid Dunn, Al Pristera, Mikel Goldblatt)
  Panelist preparation: *consider that you must now "do your job" – analyze the problem, identify the required expertise, gather the data and determine the best opportunities for water reuse. Walk through this process with the team members – the other panelists – and describe the major obstacles and options as well the deliverable. Answer the question, "How do you provide the required information to the engineering design firm who will actually design the project?"*

  - Roles and Responsibilities
    - Local and corporate plant personnel
    - Outsource resources: consultants, equipment suppliers, water treatment suppliers, others?
  - Information gathering
    - Auditing existing water systems
    - Tools to map water balance
    - Creating a design basis

- **Hurdles**
  - Water reuse projects may be a hard sell to CEO's, especially in times of water abundance.
  - Proactive efforts to conduct water conservation are trumped by events like droughts.
  - The cost of fresh water, and even potable water, for both industrial and residential users, does not reflect the true cost of this scarce resource and does not attempt to modify the users' behavior through a supply-based pricing model.
  - The lack of a validated flow and "salt" balance for a plant increase the project cost and dramatically raises risk of failure for a water reuse project.
  - Failure to create a defensible design basis – a tabulation of the worst case, best case and average case for the influent water to a process – increases the project cost and dramatically raises the risk of failure for a water reuse project.
  - There are severe political pressures that oppose raising the price of water for constituencies that may not re-elect those commissioners.
  - Increased sludge volumes and increased waste disposal costs are sometimes an unintended consequence of water reuse projects.
  - The quality of treated wastewater is usually more dynamically variable than the quality of fresh water. In other words, the quality of fresh water varies seasonally with some predictability, while the quality of treated wastewater varies with different feedstock sources (e. g. crude) and with different efficiencies of the wastewater unit operations (especially the biological processes).

- **Drivers**
  - **Regulatory**
    - Lower discharge volumes
    - Stricter limits on maximum concentrations and total pounds per day of contaminants
    - Key contaminants: TSS, phenols, sulfides
    - Expect tighter limits on: nutrients, especially soluble phosphates, selenium, mercury
    - Regulatory Agency may not be willing or able to provide helpful guidance for plant owner regarding trends in permit restrictions or alternatives to resolve constraints to water reuse projects
    - NPDES permit writers need to be educated about the complexities of water reuse – lower volumes and, consequently, higher concentrations of contaminants. One issue is that the higher concentrations of contaminants may pose a threat to the ecology of the receiving watershed.
  - **Statewide Goals (Policy)**
    - Example: Southern CA
    - Several qualities of recycled water (treated wastewater) from the water authority
      - Title 22 – tertiary-treated disinfected water
      - Nitrified water (Title 22 without ammonia)
      - 1^{st} pass RO (suitable for low pressure BFW)
      - 2^{nd} pass RO (suitable for low and moderate-pressure BFW)
    - Water authority subsidizes the cost of the recycled water – calculate the cost to make it competitive as compared to fresh treated water, and consider the increased cost for the water in the circuit (increased corrosion and deposit control costs in various unit operations)
    - There are significant political hurdles to influence the economics by increasing the cost of fresh treated water to make recycled water more competitively priced and drive users to choose recycled water.

- **Opportunities**
  - Most water reuse projects are a part of a larger plant expansion – which means that there are several opportunities to justify the project. Retreating water within a unit:
    - may avoid an expansion of the pretreatment and/or wastewater treatment plant
    - may result in greater reliability and lower risk due to a more consistent and/or higher quality of retreated water
    - may result in energy recovery
    - may result in an economically neutral trade-off of cost of retreatment versus installation of transfer piping over long distances
    - the amount of capital money required to fund the "water reuse" portion of the project is small compared to the total capital cost of the project – perhaps allowing other justifications such as "responsible citizen" or other sustainability-related value to complement the economic justification (return on investment)
- **The value of scenario planning (a. k. a. contingency planning)**

  Scenario or contingency planning is often conducted for short-term catastrophic events, such as hurricanes, but seldom conducted for long-term gradual events like drought or climate change. In this context, the concept of scenario planning entails speculating about future events that would have negative impacts on the safety, reliability, operability and integrity of assets. Planners assign a relative score to each possible event based on the severity of the outcome (the "consequences") and the probability of occurrence (the "frequency").

  Lesson learned: The raw water reservoir at Valero's Port Arthur, TX refinery was located outside of the sea wall, making it vulnerable to inundation by seawater during a severe hurricane. Refinery staff conducted scenario planning and determined that this risk of seawater inundation and complete interruption of the fresh water supply for the refinery was extremely small and had a very low probability of occurring – a "low frequency, high consequences" event. Therefore, the refinery did not invest in any contingency efforts.

  The storm surge from Hurricane Ike inundated the raw water reservoir, preventing the refinery from restarting after the storm ended. Plant personnel estimated that draining and flushing the pond would require several months due to the large volume and the complexity of the task. A suggestion to use readily-available irrigation piping and special permission to withdraw water from a nearby canal provided approximately 20% of the normal raw water volumes and allowed the refinery to "warm up" the refinery using a single boiler within three weeks. Simultaneously, refinery personnel improved on the transfer piping idea to create a larger-diameter floating pipeline to provide sufficient volumes to restore 100% of the required raw water volumes. Within six weeks, the refinery was at full water flowrate using a temporary floating pipeline. After complete recovery from the hurricane, refinery personnel "hardened" the pipeline to make it a permanent contingency.

  This case history illustrates that a crisis management event can sometimes result in a capability that normal contingency planning could not justify using traditional risk assessment metrics.

- **Execution of a project** (Don Akers, Tim Eggert, Jerry Levine, Sid Dunn, Al Pristera, Mikel Goldblatt)
  Panelist preparation: *think about the design phase. How did you select the engineering design firm? What are the roles and responsibilities of team members? How much oversight and input do you want or need regarding the engineering design (see section "Engineering design" below)? What about commissioning complexities? How will you validate performance of the system, especially if the water quality differs from the design basis?*

    - Business decisions
        - Capital purchase, lease, insourced or outsourced operation
    - Engineering design
        - Selection of engineering design firm
        - Key resources needed
        - Technology selection
        - Operability analysis
        - Maintainability analysis
        - Integration issues
        - Identification of negotiable and non-negotiable features
    - Commissioning
        - Shutdown or rental equipment to prevent lost production
        - Key resources needed
        - Validation of performance

- **Project Management**
    - Process safety management has made the engineering and management of projects much more rigorous.
    - The organization of teams, communications, workflow and even the terminology may vary based on the culture of the project owner's organization.
    - Identifying the stakeholders, defining the design basis, the hydraulic and "salt" balance and the scope of work and explaining the outcomes and criteria for success are the first tasks for a project. Failure in any of these tasks will result in increased costs and possible delays – those dreaded "change orders."
    - As the project team defines the scope of the project, it's critical to consider the near-term plans for expansion, process reconfigurations or idling of units within the plant. These projects typically require four or more years from initial conception to implementation.
    - Once the budget committee authorizes the project, the next step is to identify and ensure engagement of the two key owner roles in a project: the project manager and the technical lead.
        - The project manager is the person whose mandate is to be under budget and on schedule.
        - The project lead is the "technical decision maker," responsible for ensuring that critical design elements and system capabilities aren't negotiated away as the project seeks to stay on budget and on schedule.
    - The engagement of the project lead and other stakeholders such as the water treatment supplier and a consultant, if desired, are critical as the team prepares the Request for Proposal (RFP) and qualifies the engineering design firm. These professionals will collaborate to ensure the accuracy of the information included in the RFP and the accuracy and operability of the proposed design. Integration issues are often a critical issue for operability.