



Water Sustainability & Conservation in an Exhaust Cooling Discharge System Case Study

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Component Research Air Facility (CRAF)



- **Simulates high altitude conditions for aircraft and aviation fuels research**
- **Exhaust >3000 F at flows >36,000 cfm**
- **Cooled by water to 100 F**
- **Up to 1000 gpm water flow**





Challenge

- **Design an Exhaust Cooling Discharge System (ECDS)**
 - Treat free product
 - Treat emulsified fuel in water
 - Treat 300,000 gallons of water/research effort
 - Efficiently cool while limiting wastes
 - Determine viability of using fuel contaminated water to cool
 - Determine ability to recycle the water
 - Work within existing infrastructure



Technologies Evaluated



- **Oil/Water Separator (OWS)**
- **Air-Sparged Hydrocyclone**
- **Direct Sanitary Discharge**
- **Diffused Air Flotation (DAF)**
- **OWS & Clay Towers – discharge to storm or sanitary**
- **OWS & Clay Towers – closed loop system**



Ranking Parameters



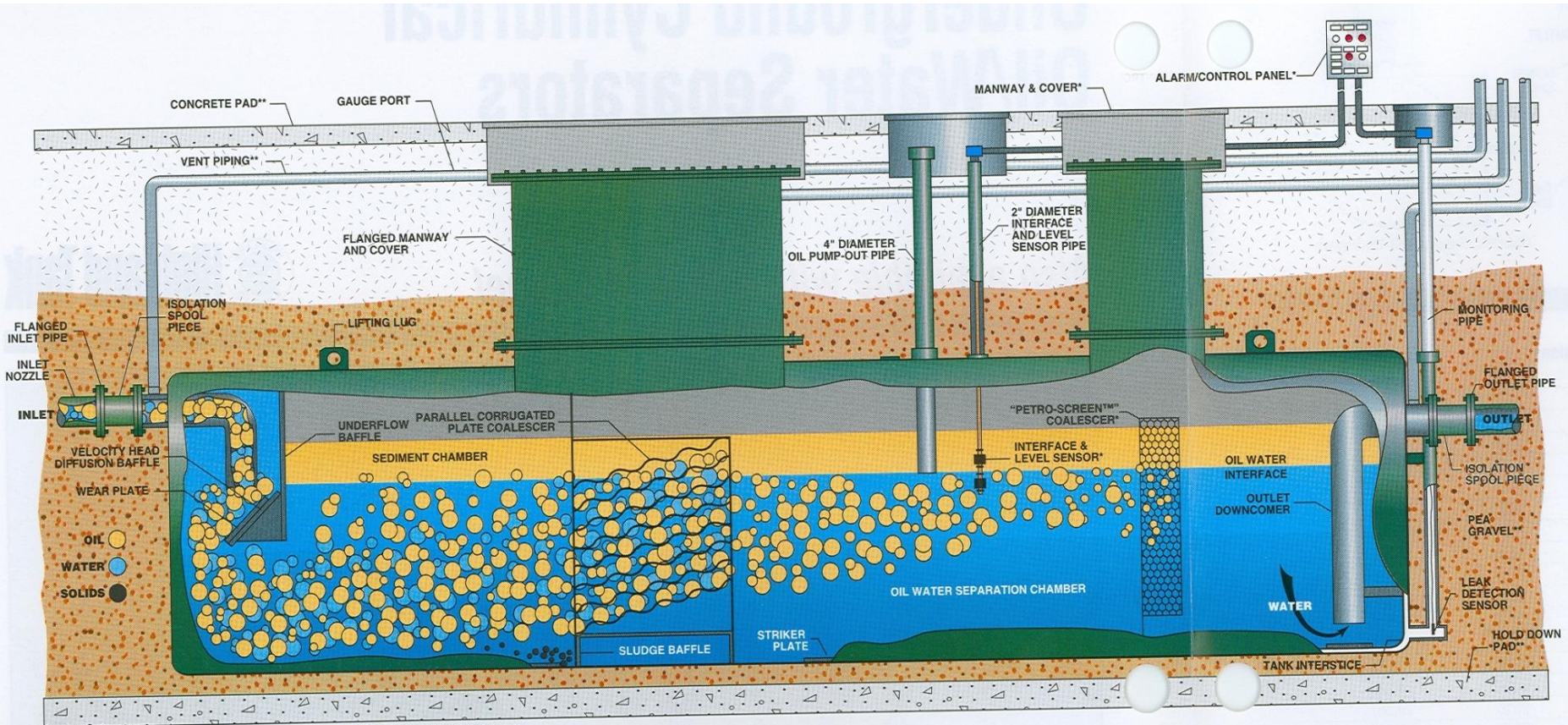
- **Initial cost**
- **Recurring annual cost**
- **Installation cost**
- **Risk**



Oil/Water Separator



- **Mechanical separation of oil and water**
- **Pros**
 - Separates free product
- **Cons**
 - Cannot separate emulsified fuels



* Optional equipment available from Highland Tank
 ** Installer supplied equipment



Air-Sparged Hydrocyclone



- **Removes hydrophobic particles from aqueous solutions**
- **Vehicle wash racks & engine test cells**
- **Pros**
 - High removal of oil & grease
- **Cons**
 - Low flows 20 gpm – 250 gpm



Direct Sanitary Discharge



- **OWS – Separates free product – discharge to sanitary**
- **Pros**
 - No EPA compliance monitoring
 - No waste disposal
 - No chemical handling
- **Cons**
 - Existing line too small
 - Disposal costs for sewage (present & future)
 - Lack of water conservation



Diffused Air Flotation



- **Chemicals used to flocculate emulsified fuels**
- **Air bubbles raise fuel to surface**
- **Pros**
 - **Meets compliance levels for storm water discharge**
- **Cons**
 - **Large footprint needed**
 - **Recurring waste production –sludge disposal**
 - **EPA compliance monitoring (storm water)**
 - **Chemical purchases and handling**



OWS & Clay Towers – Discharge to Storm or Sanitary



- **OWS – removes free product**
- **Clay towers – remove emulsified fuel**
- **Pros**
 - Can meet storm water compliance
 - No chemical handling
- **Cons**
 - Replacement of clay & waste disposal
 - Compliance monitoring
 - Freezing problems



OWS & Clay Towers – Closed Loop



- **OWS – removes free product**
- **Clay towers – remove emulsified fuel**
- **Pros**
 - Recycles water
 - Can meet storm water compliance or can discharge to existing sanitary
 - No chemical handling
- **Cons**
 - Replacement of clay & waste disposal
 - Freezing problems
 - Fuel in recycled water



Selection Parameters (1 Lowest , 4 Highest)



	Initial Costs	Annual/ Recurring	Installation months	Risk
Sanitary Line	3	1	3	1
Closed Loop	2	3	2	2
OWS with Clay	1	3	1	3
DAF	4	2	4	4



Preferred Option

- **Closed Loop**
 - Can it actually be accomplished?
- **Additional Details**
 - **Estimate fuel concentration in recycled water**
 - Can it safely be recycled to cool exhaust?
 - Can water be recycled without clay?
 - **Can existing sanitary line be used?**
 - **How much water needs to be stored for release to sanitary?**
 - **Infrastructure limitations**





Fuel Concentration



- 4000 ppm average (200 gal fuel, 50,000 gal water)
- Not to exceed 15,000 ppm
- Measured concentration in trial run
 - 600 ppm time 0
 - 250 ppm time 2hrs
- **Water with emulsified fuel can be recycled safely without clay polishing**



Sanitary Line



- **OWS ensures free product capture**
- **Sanitary line survey conducted**
 - Existing line - <200 gpm discharge acceptable
- **Flashpoint test**
 - > 140 F for emulsified fuel
- **Discharge temperature**
 - < 70 F
- **Existing line can be used for discharge**



Water Storage



- **60,000 - 100,000 gallons**
- **2 or 3 tanks 35,000 gallons each**



Infrastructure Limitations



- **Location of 1500 gpm OWS**
- **Location of 35,000 gallon towers**























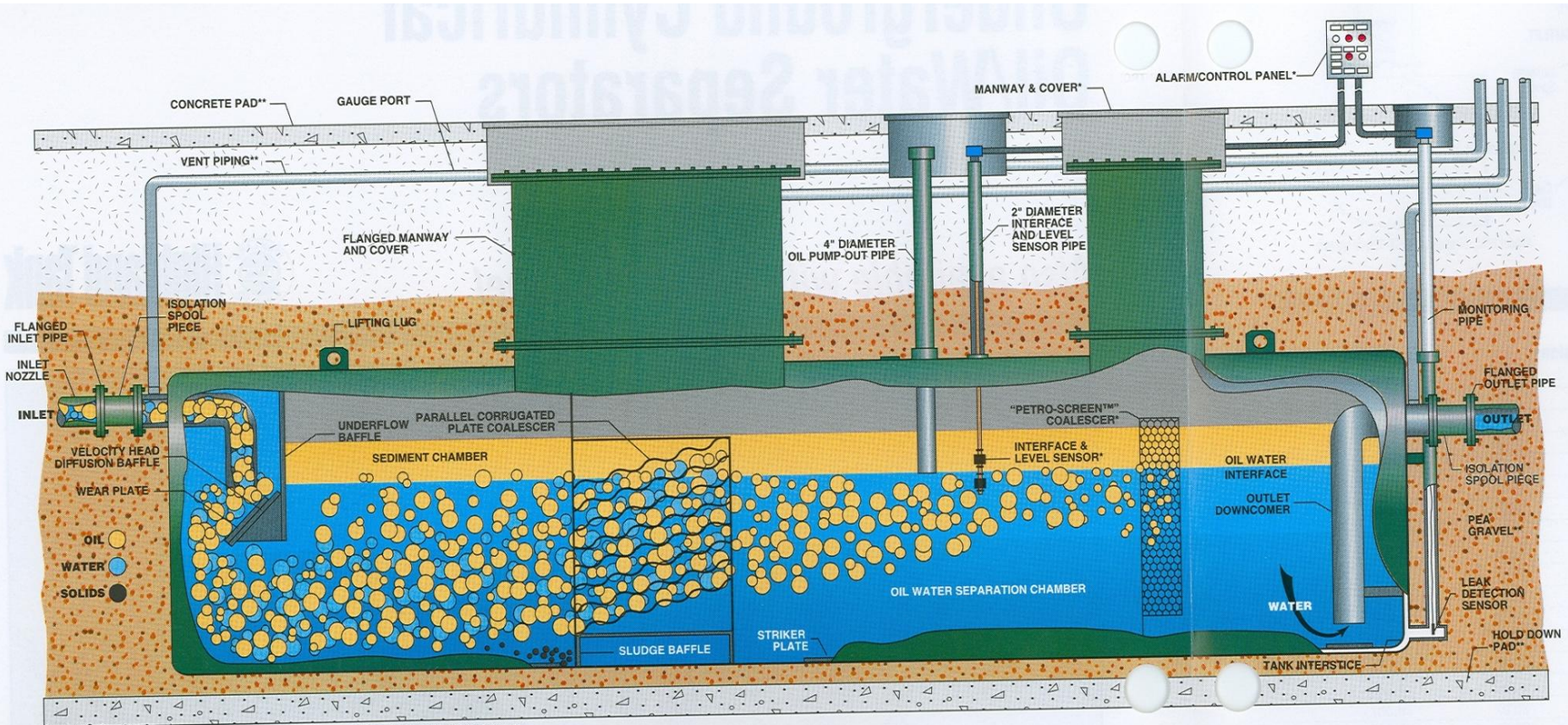






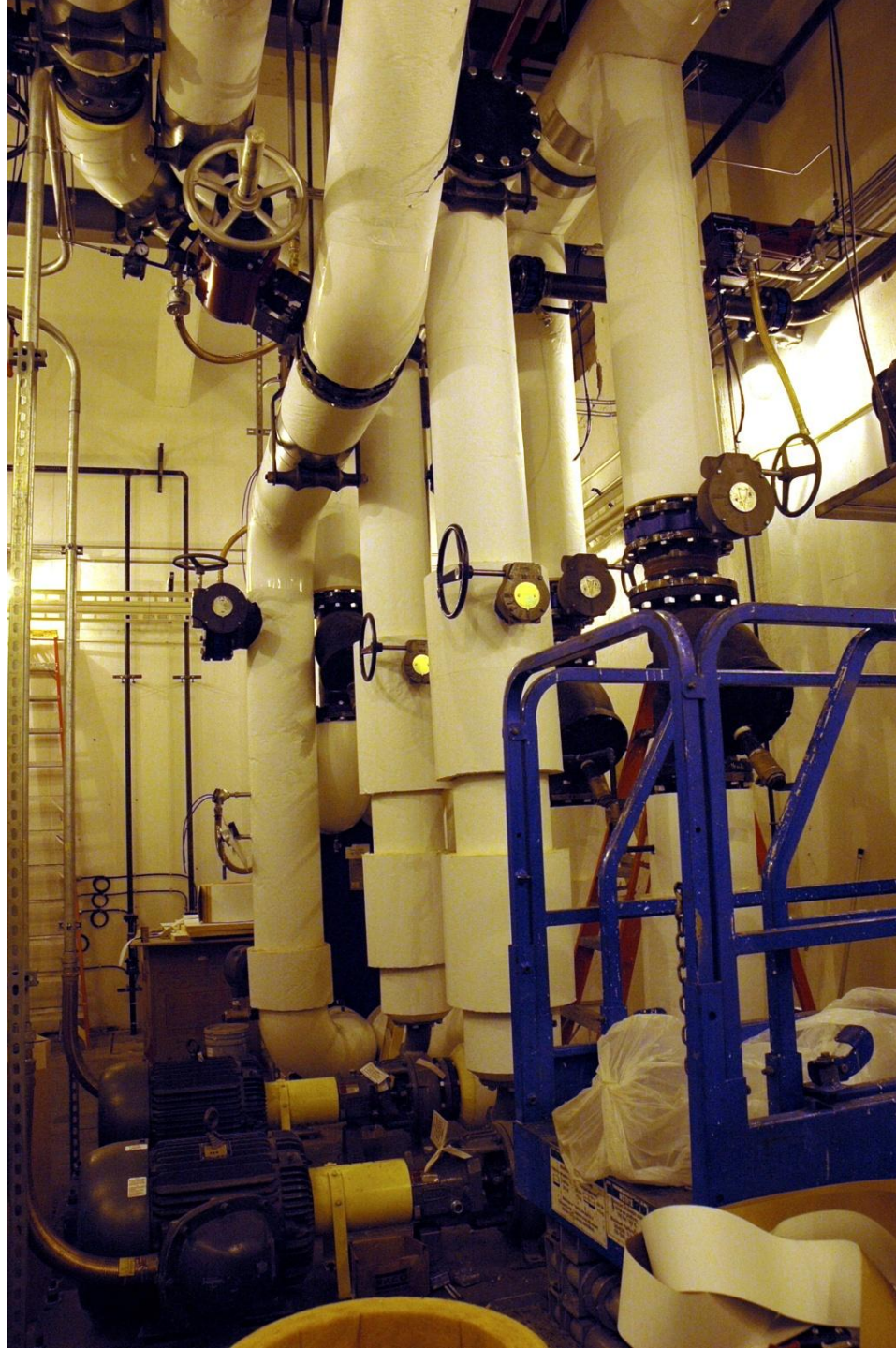
Conclusion

- **Closed Loop System can be accomplished**
 - Unique combination of OWS, two-35,000 gallon storage tanks, recirculation of water to cool the exhaust and low flow controlled discharge to sanitary sewer



* Optional equipment available from Highland Tank ** Installer supplied equipment









Conclusion (Cont)



- **Recirculation saves approximately 20M gallons of water/year**