UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

UNC Charlotte – Lee College of Engineering Senior Design Program

Senior Design Project Description

Company Name	*Orano Federal Services*	**Date Submitted**	*12/3/19*
Project Title	*Optimization and Partial Demonstration of Oxalic Acid Dissolution System* **(ORANO_ACID)**	**Planned Starting Semester**	*Spring 2020*

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	2	Electrical	
Computer		Systems	1
Other ( )			

Company and Project Overview:

Headquartered in Washington, D.C., Orano USA is a leading technology and services provider for decommissioning shutdown nuclear energy facilities, used fuel management, federal site cleanup and closure, and the sale of uranium, conversion, and enrichment services to the U.S. commercial and federal markets. With its parent company Orano, Orano USA has more than 30 years' experience in decontaminating and dismantling nuclear facilities, and more than 50 years' experience securely transporting and storing used nuclear fuel (UNF). Prior to a global rebranding in January 2018, Orano USA was AREVA Nuclear Materials.

The Orano Federal Services business – formerly AREVA Federal Services (AFS) – combines the capabilities, technologies and resources from multiple Orano companies to serve the United States Department of Energy (DOE) and its subcontractors in all phases of the nuclear fuel cycle. Orano Federal Services provides key services as an active member in various projects that support DOE's five strategic services**:** Environmental Management (EM)**,** Nuclear Energy (NE)**,** Office of Science (SC)**,** Office of Energy Efficiency & Renewable Energy (EERE), and National Nuclear Security Administration (NNSA)**.** Orano Federal Services currently is a contract team member of the following significant projects: the High Burnup (HBU) Demonstration Project; the Atlas railcar designed to ship UNF in transportation casks; the Yucca Mountain repository program (dormant); the Tank Operations Contract (TOC) at Hanford; et al. In anticipation of the need for several sites to cleanup mercury contaminated soils and facilities, Orano is proposing the application of multiple mercury isolation and recovery processes currently implemented through-out the Orano company;

these include the clean-up of mercury-contaminated sandy soils of a nuclear weapons fabrication facility in southern France, and a newly-patented process that uses alkaline chemicals to isolate and capture elemental mercury without acidic corrosion of contaminated components.
During and after use, process piping and components can grow a layer of corrosion and scales. Oxalic acid ($C_2H_2O_4$) is an organic compound found in common household cleaning products; its conjugate base, oxalate ($C_2O^{2-}_4$), is a chelating agent for most industrial metal cations. The nuclear industry has significant experience applying oxalic acid to tanks, piping and heat exchangers to remove metallic scales. After a facility is taken out of service, if mercury is present in the environment, a significant amount of volatile elemental mercury can be trapped under or within these scales. Oxalic acid would be used to remove the scales, allowing the majority of the mercury to flow freely. The oxalic acid is then destroyed, and the captured metals, including a significant portion of the mercury, are recovered. An attractive aspect of this process is that once the metals have been removed, the water can be re-used, limiting secondary waste streams.
This project will investigate the optimization of this process, using old piping samples, by varying multiple steps.

Project Requirements:

This project will optimize the above-outlined residue removal and mercury capture process. A system will need to be constructed, as briefly presented in Figure 1. The system should include a make-up tank where oxalic acid is added to water, a pump, a holding vessel for the sample to be cleaned, and a recovery tank where the oxalic acid is destroyed and the chelated metals are captured.

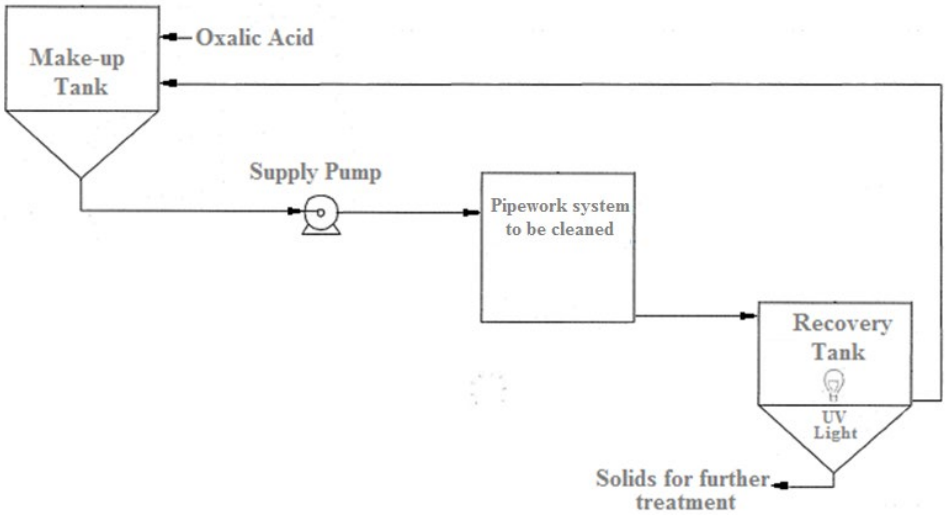

Figure 1: System Sketch

No mercury is anticipated to be required to perform this project. The purpose is purely to replicate the process and investigate the effects of various changes. System sizes will be determined to fit sample sizes. Once the system is assembled and tested, investigations will be performed into the effectiveness of the following:

- the characteristics of the cleaning fluid (oxalic acid concentrations, cleaning fluid volume and temperature)
- placing the components into a bath or into a recirculating flow
- agitation and residence time of the cleaning fluid

- oxalic acid destruction method (UV light, H_2O_2, O_3)
- recirculation filtration requirements.

Expected Deliverables/Results:

- System design, assembly and start-up procedures
- Experimental procedures for each of the tests to be performed
- Results of each of the tests that examine the various portions of the process, as explained above
- A report documenting the tests and the potential modifications to the process.

Disposition of Deliverables at the End of the Project:

Display of results at the Expo; results and any developed materials handed over to Orano following the Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Experience with mechanical and/or chemical separation processes
- Experience with industrial processes and optimization of such processes
- Experience with laboratory testing processes.
- SEGR4141 – Engineering Experimental Design