

UNC Charlotte – Lee College of Engineering Senior Design Program

Senior Design Project Description

Company Name	<i>Orano Federal Services, LLC</i>	Date Submitted	7/17/2019
Project Title	<i>Optimization Study for Off-Loading the Shearon Harris Spent Nuclear Fuel Pool using Transportable, Aging and Disposal (TAD) Canisters</i> ORANO_TAD	Planned Starting Semester	Fall 2019

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	3	Electrical	
Computer		Systems	3
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 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



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(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 removing UNF from spent fuel pools (SNF) in the future for either interim storage at a consolidated interim storage facility (Waste Control Specialists facility in Texas) or permanent disposal in a repository (e.g., Yucca Mountain), Orano is proposing to examine the use of transportable, aging, and disposal (TAD) canisters and/or transportation casks such as the MP197HB. This project would examine the means for emptying the SFPs at Duke Energy's Shearon Harris Nuclear Power Plant in New Hill, NC. Unlike other nuclear power plants in the U.S., the Shearon Harris SFPs are not nearing capacity and hence do not require UNF to be off-loaded into dry storage systems located on an on-site Independent Spent Fuel Storage Installation (ISFSI). This is because the Shearon Harris SFPs were sized to handle the UNF from up to 4 reactors, however only one reactor was built. This net oversized SFP became further utilized by Duke Energy's predecessor Progress Energy/Carolina Power & Light to move UNF from three other reactors whose SFPs were growing full (Robinson and Brunswick I & II nuclear power plants). Hence, the UNF in the Shearon Harris SFPs is a mix of both pressurized water reactor (PWR) fuel from Shearon Harris and Robinson and boiling water reactor fuel (BWR) from Brunswick I & II. This unusual mix creates an interesting problem in that it requires both a BWR TAD, which can hold 44 fuel assemblies, and PWR TAD, which can hold 21 fuel assemblies, to empty the SFPs.

Project Requirements:

This project will examine the approach needed to empty the Shearon Harris SFPs using BWR and PWR TADs. The project will begin by identifying the UNF found in the SFPs at Shearon Harris and identifying what fraction of this UNF meets the Fuel Qualification Tables (FQT) identified in the TAD Safety Analysis Reports (SARs). For the UNF that does not meet the FQTs, identify what potential modifications to the FQTs might be required. For this UNF that does not meet the FQT, Orano will identify what, if any, modifications may need to be done to the TADs in order to expand the FQT to capture all the UNF in the SFPs. Using this data, establish the number of BWR and PWR TAD canisters are necessary to empty the SFPs.

Additionally, this project will require either verification the equipment (e.g., the SFP cranes) are capable of handling full flooded PWR and BWR TADs and if not, identify the means to overcome the limitations (e.g., crane upgrade, short loading of TAD, draining of TAD as raised from SFP and accounting for buoyancy, etc.) or identification of equipment requirements (e.g., crane capacity). Furthermore, other equipment instrumental to the TAD loading activities will need to be identified and verified compatible with the SFP facilities, including water chemistry compliance.

This project will require development of an optimization scheme and timing study for the off-loading of the UNF from the SFPs which should consider/include:

- Utilization rate of the SFP cranes (this includes normal operations that do not include the loading of TADs)
- Assuming campaigns consist of loading 5 TADs separated by at least ~20 days
- Identification of potential off-load schemes (e.g., alternating between BWR and PWR TADs or off-load all PWR first or off-load oldest UNF first etc.) and their timelines
- Identify means for loading TAD while in either a transportation cask or a transfer cask in SFPs or on SFP deck or elsewhere (noting when temporary shielding may be necessary)



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- Establish approximate loadboards for the loading activities
- Optimization of TAD loading, drying, and seal-welding operations to minimize interference with normal SFP operations, which will also need to be identified

Expected Deliverables/Results:

- A report documenting the above activities.
- A logic diagram, Gantt Chart, and/or animation of operations.
- Informative spreadsheet-based supporting documents/tools for data analysis.

Disposition of Deliverables at the End of the Project:

Work product is displayed at the last Expo and then 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):

- Mechanical loading calculations (e.g., to establish crane limits)
- Solid Works or similar software (e.g., for animation of operations)
- Statistical analysis for development of optimization scheme(s)
- Logic diagrams (Gantt Charts)